



UNITED ARAB EMIRATES
MINISTRY OF ENERGY & INDUSTRY

UAE STATE OF ENERGY REPORT

2019

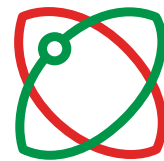


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**HIS HIGHNESS SHEIKH
KHALIFA BIN ZAYED AL NAHYAN**

PRESIDENT OF THE UNITED ARAB EMIRATES



“ The path towards a better future begins with the diversification of the sources of national income. When we launch projects for renewable energy, and oil derivatives industries and invest in human resources, we actually mean diversification. ”





**HIS HIGHNESS SHEIKH
MOHAMMED BIN RASHID AL MAKTOUM**

VICE PRESIDENT, PRIME MINISTER OF THE UNITED ARAB EMIRATES
AND RULER OF DUBAI



“

Who does not think of energy is not thinking
about the future.

”





HIS EXCELLENCY
Eng. SUHAIL AL
MAZROUEI

UAE MINISTER OF ENERGY AND
INDUSTRY

The Ministry of Energy and Industry (MOEI) has been actively working to position the UAE as a leader in the energy transition. Over the past few years, we have supported initiatives and programs to achieve the targets set forth by our visionary leadership.

The country launched its energy strategy with targets to 2050 two years ago as the first unified energy strategy based on supply and demand in the UAE. The MOEI is helping to achieve the goals of implementing clean energy in the total energy mix from 25 percent to 50 percent, reducing carbon emissions of power generation by 70 percent and increasing energy efficiency by 40 percent.

We are working to build a sustainable and a diversified non-oil economy, and part of that has been our most recent integrated strategy for the industrial sector. The initiative will focus on artificial intelligence and technical industries to set forth clearly defined work programs for each emirate. This is especially important in achieving our overall mission as industries make up most of the energy consumption in the UAE.

We are also prioritizing water security to reduce consumption of ground water reserves and provide new, economic alternatives such as treated water. Water desalination is also very important, and the UAE is one of the few developed countries in the world that has reduced the cost. The Al Taweela station currently has the world's lowest price for desalination which is less than AED0.01 compared to up to AED0.05 previously.

The MOEI will continue its path to support the UAE's journey to excellence by creating a robust, sustainable and competitive energy sector.

The United Nations Development Programme (UNDP) is pleased to partner with the United Arab Emirates (UAE) in producing this 2019 State of Energy Report.

The world faces unprecedented challenges from climate change with world greenhouse gas (GHG) emissions reaching record levels in 2018. If these trends continue, world average temperatures could rise by as much as 5 degrees Celsius above pre-industrial levels by the end of this century. This threatens the ability of countries to achieve and sustain results under the Sustainable Development Goals (SDGs).

2019 marks a critical year to accelerate results under the Paris Agreement on climate change. To raise collective ambition and to catalyze local solutions, the UN Secretary-General will convene the UN Climate Action Summit in September of this year. The UAE is playing an important role in the process, hosting the critical Preparatory Conference on road to the Summit. This is an expression of the UAE's strong commitment to the global climate agenda as well as its support of new, local solutions to generate a low carbon future.

As highlighted by the 2019 State of Energy Report, the UAE is emerging as a pioneer of green innovation. It is also fostering new public-private partnerships to reduce the energy intensity of growth. While renewable energy remains a small share of the energy mix in the UAE, growth rates of low carbon solutions are amongst the fastest in the region. Further accelerating climate action and scaling-up results will be vital, especially in buildings, power, water as well as in the transport, industry and urban development sectors. In addition to local initiatives, the UAE is also emerging as a global partner for low-carbon solutions, as well as in outward investments for renewable energy in developing countries.

UNDP has been a long-standing partner to the UAE on climate action, helping in recent years to develop the UAE's first set of Clean Development Mechanism (CDM) investments. It has also supported the establishment of the Dubai Carbon Center of Excellence, and to design and launch the new World Green Economy Organization. The UAE State of Energy Report has been an important part of this partnership, with UNDP serving as a partner since the report was first issued in 2015.

We applaud the vision and actions set forth by the UAE in this report, to generate new low carbon solutions locally and for the expansion of its role as a global partner for climate action. Such commitment and concrete solutions are vital in helping the world to achieve the SDGs and the Paris Agreement.



ACHIM STEINER
UNDP ADMINISTRATOR



HIS EXCELLENCY
Dr. SULTAN AHMED
AL JABER

UAE MINISTER OF STATE AND
GROUP CEO OF ADNOC

The global economy is undergoing an unprecedented transformation, known as the 4th Industrial Age, which is shaping companies' operations, unlocking new business paradigms and driving socio-economic change – even transforming the very nations in which companies operate. In this new era of progress, prosperity is expanding from traditional financial centers to the rest of world – from North to South, West to East.

This transformation is enabled by virtually every industry and sector – but, arguably, the energy industry more so than any other – placing NOCs and IOCs on the front lines, where the most innovative, forward-looking energy companies are well-positioned to meet the demands of the 4th Industrial Age and capitalize on its opportunities.

At ADNOC, we call this mission Oil & Gas 4.0. We deliver this mission through our creative approach to forging partnerships, empowering people, leveraging technology and committing to sustainability.

As we continue to deliver against our 2030 growth strategy, Oil & Gas 4.0 will enable ADNOC to harness the full extent of our resources to continue driving growth, development and progress – not only for the UAE, but for growing economies around the world.

Energy is fundamental to life and to our economy and society. The UAE is therefore well aware of the importance of energy diversification – both domestically and internationally, to ensure that we do not solely depend on the finite hydrocarbon resources which also contribute to global warming.

That is why the UAE has been a pioneer in energy diversification starting with the establishment of Masdar in 2006, the Abu Dhabi's flagship renewable energy company. A number of world-class renewable energy projects have since followed, such as the 1.77 GW Noor Abu Dhabi Solar PV project scheduled to be operational in 2019, and the 5 GW Sheikh Mohammed bin Rashid Al Maktoum Solar Park which will be the largest single-site solar project in the world upon completion in 2030. The UAE has also invested in the peaceful development of nuclear energy – the highly anticipated 5.6 GW Barakah Nuclear Energy Plant, which will supply steady energy supply accounting to 25 percent of the UAE energy demand, without generating harmful greenhouse gas emissions.

These are no easy undertaking, but the UAE is fortunate to have a visionary leadership that has been leading the country to diversify its energy base and the economy, as outlined by the UAE Vision 2021 and UAE Centennial Plan 2071, and complemented by the UAE Energy Strategy 2050 and the National Climate Change Plan 2050. The development of clean energy sector in the UAE has resulted in job creation at scale, establishment of new research facilities and business incubators as seen in Masdar City, and new generation of skilled Emirati ready to take on the challenge to transition the UAE to a low-carbon, green economy.

Energy and economic diversification is also critical in the attainment of the ambitious goals of the Paris Agreement on climate change to halt global warming and the UN Sustainable Development Goal 7 to promote and deploy sustainable energy by 2030. The UAE is ready to take on this challenge, leading by example, and to continue working with the global community for a sustainable future.



HIS EXCELLENCY
Dr. THANI AL
ZEYOUDI

MINISTER OF CLIMATE CHANGE
AND ENVIRONMENT
UNITED ARAB EMIRATES



HIS EXCELLENCY
Dr. MATAR AL
NEYADI

UAE UNDERSECRETARY OF
THE MINISTRY OF ENERGY AND
INDUSTRY

While historically fossil fuels have been the major driver to economic growth in the UAE, we are now at a foundation of a new paradigm. The Ministry of Energy and Industry is committed to helping the UAE transition to a diversified economy, and that includes spearheading a greener future.

Currently, 98 percent of our electricity generation capacity is through natural gas-powered turbines. We forecast that the UAE will require 100 gigawatts of electricity generation by 2050, and that will require a basket of resources. Over the past few years, we have worked to increase our steps toward clean energy including the region's first nuclear energy plant as well as continuous world records for prices in solar power.

We have seen solar photovoltaics come in at some of the world's cheapest prices in both Abu Dhabi and Dubai. We have also witnessed the world's cheapest price for concentrated solar power at the Mohammed bin Rashid Al Maktoum solar park. Our venture into nuclear will see nuclear energy meet 25 percent of our electricity needs once fully operational.

It's about having a balance and renewables and nuclear complement our traditional means of energy production. Our path forward at the MOEI surrounds energy diversification, sustainability and energy security.

Across the world, we stand at a critical time for the energy sector. Increasingly modernized populations, coupled with the realities of climate change and an increasing demand in electrification are pushing energy policymakers to change their approach to how energy is consumed, stored, distributed and consumed.

On one hand, increasing levels of prosperity demand the production of more energy, but this energy must be produced reliably, without compromising energy security, and in a more sustainable manner to mitigate the impacts of climate change for the next generations ahead.

The decarbonization of electricity is central to achieving this mission, and the UAE is working to make this a reality.

Over the last decade, the UAE has emerged as a leader in clean energy development with a unique approach to diversifying energy sources for sustainability and security. Through its visionary leadership, the nation has looked to broaden its means of energy production while placing environmental sustainability at the heart of the energy agenda. As a result, the UAE concluded, back in 2008, to invest in peaceful nuclear energy as a central component of its energy diversification strategy, as outlined in the UAE Energy Strategy 2050.

Launched in 2009, the UAE Peaceful Nuclear Energy Program is focused on delivering clean, efficient and reliable electricity from nuclear energy to the UAE grid, develop our people and build sustainable nuclear sector capability. The cornerstone of the UAE Program is the Barakah Nuclear Energy Plant, located in Abu Dhabi's Al Dhafra Region. As the first nuclear energy plant in the Arab world, it is already setting the benchmark regionally, and I am proud of the positive economic and social impacts the plant is driving for our nation.

Once fully operational, the plant will deliver up to a quarter of the UAE's energy needs, with almost zero carbon emissions, as well as creating high value careers for talented UAE Nationals, and a new domestic nuclear industry, raising quality standards and generating contracts for local businesses across the nation for decades to come.

With 5,600 MW of clean, baseload electricity produced 24/7 with minimal carbon emissions, the Barakah plant is a clear example of decarbonization in practice. Combining the generation of electricity through peaceful nuclear energy with renewable technologies such as solar, as well as the UAE's highly efficient gas powered plants, we are creating a diversified and secure energy portfolio that meets the needs of our country today, while integrating flexibility and environmental sustainability to ensure it remains resilient and responsive to future needs.



HIS EXCELLENCY
Eng. MOHAMED AL
HAMMADI

CEO, EMIRATES NUCLEAR ENERGY
CORPORATION



HER EXCELLENCY **Eng. FATIMA AL FOORA AL SHAMSI**

UNDERSECRETARY FOR ELECTRICITY AND
FUTURE ENERGY

The UAE's energy industry has changed dramatically over the past decade. Few would have believed such change was possible. But our leadership outlined a bold vision for the future of our nation, and we forged ahead, successfully achieving significant economic and energy diversification by working in an exemplary manner with all the stakeholders within the industry. Having been a part of this period of transformation, I feel great pride in our collective achievement.

Today, we continue to look forward. Equipped with our pioneering spirit, and the enduring vision of our leaders outlined in the UAE National Energy Strategy 2050 – we have a clear mission to once again deliver what many would imagine to be impossible.

This year's State of Energy Report is a reflection of the growth and change we've seen across our industry, and the great ambitions for our energy future. For the first time, the report analyses the critical role and influence of the energy industry in continuously increasing the positioning and ranking of the UAE globally. It's the energy industry plays a vital role in growing strategic and enduring bilateral relationships and advancing the energy sector on a global scale.

This year's report also looks at the sector's role in facilitating industrial growth across the UAE. As with any evolving nation, a rich supply of energy has played a critical role in enabling the rapid modernization and vast industrial development that our nation has experienced in recent years. Energy also plays a direct role in industrial development, with the UAE's clean technology industry set to benefit from an investment of more than AED600 billion from the UAE government over the next three decades.

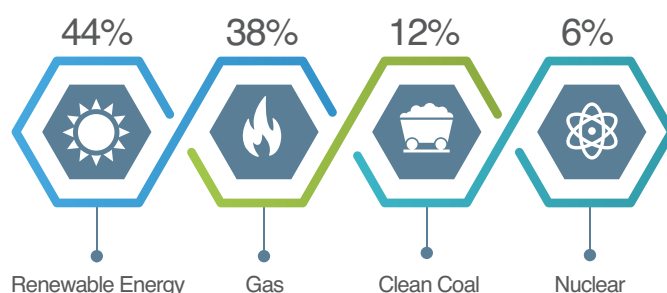
The Energy Leaders Outlook Report is another new feature in this year's report, offering significant insight into the perceptions of our energy industry's top professionals as we work towards executing the 2050 Strategy. Our nation's energy leaders hold great optimism for the future of our energy industry and our ability to achieve the goals we have set for ourselves.

2019 also marks the Year of Tolerance in the UAE. One of the most important factors underpinning our nation's success is our commitment to nurturing an environment

where people of all nationalities and religions can coexist peacefully. Our country is home to more than 200 nationalities, which provides an immense amount of exchange both culturally and intellectually. The energy industry in the UAE is certainly reflective of this diversity. We are also witnessing greater representation of women in energy than ever before. Today, almost 80 percent of Emirati women enroll in higher education and make up 70 percent of all university graduates, with women representing nearly half of all science, technology, engineering and mathematics graduates in the UAE.

There is no doubt that this is an exciting chapter in our energy history. Our influence in the world energy markets over the past few decades has been clearly significant, however, our greatest contribution may be just around the corner. By providing policy-makers around the world with a successful model of true energy transformation, we could deliver one of the greatest gifts to humankind.

We can all look ahead to the challenges and opportunities we face with hope and optimism for a cleaner, more sustainable future and the hope of an incredible legacy for our nation and the world.



EXECUTIVE SUMMARY

The UAE has embarked on a path toward diversification; positioning the nation as a clean energy leader at the forefront of a new energy era.

Energy has been one of the building blocks of the UAE's success, and as the global landscape shifts, the country is forging a new path. The UAE State of Energy Report (SOER) provides a deep dive into the past, present and future of the nation's energy sector.

One of the most integral parts to this transition has been the Energy Strategy 2050, setting the stage for a life after oil. The ambitious strategy, targeting a basket of energy solutions, was implemented in 2017. In 2012, the oil and gas industry made up nearly 40 percent of the UAE's GDP; however, hydrocarbon contributions are currently less than 20 percent.

"While the oil and gas industries will continue to be important for the country, our aim is to create a well-balanced ecosystem that relies on various industries to maintain the UAE's role as a world leader," said Eng. Suhail Al Mazrouei, UAE Energy Minister. "Each of the seven emirates are undergoing their own transformations, which is setting the stage for future growth."

This year's SOER explores the history of the country's hydrocarbon sector with insights from Abu Dhabi National Oil Company (ADNOC) and Dolphin Energy as well as other important energy players such as Abu Dhabi's Future Energy Company (Masdar) and Emirates Nuclear Energy Corporation (ENEC). SOER also looks at the ever-changing electricity sector from the impact of market liberalization, clean energy and energy efficiency measures.

"As we introduce other sources to our energy mix – including renewable energy and nuclear energy – we are also implementing legislative and energy efficiency measures because there is no one size fits all solution," said Dr Matar Al Neyadi, Undersecretary for the UAE Ministry of Energy and Industry (MOEI). "The UAE's energy strategy is promoting flexibility and longevity."

While the UAE has made moves to liberalize the electricity markets, the country remains one of the highest electricity consumers per capita in the world. However, that has slowed in recent years compared to the spikes in 2014 and 2015.

This can be attributed to the demand side management (DSM) efforts that are underway including targets established by both Abu Dhabi and Dubai to cut consumption by 20 and 30 percent, respectively. One way that this has been carried out is through neighborhood campaigns in line with its DSM Strategy. In one area alone, electricity usage decreased by 714 megawatt hours as well as 13 million imperial gallons of water, saving the emirate a total of AED829,000.

Energy isn't just a domestic powerhouse, the sector plays a significant role in the country's soft power strategy. The pursuit of strategic international assets has grown in recent years, both in terms of their number and level of sophistication as part of the long-term strategy to extract maximum value from the country's position as a leading energy provider. UAE oil, gas and renewable companies have increased relationships with partners throughout Asia and have taken center stage for some of the world's largest industry forums including the World Future Energy Summit, the Atlantic Council's Global Energy Forum and the upcoming World Energy Congress.

"The energy sector will remain a powerhouse for UAE economic development, especially through employment as more than a third of the jobs in the country are directly or indirectly related to the sector," said Eng. Fatima Al Foora, MOEI Assistant Undersecretary for Electricity. "The industry is changing and we remain focused on being ahead of the curve."

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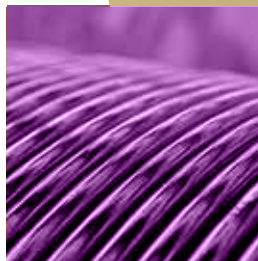
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01

ENERGY POLICY AND REGULATION



Globally, the energy landscape is shifting and the UAE is at the forefront of the region's transition.

The UAE was the first in the region to pursue steps toward energy diversification, introducing the country's first long-term strategy in 2017 called the UAE Energy Strategy 2050. The plan aims to deliver clean and affordable energy to decrease carbon emissions, maximize energy productivity to stimulate further economic growth and to build a future beyond oil.



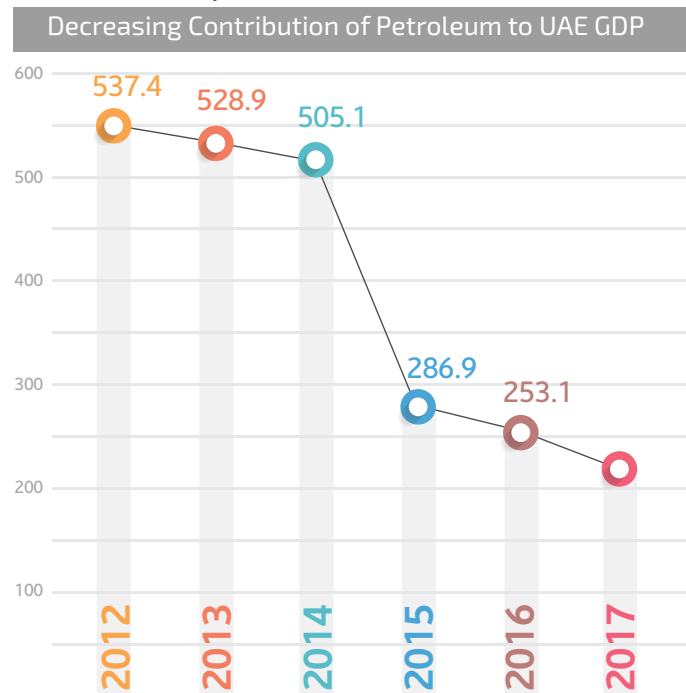
Transitioning for Tomorrow

In 2017, the UAE released a national strategy aimed at diversifying the country's energy mix while reducing greenhouse gases to mitigate the risks of climate change. The UAE will allocate AED 600 billion to meet its goal to increase the contribution of clean energy sources in the total capacity mix to 50 percent by 2050.

Then and Now

Oil and gas have historically been the dominant sources fueling the country's economy. In 2012, the sector contributed to nearly 40 percent of the UAE's GDP. However, over the past few years, that has decreased making up only 19 percent in 2016.¹

Successful Diversification of the UAE Economy

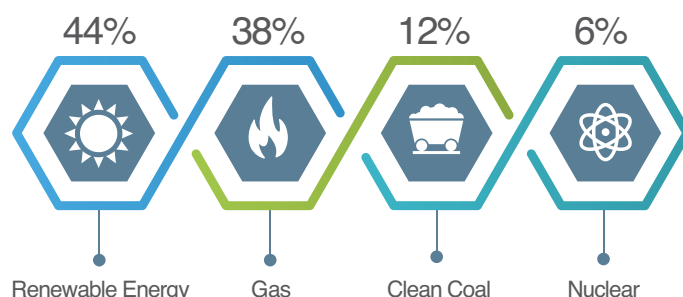


Despite being rich in hydrocarbons, the UAE began its path toward energy diversification with the UAE Energy 2050 plan clearly defining a country-wide strategy where clean energy plays the largest role.²

The country began adding more clean energy to its power generation sector; setting incremental targets. The UAE surpassed its 2017 clean energy forecasts, which are updated annually to consider project completions such as the Dubai concentrated solar power program as well as other generation forecasts.

Adding more clean energy into the mix also means a decreased reliance on natural gas, which accounts for 71 percent of the UAE's primary energy.

This is coupled with the target to decrease consumption by 40 percent, which will save the country AED 700 billion by 2050.

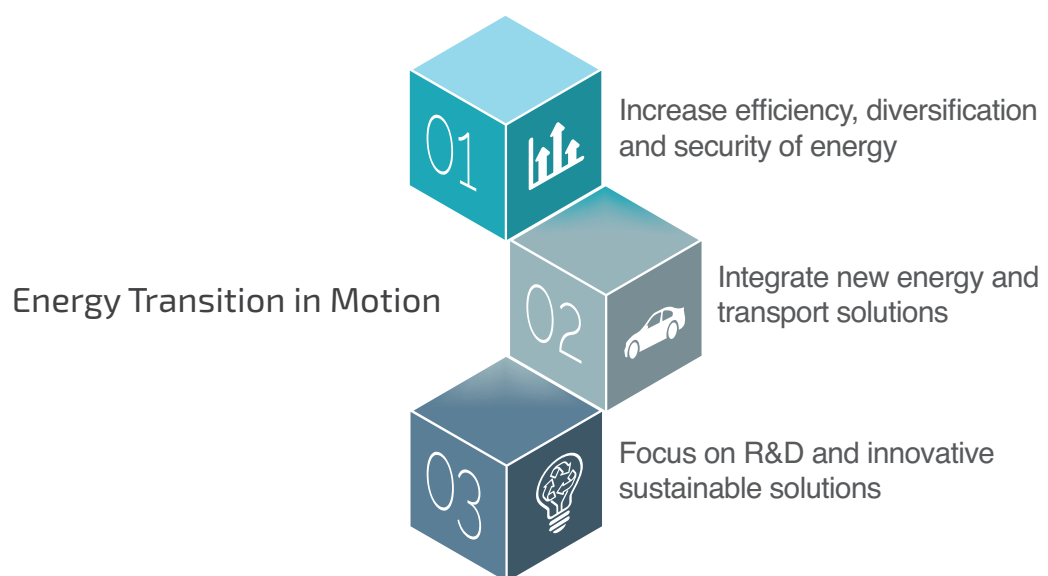


¹ MOEI Annual Statistical Report 2017

² UAE Government



The emirates of Abu Dhabi and Dubai also created individual energy strategies to help progress the national targets.



Abu Dhabi: Energy Transition in Motion

Abu Dhabi's energy policy has historically revolved around its bountiful hydrocarbons deposits, the first of which were discovered in 1958 and developed over the subsequent six decades in the national interest.

Yet despite the emirate's long hydrocarbon history, Abu Dhabi is ushering in a more diversified landscape featuring the region's first nuclear energy plant, renewable energy and carbon capture utilization techniques.

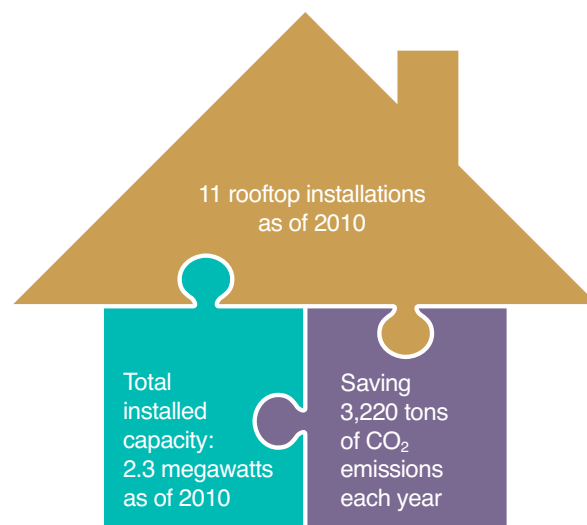
Abu Dhabi's renewable energy portfolio has seen further growth following the UAE Energy 2050 Strategy as well as other plans such as the National Biodiversity Strategy and Action Plan, Abu Dhabi Economic Vision 2030, and the Abu Dhabi Environment Vision 2030 – which are implemented and overseen by various Abu Dhabi and federal government agencies.

In 2017, Abu Dhabi Water and Electricity Authority (now known as the Department of Energy) awarded a 1.17-gigawatt solar photovoltaic independent power project in Sweihan, about 180km east of Abu Dhabi city, near Al Ain.

The government has also initiated a program to encourage small-scale solar development and targeted 500 MW solar photovoltaic installations on rooftops over the next two decades. "Abu Dhabi Solar Rooftop Program" has several

initiatives to encourage growth in this sector.³ In addition, the emirate set out at the end of 2017 to allow businesses and government buildings to install solar panels on building rooftops to help reduce electricity bills.

AD Solar Rooftop



AED3.02 billion Sweihan project is expected to come online in 2019.

³ Masdar Abu Dhabi Rooftop Solar Project

Abu Dhabi is also working to reduce waste from landfill. The Abu Dhabi National Energy Co. (known as Taqa), and the Center of Waste Management (Tadweer) have partnered to develop a 100 MW facility at the Mussafah Sea Port, on the edge of Abu Dhabi city. It is estimated that the AED850m project will cut more than one million tons of CO₂ emissions per year.⁴

The plant is scheduled to be up and running by 2021, generating enough power for 20,000 households in Abu Dhabi as well as cutting greenhouse gases.⁵ It is expected to reduce CO₂ emissions by more than one million ton per year. The project will be one of the biggest waste-to-

energy facilities in the world, stretching across an area of 100,000 square meters.

Abu Dhabi has also taken several measures towards achieving the national goal of improving energy efficiency by 40 percent by the middle of the century. The most significant moves in recent years has been the reduction of subsidies for gas and electricity – which the government has announced it plans to eliminate entirely – and the removal of transport fuel subsidies in 2015.

The UAE government, in its 2050 plans, have announced a wide range of industrial, commercial, building sector and residential initiatives to foster and

develop efficiency measures. These include the introduction of a countrywide green building code certification program.

In the oil and gas sector, the country has advanced toward its goal of achieving zero gas flaring.

In 2016, Abu Dhabi started up the world's first fully commercial carbon capture utilization and storage (CCUS) facility for the steel industry. ADNOC'S \$122 million Al Reyadah project captures carbon dioxide collected from Emirates Steel and reinjects the resource into oil fields to help maximize output while creating zero net carbon dioxide emissions.⁶



⁴ TAQA

⁵ Enabling the UAE's Energy Transition (Page 12)

⁶ Adnoc, Masdar carbon capture facility holds key to limiting CO₂ emissions

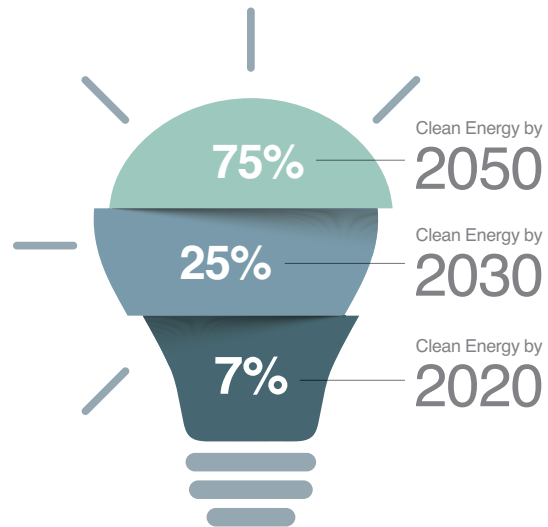
Dubai: Embracing the Green Energy Revolution

As cities globally race to secure their positions in today's dynamic new energy landscape, Dubai is emerging as a green economy global center. By implementing a smart energy policy, pioneering new technologies and investing in cutting-edge energy solutions, the city is forging a path as a regional leader in sustainable development and key player on the world clean energy stage.

To reduce its reliance on natural gas and secure a more sustainable energy supply for its growing population, Dubai has committed to a diversified energy mix that will deliver 75 percent of the city's energy demand through clean energy by 2050.⁷

The Dubai Supreme Council of Energy's Dubai Integrated Energy Strategy 2030 (DIES) began setting the strategic direction for the city's energy sector in 2011 and continues to serve as the road map for guiding the emirate's many efforts towards a more secure energy future. It includes several sub-strategies that shape Dubai's priorities in the areas of energy supply, demand reduction and sustainable growth. In 2015, Dubai Clean Energy Strategy 2050 was implemented furthering the emirate's goals toward a green economy.

Dubai Clean Energy Strategy



Dubai Supreme Council of Energy

HH Sheikh Ahmed bin Saeed Al Maktoum

Chairman of DSCE, President of Dubai Civil Aviation Authority

HE Saeed Mohammed Al Tayer

Vice Chairman of DSCE, MD & CEO of DEWA

Mr Abdulla Kalban

Member of DSCE, Managing Director & CEO, EGA

Mr Saif Al Falasi

Member of DSCE, CEO of ENOC

Mr Abdulla Abdulkarim

Member of DSCE, Director General, Department of Petroleum Affairs

Mr Waleed Salman

Member of DSCE, Vice Chairman, Dubai Nuclear Energy Committee

Mr. Frederic Chemin

Member of DSCE, General Manager, Dubai Petroleum

Mr. Khalid Sharif Al-Awadhi

Member of DSCE, Assistant Director General for Environment, Health & safety Control Sector - Dubai Municipality

Mr. Nasser Abu Shehab

Member of DSCE, CEO - Strategy and Corporate Governance (RTA)

Mr Ahmad Al Muhairbi

Secretary General of DSCE

⁷ The Official Portal of the UAE Government

To support the achievement of these targets, Dubai has launched a few green energy programs and initiatives in line with strategy's five key pillars:

Infrastructure

Delivery of key initiatives such as the Mohammed Bin Rashid Al Maktoum Solar Park (MBR Solar Park). This AED50 billion project is the largest single-site solar park in the world and will eventually produce 5,000MWh by 2030⁸, an estimated 25 percent of Dubai's total energy production.⁹

The park will help power Expo 2020 Dubai, providing 464 megawatts of electricity to the event. It will mark the first time an Expo has been powered by clean energy, with Dubai Electricity and Water Authority (DEWA) investing AED4.6 billion for water and power projects in support of the mega event.¹⁰

Also included is a AED500 million investment in a state-of-the-art R&D center under construction within the MBR Solar Park, focusing on innovation in solar

power technology, smart grid integration, energy efficiency and water. Equipped with the latest laboratories, testing facilities clean and renewable energy technologies, construction is expected to be completed in 2020. A dedicated free trade zone, the Dubai Green Zone, will also be established to attract the world's leading R&D centers and emerging clean energy companies to Dubai.

Legislation

Establishes a legislative structure to support clean energy policies across two key phases. The first, the Shams Dubai initiative, aims to increase the share of clean energy through the introduction of a net metering policy.

This encourages building owners to install solar photovoltaic panels on their rooftops to produce electricity with surplus electricity exported to DEWA's grid, offering a credit on the next electricity bill. As of June 2018, DEWA had installed panels on 1,032 buildings in Dubai, with a total capacity of 43.77MW.¹¹

Funding

Creates the AED 100 billion Dubai Green Fund for investments in green businesses and to provide low-interest loans companies in the clean energy sector. The capital for the fund is provided by DEWA with additional investment from local and international banks.

Building Capabilities and Skills

Development of human resource capabilities through global training programs in the field of clean energy and renewable technologies, run in partnership with international organizations and institutes such as the International Renewable Energy Agency (IRENA).

Environment Friendly Energy Mix

Secures a sustainable energy portfolio for Dubai that comprises solar energy (25 percent), nuclear energy (7 percent), clean coal (7 percent) and gas (61 percent) by 2030. It also explores cutting-edge



⁸ The Official Portal of the UAE Government

⁹ Dubai Electricity and Water Authority, MBR Solar Park Brochure 2016, Page 11

¹⁰ Dubai Electricity and Water Authority

¹¹ Dubai Electricity and Water Authority.

waste-to-energy (WTE) technologies, including the AED2 billion Warsan WTE project which is the world's largest WTE plant operating on one site. Upon completion in 2020, the project aims to treat 2,000 metric tons daily during the first phase of operations, producing 60MW of energy.¹²

In addition, Dubai has confirmed this commitment in a comprehensive Demand Side Management (DSM) Strategy that will reduce power and water consumption by 30 percent by 2030 and a Carbon Abatement Strategy (CAS) that aims to curb carbon emissions by 16 percent by 2021.¹³

The strategy is led by a dedicated program management office for demand-side initiatives, TAQATI, established by the DSCE. It falls under Etihad Energy Services Company (Etihad ESCO), the energy management services provider established by DEWA in 2013.

Already the city has made huge gains in supporting the improvement of energy

efficiency across the emirate through these initiatives, with the DSM Strategy achieving a 2.8 TWh/year electricity saving and 3.7 billion IG/year saving of water at the end of 2016.¹⁴

The city's rapid adoption and acceleration of clean and sustainable technologies also stems from Dubai's desire to transform itself into a world-leading smart city through its Smart Dubai 2021 strategy. Under the directive of this program, Dubai is undergoing a digital transformation - revolutionizing its services, businesses and industries to become the intelligent and responsive city of the future.

By leveraging digital technologies and ICT innovations, the city is at the forefront of the technological revolution sweeping the energy sector today.

As an ambitious and rapidly growing modern city, Dubai understands the strategic role energy plays in delivering the sustainable infrastructure it needs to continue to grow, develop and prosper and is leading by example in the pursuit of its green energy future.

DEWA has launched new smart initiatives and services bring the vision of Smart Dubai 2021 to life, including adopting smart helmet and eyeglass technology for engineers working at power stations across Dubai. This allowed users to utilize virtual reality and real-time data to improve the efficiency and productivity, while the application of smart grids and smart meter technologies across the city's networks have helped to speed up connections, improve resource efficiency and conserve consumption.



¹² The Official Portal of the UAE Government.

¹³ Dubai Electricity and Water Authority.

¹⁴ Taqati, DSM Strategy Annual Report 2016, page 15.

Nuclear Energy: The Embodiment of the UAE's Commitment to Clean Energy Diversification

As our nation approaches our semicentennial in 2021, our leaders are looking to the future and setting ambitious goals to ensure that the UAE will continue its global leadership in industry, finance and energy. Importantly, our nation is a signatory to several global initiatives aimed at reducing carbon emissions, supporting energy and economic diversification and opportunities to explore new energy and scientific frontiers.

In support of these efforts, the UAE Energy Strategy 2050 is a bold plan that outlines the nation's first unified energy strategy that is based on supply and demand. It seeks to diversify our energy sources and increase the contributions of clean energy to support sustainable growth and development.

The Barakah Nuclear Energy Plant will play a vital role in achieving these clean energy goals. Barakah is the first peaceful nuclear energy plant in the Arab world and will soon produce large baseload volumes of efficient, reliable and low-carbon electricity.

Clean Energy for Our Future and for the Planet

The UAE Energy Strategy 2050 aims to diversify national energy production by developing and producing power from more sources of clean, carbon-free electricity. The strategy includes objectives to reduce the carbon footprint of power generation by 70 percent, improve energy efficiency of individuals and corporations by 40 percent, and increase the contributions of clean energy in the total energy mix to 50 percent.

Today, the Barakah Nuclear Energy Plant embodies the UAE's commitment to its clean energy future, including the goals outlined as part of the UAE Energy Strategy 2050 and international obligations like the Paris Agreement. The plant will provide approximately a quarter of the UAE's electricity once all four units of Barakah are operational, while saving 21 million tons of carbon emissions annually. That's equivalent to removing approximately 3.2 million cars from the roads each year.

Further, nuclear energy provides abundant, low-carbon electricity with an incredibly efficient fuel source. Uranium, a naturally occurring, mildly radioactive element, is used to fuel many nuclear energy plants. According to the Nuclear Energy Institute in the United

“ There's a plan to create a dynamic, flexible basket of energies. Nuclear will play a major role in that equation. We'll still need [natural] gas; we'll still need renewables. We'll need all sources of energy because the country continues to grow. The good thing is that nuclear is a clean, safe, and reliable energy source, and there is no question about that. There are no CO₂ emissions. Once all four units of the Barakah plant are operational, [the UAE] will avoid around 21 million tons of CO₂ emissions every year.¹² ”

H.E. Eng. Mohamed Al Hammadi
CEO, Emirates Nuclear Energy Corporation

¹² <https://www.utilities-me.com/content/11310-industry-personality-of-the-month-nuclear-power-champ>

States, a single uranium fuel pellet, which is about the size of an adult's fingertip, can produce the same amount of energy as roughly a ton of coal, 560 liters of oil or 480 cubic meters of gas, and is enough to power an average UAE household for two months.

Clean Energy Investments Create Economic Opportunity

While our nuclear energy program supports our nation's energy diversification goals, it also ensures that we have the electricity we need to power our economic growth, including new industries that generate long-term careers for UAE Nationals.

The Emirates Nuclear Energy Corporation (ENEC), which is responsible for delivering the project, and its subsidiary companies have a combined workforce of more than 2,900 people. Approximately 60 percent of that workforce is Emirati and 20 percent of the total is female.

Further, more than 1,500 local companies have been contracted for the delivery of products and services for the Barakah Nuclear Energy Plant, with contracts totaling more than AED 14 billion.

This approach to electricity diversification coupled with economic and social development goals is unique and has resulted in the Barakah plant being hailed as one of the world's most successful new nuclear energy programs.

Stable Growth through Stable Pricing

Along with supporting the nation's energy and economic diversification, nuclear energy provides important stability for the domestic energy market while oil and natural gas remain key contributors to the UAE's economic and energy outputs.

Nuclear-generated electricity provides the power needed to produce more clean water, cool homes and businesses, and support manufacturing and finance

industries with more stabilized energy costs.

Nuclear Energy Provides Efficient, Reliable and Low-carbon Electricity

The UAE has become a global leader in nuclear energy development – and in the clean energy sector more broadly. As one of the highest per capita electricity consumers in the world, the UAE sets an example for what is possible with strong leadership that is committed to ensuring clean energy is a key component of our national vision.

Nuclear energy provides efficient, reliable and low-carbon electricity that allows us to meet our growing demand in an efficient and sustainable manner. ENEC is committed to the highest standards of quality and safety as the organization works to support the delivery of the nation's ambitious energy goals and power the UAE economy for generations to come.

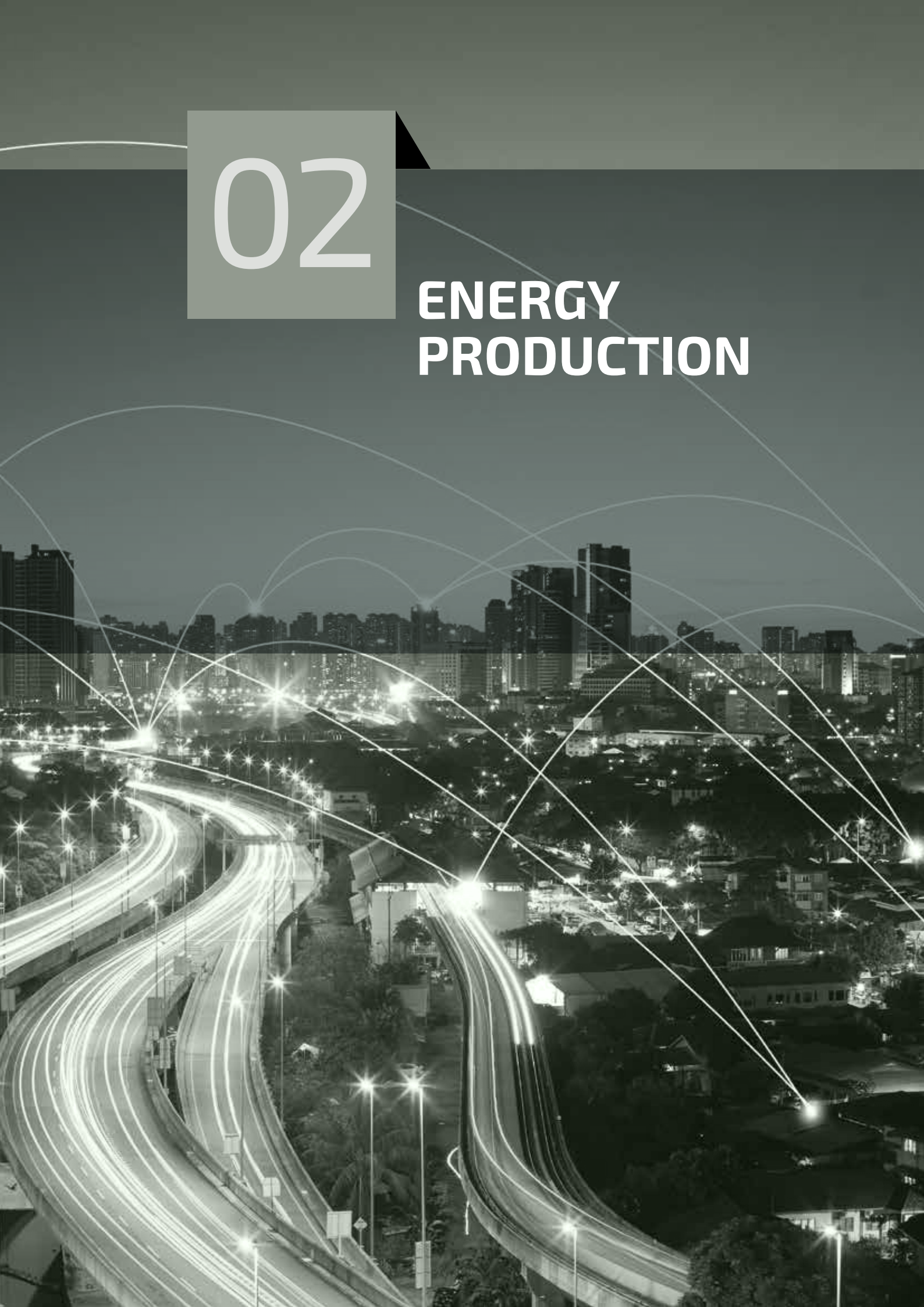
مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation





02

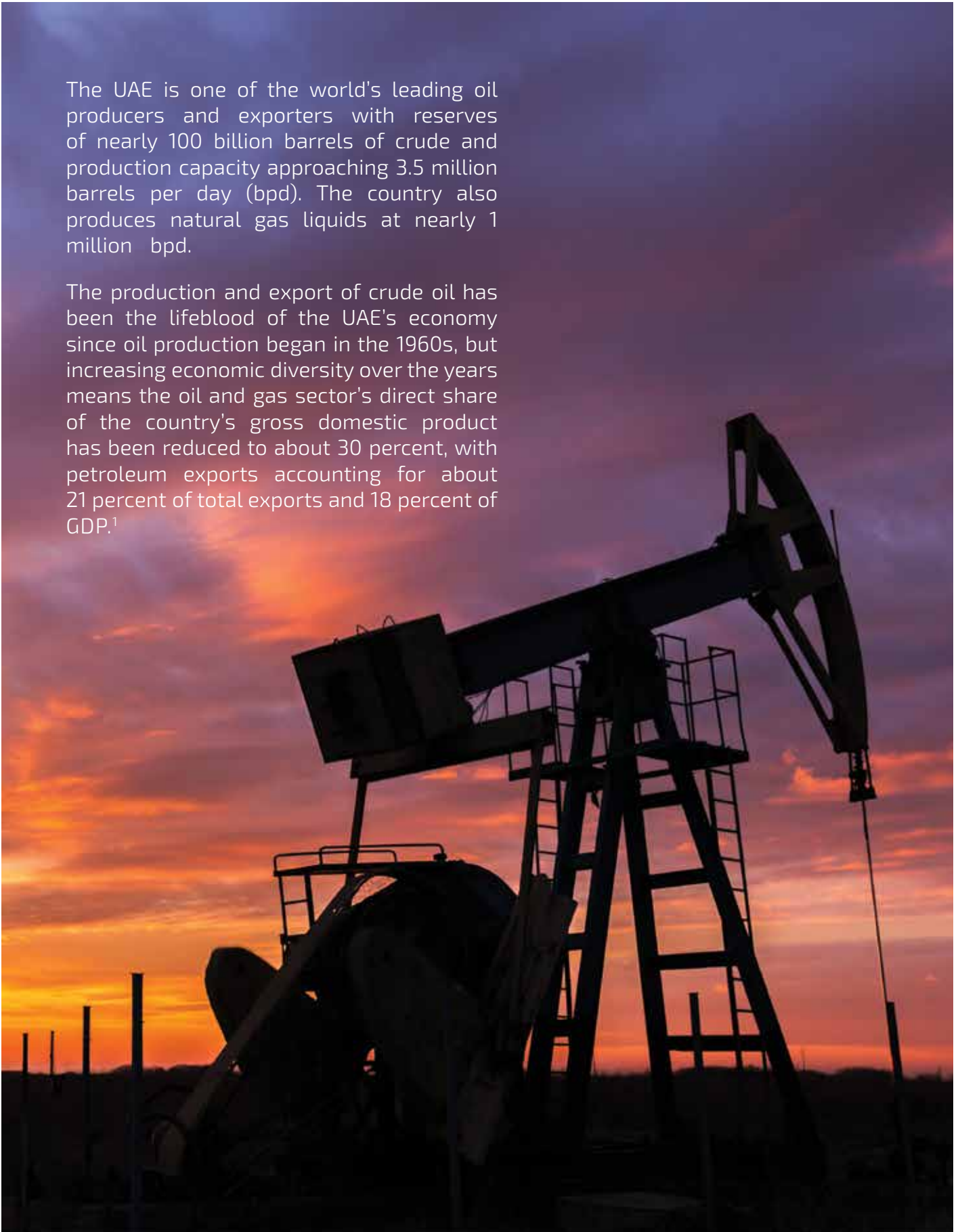
ENERGY PRODUCTION





The UAE is one of the world's leading oil producers and exporters with reserves of nearly 100 billion barrels of crude and production capacity approaching 3.5 million barrels per day (bpd). The country also produces natural gas liquids at nearly 1 million bpd.

The production and export of crude oil has been the lifeblood of the UAE's economy since oil production began in the 1960s, but increasing economic diversity over the years means the oil and gas sector's direct share of the country's gross domestic product has been reduced to about 30 percent, with petroleum exports accounting for about 21 percent of total exports and 18 percent of GDP.¹

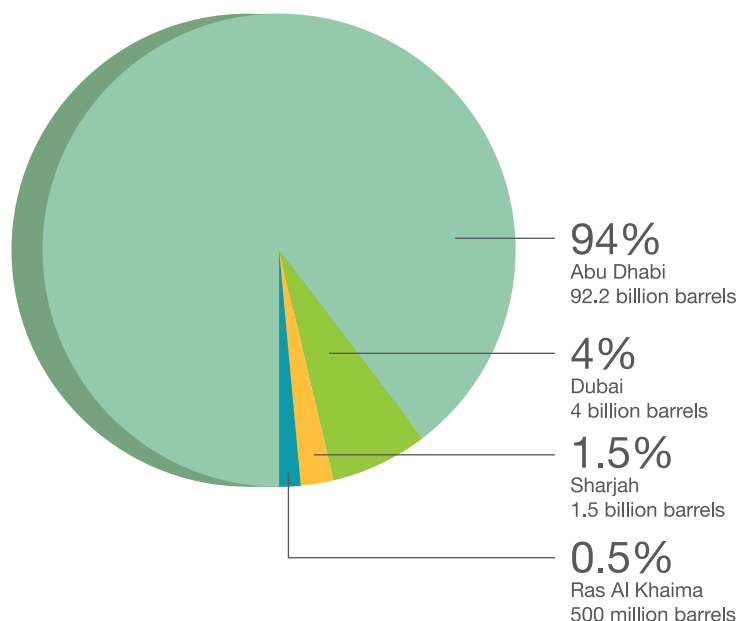


¹ Organization of Petroleum Exporting Countries, 2018

In recent years, the UAE has pursued a strategy of increasing crude oil production capacity and maximizing the life of its reservoirs, especially by deploying enhanced oil recovery (EOR) techniques. The country has also built up its domestic oil transformation capacity by upgrading existing refining facilities and adding a world class petrochemicals plant capacity.

The UAE also has significant natural gas reserves – estimated at about 215 tcf, the seventh largest in the world. The country is pursuing a strategy to develop indigenous natural gas, including sour and ultra sour reserves that are high in sulfuric content and otherwise not economically viable to develop. This will be used to help meet the growing domestic demand and to reduce reliance on imported gas.

UAE Petroleum Estimated Oil Reserves by Emirate



Petroleum

Abu Dhabi holds the majority of the UAE's estimated 98 billion barrels of oil reserves, controlled by the state-owned Abu Dhabi National Oil Company (ADNOC).²

Operating under mandate from the emirate's Supreme Petroleum Council, chaired by HH Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE and Ruler of Abu Dhabi, ADNOC laid out its 2030 Strategy at the end of 2016, setting new goals for a more profitable upstream, more valuable downstream,

more sustainable and economic gas supply and more proactive and adaptive marketing.

Its 2030 strategy included the unification of ADNOC's brand, bringing together its 14 subsidiary companies under one common identity, the ADNOC Group. Two of ADNOC's largest operating companies are ADNOC Onshore and ADNOC Offshore, which, together, account for most the UAE's crude and gas production.



² UAE Embassy, Washington DC

ADNOC Companies



Exploration & Production

- ADNOC Onshore
- ADNOC Offshore
- ADNOC Drilling
- Al Yasat Petroleum
- Al Dhafra Petroleum



Process & Refining

- ADNOC Gas Processing
- ADNOC Sour Gas
- ADNOC LNG
- ADNOC Refining
- ADNOC Fertilizers
- ADNOC Industrial Gas
- Borouge



Marketing & Distribution

- ADNOC Distribution
- ADNOC Logistics and Services
- ADCOP

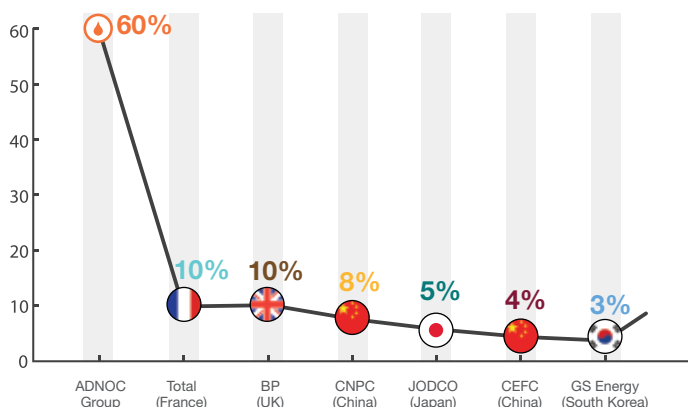


ADNOC Onshore produced about 1.6 million bpd of crude oil in 2017, or about 53 percent of total UAE output, and has a goal to raise capacity 2 million bpd by 2020.³

In November 2018, the Supreme Petroleum Council pledged AED486 billion to support ADNOC's five-year growth plan, which includes increasing oil production capacity to 5 million bpd by 2030.⁴

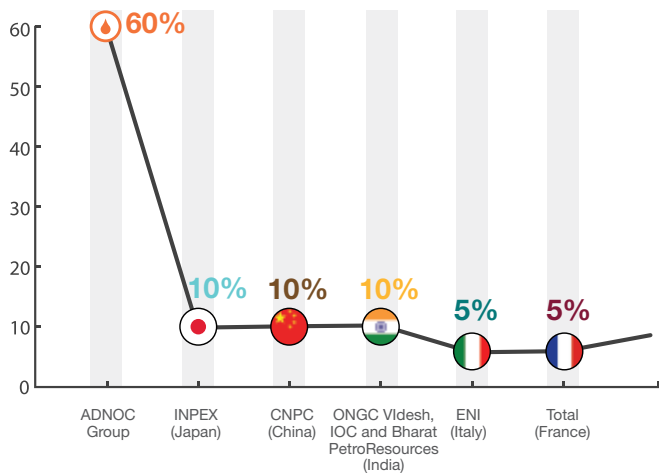
ADNOC Onshore comprises 11 oil and gas fields, operated by ADNOC and partners under terms set out by the 40-year concessions that run through 2055. Bab, Bu Hasa and Asab are the largest producing fields and contribute approximately 80 to 85 percent of the contract area's oil production.⁵

ADNOC Onshore Concession Shareholders



Adnoc Offshore is the subsidiary created following the merger of two of ADNOC's legacy offshore operating companies, ADMA-OPCO and ZADCO. In 2016, they accounted for about 1.4 million bpd of UAE crude output, with ADNOC Offshore now targeting a capacity of 2 million bpd by 2024. The fields also produce about 3 billion cubic feet of gas per day.

ADNOC Offshore Concession Shareholders



³ Abu Dhabi National Oil Company

⁴ MBZ Tweet, November 4, 2018

⁵ Wood Mackenzie

ADNOC Offshore Upper Zakum Concession	
ADNOC Group	60%
Exxon Mobil (USA)	28%
INPEX (Japan)	12%

ADNOC Offshore Satah & Umm Al Dalkh	
ADNOC Group	60%
INPEX (Japan)	40%

ADNOC Offshore Umm Shaif & Nasr Concession	
ADNOC Group	60%
Total (France)	20%
CNPC (China)	10%
ENI (Italy)	10%

ADNOC Offshore SARB & Umm Lulu Concession	
ADNOC Group	60%
Cepsa (Spain)	20%
OMV (Austria)	20%

At ADNOC Sour Gas, the company's Shah operation is the largest sour gas project in the world, having commenced production in 2016 and exceeding its initial output target of 1 bcf per day by 10 percent in its first year. The nature of the gas means it has very high levels of hydrogen sulfide, averaging 23 percent, as well as high levels of carbon dioxide. The advanced technologies employed on Shah have helped the project deliver about 500 million cubic feet per day to the national grid, meeting 10 percent of the country's natural gas demand. The pure granular sulfur removed, totaling 10,000 tons a day, is taken to Ruwais and converted to fertilizer and other products sold on the world market

Dubai, which accounts for approximately 4 billion barrels of oil reserves or 4 per cent of the UAE total, has been producing oil since the Fateh offshore field was discovered in the late 1960s. Production peaked in the 1990s at around 410,000 bpd and currently runs at about 70,000 bpd.⁶

Downstream

The country's downstream sector covers the processing of resources such as refining.

ADNOC's 2030 Strategy also set out plans to maximize the margin of each refined barrel of oil, capitalizing on increasing global demand for refined and petrochemical products. As part of this effort, ADNOC is investing in – and significantly expanding – its assets, capabilities and product range at the Ruwais Industrial Complex, transforming it into the world's largest, fully integrated refining and petrochemicals complex – underpinned by a \$45 billion downstream investment program.

ADNOC Offshore Fields



As part of ADNOC's downstream strategy, the company is also making targeted investments abroad, leveraging its crude oil production capacity as a key driver to gain greater access to key markets and secure a home for its crude.

The company plans to increase its refining capacity by 65 percent to 1.5 million bpd. This will also include raising domestic gasoline production to 10.2 million tons per annum (mtpa) by 2022, with the addition of new petrol and aromatics plant at the Ruwais Industrial Complex. ADNOC will triple its petrochemical production, from 4.5 mtpa in (Year) to 14.5 mtpa by 2025. The expansion will add polyolefin capacity and new petrochemical products coming from a world-scale mixed feed liquid cracker, targeting the fast-growing Asian markets.

The expansion includes a near doubling of refining capacity to 1.5 million bpd from about 800,000 bpd. This will also include raising domestic gasoline production to 10.2 million tons per annum (mtpa) by 2022 with the addition of new petrol and aromatics plant at the facility. Petrochemical production is also targeted to grow to 11.4 mtpa from 4.5 mtpa by 2025. The expansion will add polyolefin capacity and new petrochemical products coming from a world-scale mixed feed liquid cracker, targeting the fast-growing Asian markets.

ADNOC Refining's current capacity of 922,000 bpd accounts for the lion's share of the UAE's total capacity of 1.12 million bpd.

Moving to Dubai and the Emirates National Oil Company (ENOC) also has plans to expand its refining capacity, from 140,000 bpd to 210,000 bpd, expanding production of jet fuel, gasoline and diesel. ENOC also is building additional infrastructure to supply fuels to the Dubai International Airport and adding significantly to its retail outlets in Dubai.

⁶ Dubai Petroleum

However, Dubai remains one of the world's most important oil trading hubs. The Dubai crude grade and the corresponding futures contract traded on the Dubai Mercantile Exchange act as the reference benchmark for most oil traded east of the Suez Canal. Dubai's domestic oil production is operated by Dubai Petroleum Establishment, overseen by the Dubai Supreme Council of Energy.

Another important element comes from Fujairah. Though the emirate has no oil or gas deposits of its own, it has become one of the world's largest fuel bunkering ports and a major oil and products storage and trading hub. It is also one of the main exporting routes for Abu Dhabi crude oil since the completion of the Abu Dhabi Crude Oil Pipeline (ADCOP) from Habshan to the Fujairah port.⁷



Natural Gas

The UAE has large natural gas resources totaling around 215 tcf of reserves and produces about 10.5 billion cubic feet (bcf) per day of natural gas. Much of that is either reinjected into reservoirs to enhance oil production, processed into petroleum gases at the Ruwais refinery, or converted into liquefied natural gas (LNG) and exported to Japan under a long-term contract.⁸ ADNOC Gas Processing, a joint venture between ADNOC, Shell, Total and Partex, runs Abu Dhabi's associated gas processing, which feeds the associated gas to the Ruwais plant for conversion into LNG as well as using 1 bcf per day to power the national grid. The company produces products such as methane, ethane, propane, butane, paraffinic naphtha, condensates and sulfur, sold via a 3,000-kilometer pipeline network to domestic industry or exported to world markets.

ADNOC LNG was the first company to export LNG from the Middle East in the 1970s and supplies most of its output from three trains on Das Island to Japan's Jera power company and other international customers. This, coupled with the increasing domestic demand, the UAE imports natural gas to meet a significant portion of its needs – mostly via the Dolphin pipeline as well as increasing amounts of imported LNG via floating storage and regasification units.

In Dubai, ENOC is responsible for developing gas operations and the Dubai Natural Gas Company Limited (DUGAS) handles processing from Dubai's offshore oil and gas fields, which makes products that include liquefied petroleum gas, propane, butane and condensate, mostly going for domestic consumption. It also manufactures MTBE (methyl tertiary butyl ether), which is mostly exported for blending with unleaded gasoline.

The Dubai Supply Authority (Dusup) runs the emirate's gas importation and distribution infrastructure. Dusup operates Dubai's largest gasfield at Margham, imports and distributes gas via the Dolphin pipeline and operates a floating storage and regasification unit at Dubai's Jebel Ali port.

Sharjah National Oil Corp., established in 2010 to take over the original Amaco concession over the Sajaa natural gas and condensate field, operates that and related fields, as well as export terminals and storage facilities.⁹

In Ras Al Khaimah, RAK Gas operates the Saleh gas and condensate field in its own waters, the Bukha and West Bukha fields in nearby Omani waters, and the recently expanded Umm Al Quwain fields.¹⁰

⁷ Energy Information Administration

⁸ UAE Embassy, Washington D.C.

⁹ Sharjah National Oil Company

¹⁰ RAK Gas

Electricity

The power sector in the UAE is in the process of changing under the country's 2050 plan, switching from nearly all the electricity being produced from natural gas to a basket of sources.

In addition, the country began liberalizing electricity markets in 2015 to support the national economy, lower consumption and protect the environment.

The UAE is one of the highest electricity consumers per capita in the world, relying on natural gas to meet more than 90 percent

of its power generation needs. The resource also makes up more than 60 percent of total primary energy consumption.¹¹

The country's energy consumption has slowed in recent years compared to the jumps in 2014 and 2015, but demand continues to increase in line with population and economic growth.



¹¹ World Energy Council, 2016

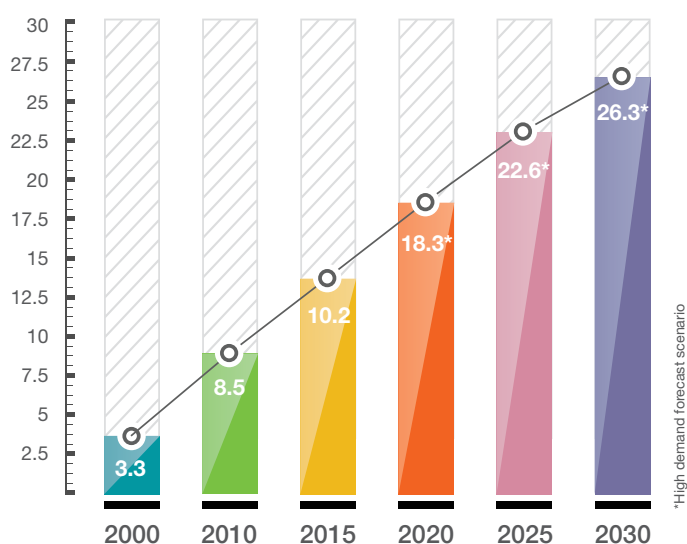
Abu Dhabi

Abu Dhabi follows the national path toward decreased consumption rates, but the emirate continues to see a robust growth in peak demand or higher electricity use at certain times such as summer.

Abu Dhabi will see an expected annual average of 3.4 percent through 2030 from 9.5 percent in the 2000–2016 period resulting from lower expectations for population and GDP growth as well as increased energy efficiency.

Yet the emirate's peak demand (which includes supplies to the Northern Emirates) is still forecast to grow by more than 80 percent, from 14.2 gigawatts to as much as 26GW, by 2030.¹²

Abu Dhabi's peak load (GW)



Main Drivers to Abu Dhabi's Electricity Sector:

- Onshore hydrocarbon developments
- Expanding industrial zones
- New large residential and commercial developments
- Increased exports to the Northern Emirates

In 2018, the emirate's power utility, Abu Dhabi Water and Electricity Authority, and the Regulation and Supervision Bureau merged to form the Department of Energy (DoE).

The newly created Department of Energy is responsible to develop strategic initiatives and the overall sector's security and sustainability in Abu Dhabi, including programs to help increase energy efficiency.



¹² Transco, 2017 Page 14



Abu Dhabi Department of Energy

Stakeholders

Government of Abu Dhabi	The Executive Council	Supreme Petroleum Council	Federal Authority for Nuclear Regulation	Ministry of Energy & Industry
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Subsidiaries

Abu Dhabi Distribution Co.	Abu Dhabi Water & Electricity Company	Abu Dhabi Transmission & Dispatch Company	Al Ain Distribution Company	Al Mirfa Power Company
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Partners

Abu Dhabi Digital Government	Abu Dhabi National Oil Company	Abu Dhabi Sewerage Services Company	Dolphin Energy	Emirates Nuclear Energy Corporation
Gulf Cooperation Council Interconnection Authority	Masdar	Tabreed	Tadweer	TAQA

Privatization Companies

Al Wathba Veolia Besix Waste Water	Arabian Power Company	Emirates CMS Power Company	Emirates Sembcorp Water & Power Company	Fujairah Asia Power Company	Gulf Energy SADC
Gulf Total Tractabel Power Company	International Investment LLC	Ruwais Power Company	Shuweihat O&M Limited Partnership	Taweelah Asia Power Company	

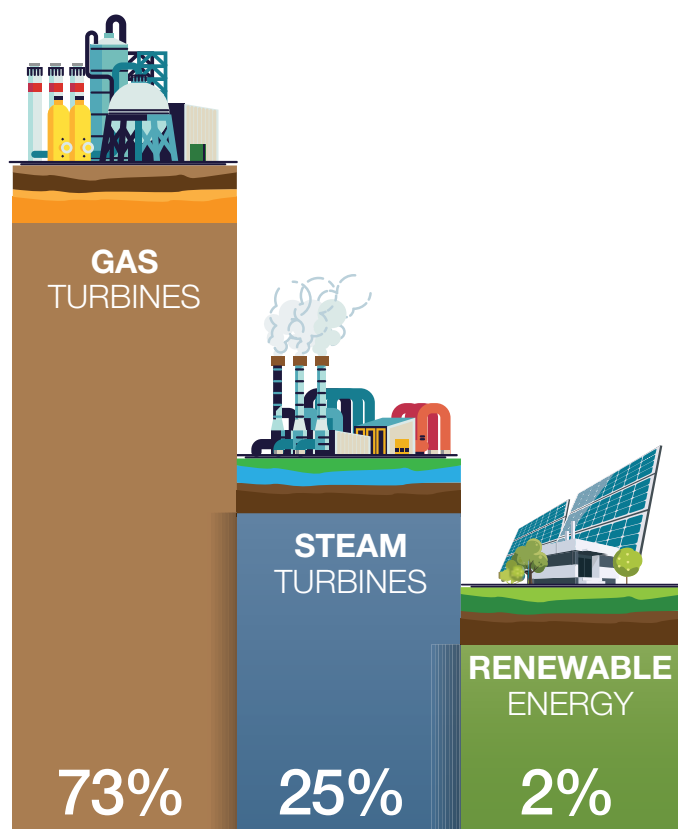
To meet this growing power demand, the DoE is also planning to add new capacity to the grid. In 2016, the total installed generation capacity was 15.2GW. Projects currently underway include the Mirfa combined cycle fossil fuel power plant which will be added adjacent to the existing Mirfa plant, the Barakah Nuclear Energy Plant and the Sweihan solar photovoltaic project – which combined total more than 8GW of power capacity (variances may occur based on solar irradiation levels).

Dubai

The emirate of Dubai has the highest customer growth in the country, increasing 28 percent in 2017 from 2012 levels.¹³

Natural gas continues to make up the bulk of Dubai's power generation, though the emirate is working to diversify its energy mix to have electricity from renewable energy sources make up 25 percent.

Dubai's Electricity Sources (2017)



Dubai receives natural gas via the Dolphin Pipeline, which transports 2 billion cubic feet of gas per day to the UAE and Oman. The emirate also receives gas from Abu Dhabi, recently extending an earlier agreement made in 1998 for another 15 years.

In February 2018, Dubai Supply Authority (DUSUP) and Abu Dhabi National Oil Company (ADNOC) signed a 15-year gas agreement to help meet Dubai's energy needs. This will help with Dubai's electricity sector, where the largest consumers come from the residential and commercial segments.

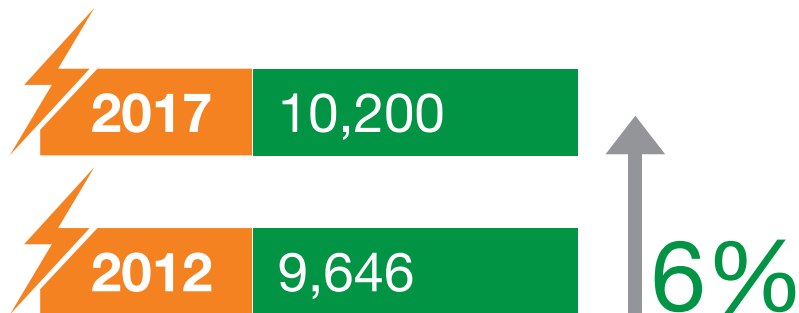
In addition to securing further supplies, Dubai Electricity and Water Authority (DEWA) began expanding the emirate's capacity and transmission and distribution network to meet the increase in demand.



¹³ 2017 Annual Statistical Report, MOEI (page 45 print); DEWA 2017 Annual Statistics

DEWA will invest AED81 billion over the next five years to meet the growing demand for electricity and water in the emirate as well as developing further clean energy and energy efficiency technologies. In mid-2018, the utility awarded more than AED11 billion in electricity transmission contracts to build 91 substations by 2021. Another AED11.4 billion of projects, including stations and substations, will be awarded by 2021.¹⁴

Dubai Power Plants (installed capacity, MW)



Installed capacity added over the five years to 2017



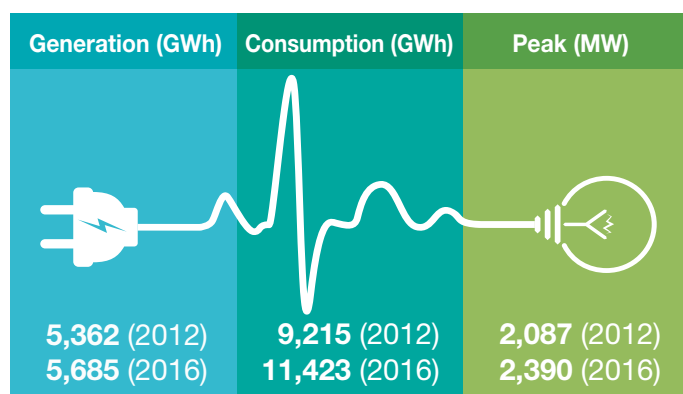
¹⁴ Dubai Electricity and Water Authority

Sharjah

In line with the rest of the emirates, Sharjah is working to increase its electricity grid from adding new generation units and transmission substations as well as heightening transmission and distribution capacities. Yet currently, the electricity used to power the emirate comes from Abu Dhabi.¹⁵

In September 2018, the emirate's power and water utility, Sharjah Electricity and Water Authority (SEWA) announced that it was looking to develop electricity networks throughout the emirate. SEWA said that it would reduce the connection time for residential and commercial buildings resulting in connecting more than 1,300 buildings in the first eight months of 2018.

SEWA's Electricity



Northern Emirates

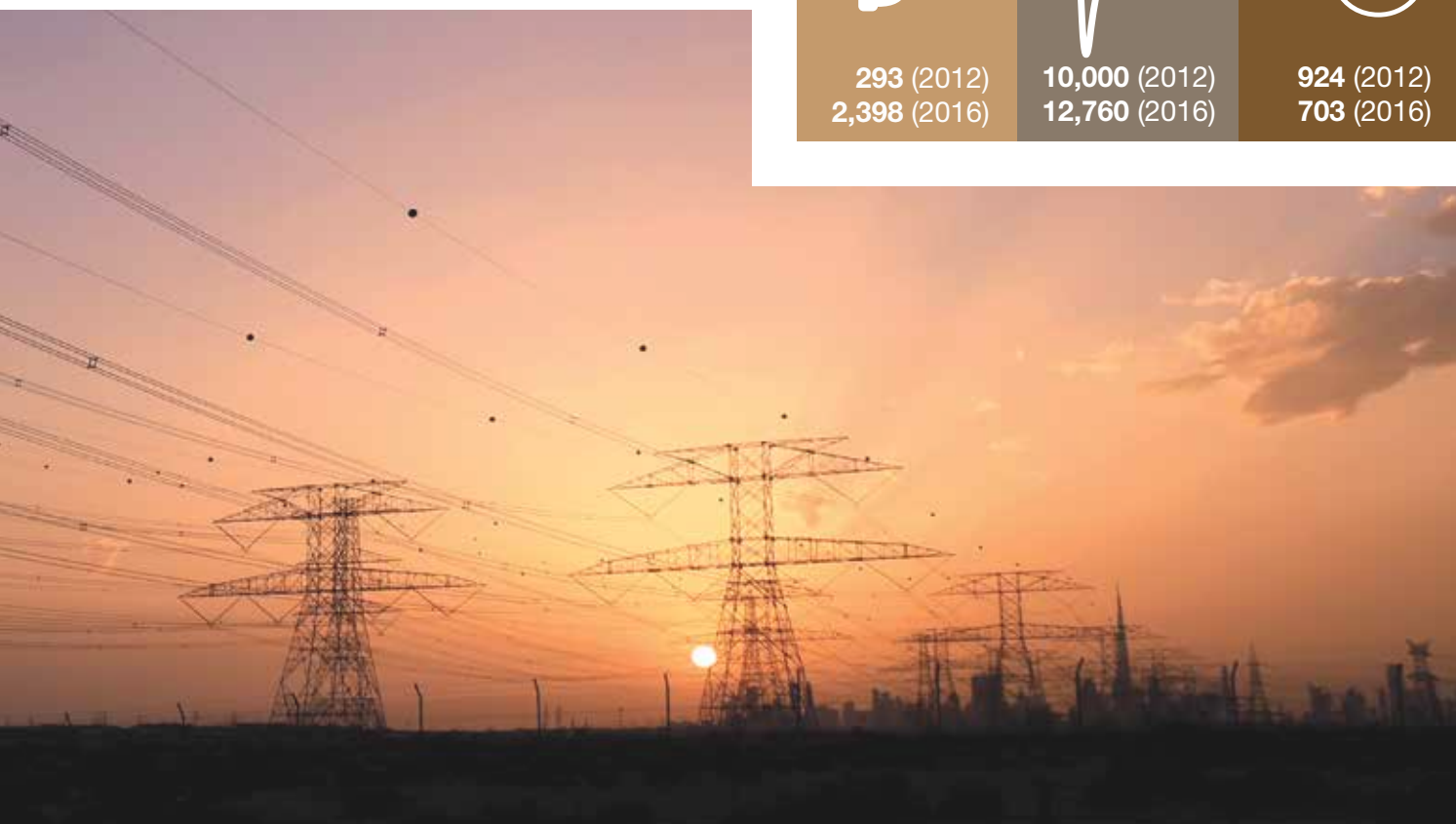
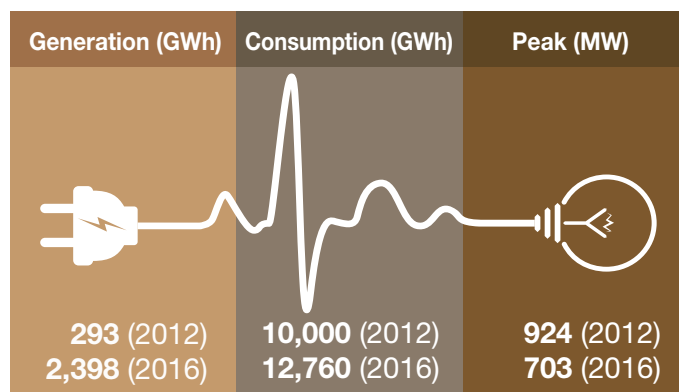
The emirates of Ajman, Fujairah, Ras Al Khaimah and Um Al Quwain make up the Northern Emirates and falls under the Federal Electricity and Water Authority (FEWA).

The number of consumers in these emirates increased by more than 36 percent in 2016 compared to four years earlier, and the demand base is expected to increase to 4.7GW in 2024.¹⁶

Power generation in the Northern Emirates has dropped and to meet the demand, Abu Dhabi's transmission company, TRANSCO, has increased the quantity of power that has been supplied to the area.

FEWA is planning to develop a combined cycle power and coal fired power plants in Ras Al Khaimah with additional new generation plans. Opportunities for projects exist in Fujairah given the proximity to a 400 kV transmission facilities which would cut costs on infrastructure.¹⁷

Northern Emirates Electricity



¹⁵ Sharjah Electricity and Water Authority Electricity Statistics

¹⁶ Transco, 2017 Page 97

¹⁷ Transco, 2017 Page 97

Nuclear Energy

Securing the UAE's Sustainable Future with Peaceful Nuclear Energy

Nuclear energy will play an important role in the future of the UAE. With a burgeoning population and rapidly growing energy demand, this proven energy technology will provide the country with a clean, reliable and abundant source of electricity, while diversifying the country's energy portfolio and helping to secure a more sustainable future.

Since 2008, the country has been working towards the delivery of the UAE's first nuclear energy plant in the Al Dhafra region of Abu Dhabi. Federal Law by Decree No. 6 was issued for the Peaceful Use of Nuclear Energy, which created the Federal Authority for Nuclear Regulation (FANR). Shortly thereafter,

His Highness Sheikh Khalifa Bin Zayed Al Nahyan established the Emirates Nuclear Energy Corporation (ENEC) by decree, with a mandate to implement the UAE Peaceful Nuclear Energy Program. ENEC has been working to develop the Barakah Nuclear Energy Plant and working towards the start-up of Unit 1.

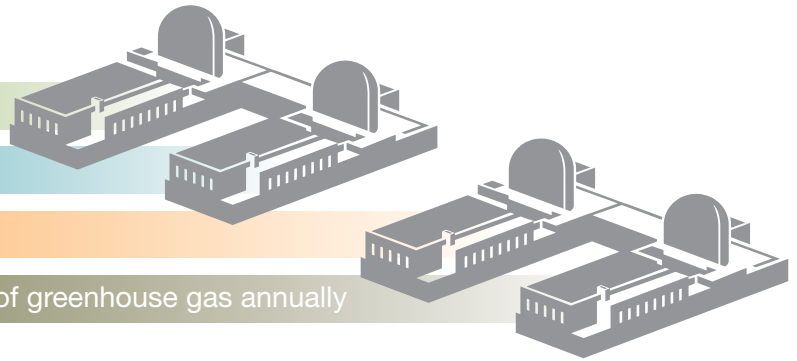
Construction of Unit 1 is now complete and the unit has been turned over to ENEC's nuclear operating and maintenance subsidiary, Nawah Energy Company (Nawah), for testing and commissioning in preparation for the start of safety-led nuclear operations.

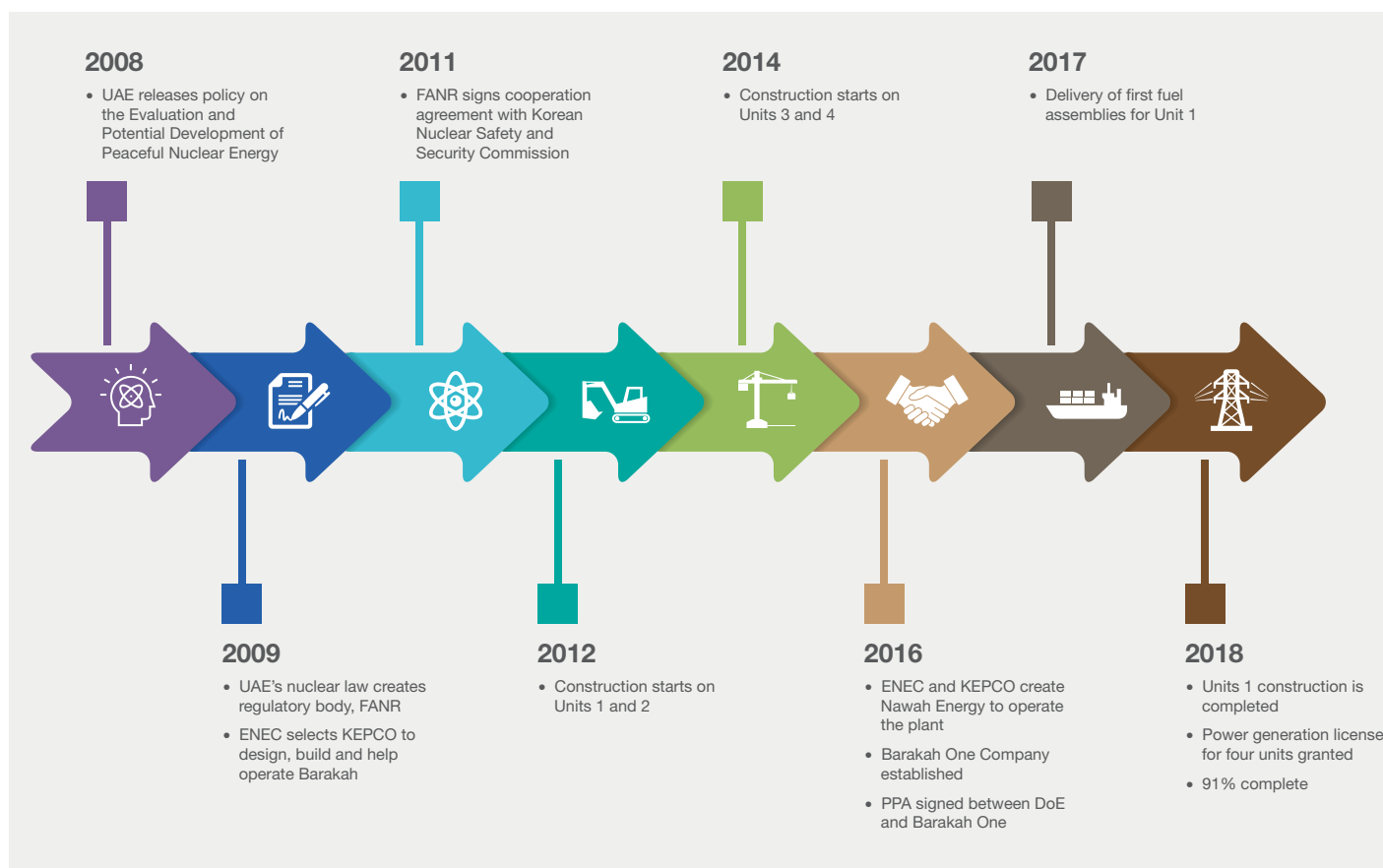
Four Generation III+ APR-1400 units

5,600 megawatts

Will provide up to 25% of the UAE's energy

Prevent the emission of up to 21 million tons of greenhouse gas annually





ENEC, together with its Prime Contractor and Joint Venture partner, KEPCO, established two subsidiary companies in 2016. Nawah was established to manage the operation and maintenance of the Barakah Nuclear Energy Plant in strict adherence with FANR regulations. Barakah One Company was established to manage the financial and commercial interests of the Barakah project. The focus now moves to ensuring the successful testing and commissioning of Unit 1 in order for Nawah to receive the Operating License from FANR and begin the supply of clean and reliable electricity to the UAE grid.

The 15,000-page Operating License Application (OLA) for Units 1 & 2 was submitted in March 2015, followed by the successful OLA submission for Units 3 & 4 in 2017. On approval, FANR will give the Operating License for the plant, which is expected to operate for at least 60 years.

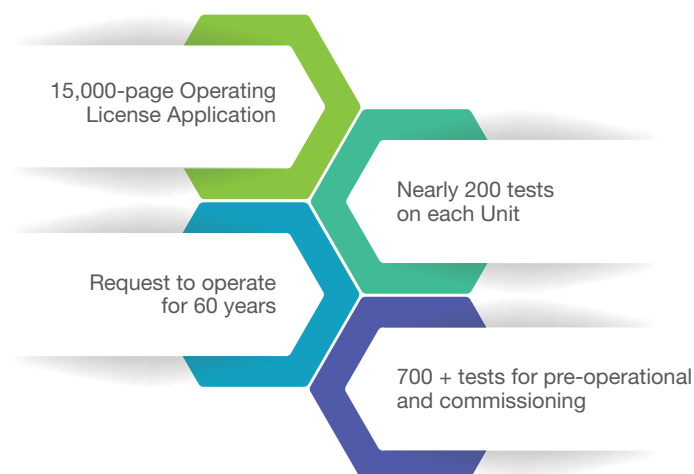
Each unit must be rigorously tested by a combined team of experts from Nawah, ENEC, KEPCO and KHNP, with more than 700 different tests conducted to ensure that all systems, processes and staff are ready for quality and safety-led nuclear operations.

Testing and commissioning for Units 1 & 2 is progressing steadily with critical pre-operational tests completed for Unit 1.¹⁸ In March 2018, ENEC celebrated the construction completion of Unit 1. In August 2018, ENEC and KEPCO, under the observation of FANR, successfully completed a major milestone in the pre-operational testing process on Unit 2, consisting of almost 200 individual and integrated tests on major systems to

check performance under normal operating conditions.¹⁹ The process applied the lessons learned from Unit 1 – highlighting the benefits of constructing four identical reactors through a closely phased approach.

FANR must review and audit all pre-start-up and commissioning activities to ensure safety and compliance before issuing Nawah with the Operating License. Only with the receipt of this license can Nawah's engineers and operational staff begin the process of loading the first nuclear fuel assemblies into Unit 1, and commence the quality-driven start up process for the plant.

Commissioning Requirements



¹⁸ Emirates Nuclear Energy Corporation <https://www.enec.gov.ae/news/latest-news/next-stage-of-testing-completed-at-barakah-nuclear-energy-plant/>

¹⁹ Emirates Nuclear Energy Corporation <https://www.enec.gov.ae/news/latest-news/barakah-unit-2-successfully-completes-significant-pre-operational-testing/>

In preparation for this milestone, ENEC took delivery of its first nuclear fuel assemblies for Unit 1 in May 2017, following the receipt of its fuel handling and storage license, nuclear fuel possession license and nuclear fuel import license from FANR. These assemblies are now being stored on site in accordance with the recommendations of the International Atomic Energy Agency (IAEA), FANR regulations and the requirements of the Critical Infrastructure and Coastal Protection Authority (CICPA), until the Operating License is granted.

A comprehensive operational readiness review conducted by nuclear experts from ENEC, KEPCO, and Nawah in May 2018 forecast that loading of first nuclear fuel assemblies for Barakah Unit 1 will occur between the end of 2019 and early 2020, pending regulatory approvals from FANR and international endorsements from the IAEA and the World Association of Nuclear Operators (WANO).²⁰

From the beginning of this project, ENEC has prioritized transparency and public engagement to build trust with the public and its stakeholders. As the program enters the operational phase, ENEC and Nawah recognize that continued engagement with their communities is vital to ensure awareness

and understanding about the UAE Peaceful Nuclear Energy Program and its importance for the future of the nation.

Results from a 2017 independent national poll, conducted by Nielsen, indicate community engagement programs have raised awareness and acceptance in 2017 compared to the previous year:

UAE Peaceful Nuclear Energy Program awareness increased 7 percent to 58 percent

Support for the nuclear plant rose 4 percent to 83 percent

Nearly all UAE Nationals, at 94 percent, believe the Barakah facility will serve as a roadmap for other countries, up 5 percent²¹



²⁰ Nawah Energy Company <https://www.nawah.ae/media/press-news/2018/05/26/Next-phase-of-preparations-for-Barakah>

²¹ Emirates Nuclear Energy Corporation <https://www.enec.gov.ae/news/latest-news/national-poll-shows-strong-support-for-uae-peaceful-nuclear-energy-program/>

The move away from gas-fired power generation, especially with the introduction of the large-scale nuclear energy generation at the Barakah site in the Al Dhafra Region, will allow for a decoupling of water and power and the location of water desalination facilities closer to consumption centers.

An example of this impact can be seen in the growth of new high-tech industries developing across the Emirates today in support of the UAE Peaceful Nuclear Energy Program. An important factor in the UAE's decision to pursue nuclear as part of its clean energy mix was the opportunity to develop a new industrial sector to support the nation's economic growth and diversification strategy.

Since its inception, ENEC has been working to support this vision by facilitating the development of a local nuclear energy supply chain. The nuclear energy industry has some of the most stringent quality and technical standards in the world. Therefore, ENEC's dedicated Industrial Development Team works alongside UAE companies to raise their standards to meet the unique requirements of the nuclear industry for them to tender for ENEC contracts. This process allows Emirati companies to not only contribute to the success of the country's nuclear energy program, but to also gain a competitive advantage in providing nuclear-quality services and materials to the world.

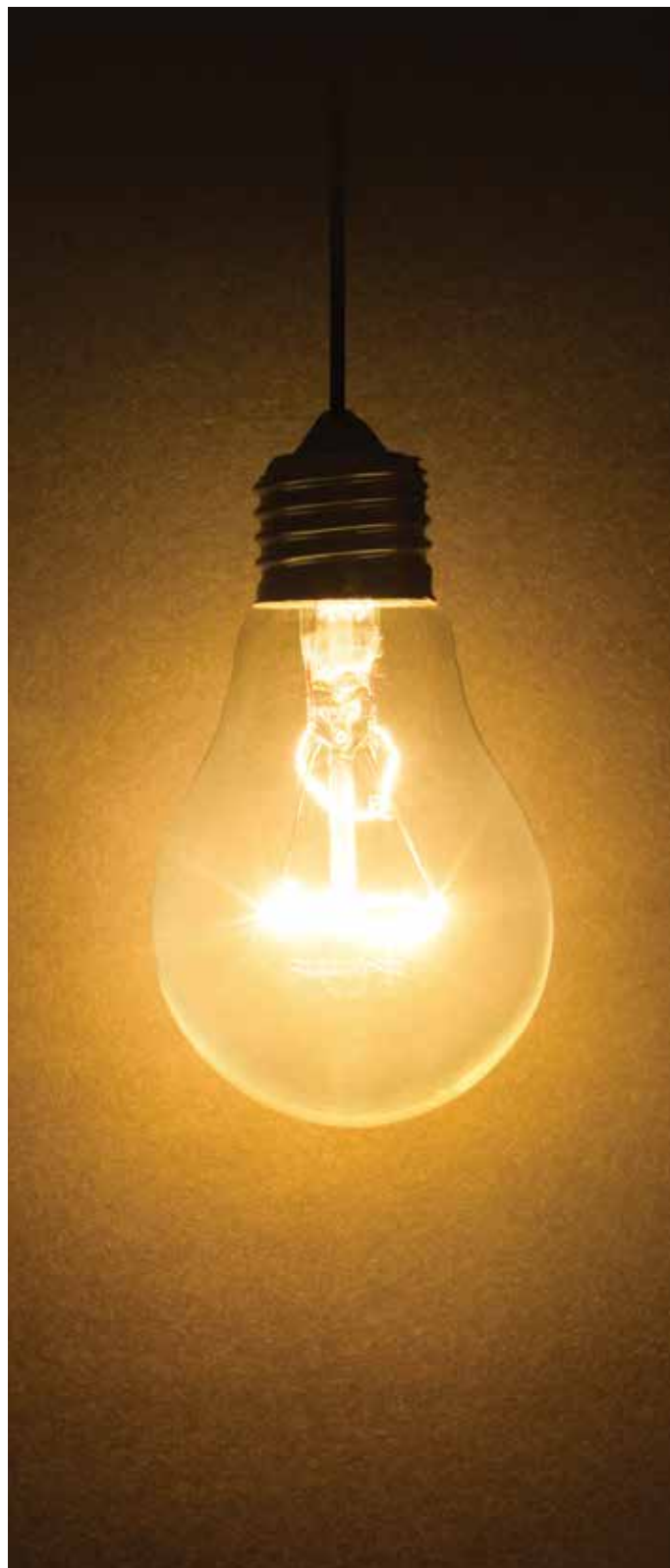
To date more than 1,500 UAE companies have successfully secured contracts totaling more than 14 billion AED for a range of products and services to support the completion of the UAE's first nuclear energy plant. Through its work with local companies, ENEC is not only supporting existing UAE businesses but also contributing to the development of the local economy while stimulating the growth of a new industry here in the UAE.

Contracts with local companies have been awarded through collaboration between ENEC and KEPCO, ENEC's Prime Contractor and Joint Venture Partner. Together, ENEC and KEPCO work with local companies to upgrade their systems to become American Society of Mechanical Engineers (ASME) Nuclear Component certified entities, which is the key certification required to become nuclear-approved suppliers. So far, contracts have been awarded to local companies including DESCON Engineering, Bin Asheer, National Marine Dredging Company, the Western Baidoon Group, Emirates Steel and Dubai Cable Company (Ducab).

Emirates Steel has entered into a strategic partnership for the supply of high-value steel products for ENEC's nuclear plants, and around 100,000 tons of steel has already been delivered for the construction of the project. With the support of ENEC and KEPCO, Emirates Steel is now the only steelmaker in the MENA region qualified to produce Q-class (nuclear quality) reinforcing steel, and the fourth company in the world to be qualified by the American Society of Mechanical Engineers to produce Nuclear Qualified reinforcing rebar.

Ducab is also benefiting from the development of the nation's nuclear energy program, supplying nuclear-grade cable for the Barakah Nuclear Energy Plant. The company was the first cable manufacturer in the Middle East to introduce and qualify 60-year, sustainable, halogen-free cables that meet the most

rigorous testing standards; and because of the company's success in supplying cables for Barakah, Ducab signed its first international export contract in early 2016 – taking its local business global.



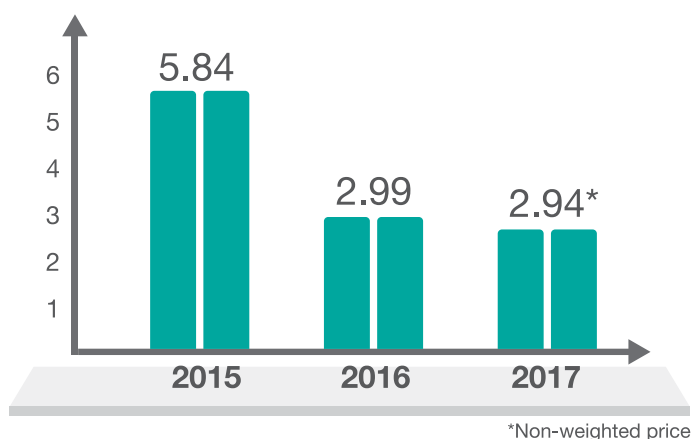
Renewables

As the UAE furthers its diversification efforts, it has also become the regional leader in renewable energy. In addition, the country has also set standards on an international stage breaking world records in the solar power pricing market nearly every year since 2015.



The 100MW Shams 1 project was the world's largest CSP plant when it opened in 2013, has been developed in partnership with Total (20 percent owner) and is part of Abu Dhabi's strategy to achieve a near-term goal of supplying 7 percent of power generation from renewable energy sources by 2020.

UAE Solar PV Prices (US cent/kWh)



Abu Dhabi and Dubai emirates have set renewable energy targets as well as other clean energy strategies, while Sharjah and the Northern Emirates – including Ajman, Fujairah, Ras Al Khaimah and Umm Al Quwain – are evaluating various tactics.

Abu Dhabi

Abu Dhabi began its clean energy endeavors in 2006 with the establishment of the Abu Dhabi Future Energy Company, or Masdar. The emirate solidified its standing as a world leader in renewables with the addition of the headquarters of inter-governmental International Renewable Energy Agency (IRENA) as well as Khalifa University's Masdar City campus (formerly Masdar Institute of Science and Technology).

Masdar, a subsidiary of Abu Dhabi's strategic Mubadala Investment Company, is the commercial entity overseeing Masdar City, which focuses on sustainable urban development, as well as Masdar Clean Energy, which has initiated several key supply-side renewable energy projects, including the Shams 1 concentrated solar power (CSP) project in the Western Region.

In 2017, the emirate began construction on a 1.17 GW solar photovoltaic (PV) project at Sweihan, about 180 kilometers east of the city of Abu Dhabi. The \$870 million project, named Noor Abu Dhabi, will be built under a 25-year power purchase agreement with commercial operation in April 2019.²²

Abu Dhabi is also looking to expand its solar rooftop installations, reaching commercial and residential areas. Earlier, Masdar installed solar PV systems on 11 government buildings.²³ However, at the end of the 2017, the emirate announced a net metering regulation which will allow businesses and government buildings to add solar panels on building rooftops which could reduce electricity bills by 25 percent.²⁴

Dubai

The Dubai Clean Energy Strategy will shape the future of Dubai's energy sector over the next three decades, and aims to provide seven percent of Dubai's total power output from clean energy sources by 2020, increasing up to 25 percent by 2030, and 75 percent by 2050.²⁵ Implementation will be supported by over AED 100 billion in funding for investments, research and development (R&D), and innovation projects.²⁶

One of the most important projects supporting that strategy is the Mohammed bin Rashid Al Maktoum Solar Park, a complex with a total capacity of 5GW by 2030 and investments worth AED50 billion.²⁷

²² Jinko Solar

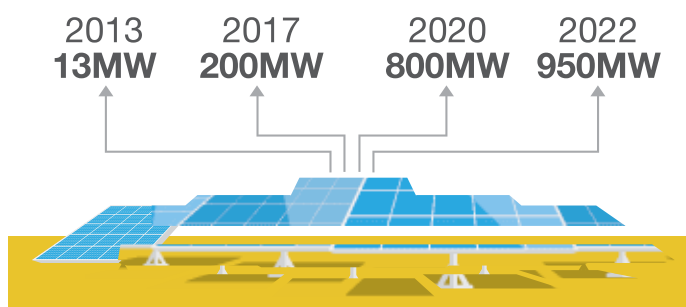
²³ Masdar

²⁴ Abu Dhabi Distribution Company

²⁵ The Official Portal of the UAE Government

²⁶ 'A Sustainable Dubai, The Dubai Municipality Report 2016' Page 11

²⁷ Dubai Electricity and Water Authority



The emirate is also working toward placing solar panels on every roof in Dubai by 2030 under the Shams Initiative, which was launched in 2014. Under the net metering program, residents and businesses can add solar panels to their rooftops to generate electricity. Any excess electricity produced can be fed back into the grid for a credit on the next power bill.

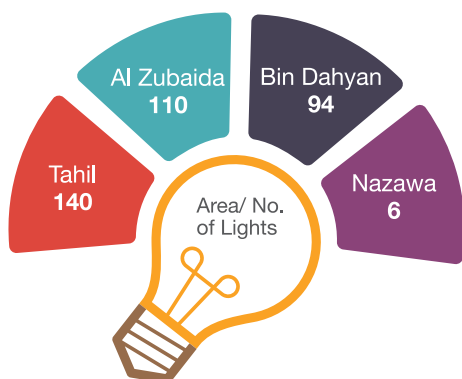
As of October 2018, the emirate's utility, Dubai Electricity and Water Authority (DEWA) had connected nearly 1,200 rooftop solar systems totaling 55MW.²⁸

Further diversification efforts can be seen in the 250MW hydropower station in Hatta. In mid-2018, DEWA had completed the engineering studies that will use the water stored in the Hatta Dam to produce electricity.

The project will use turbines that use clean and cheap solar energy that will pump water from the lower dam to the upper reservoir, marking this the first project of its kind in the region. DEWA said that the efficiency of power production will reach 90 percent with a 90-second response to demand for electricity.²⁹

Sharjah

In Sharjah, a street lighting campaign is underway. The emirate's utility, Sharjah Electricity and Water Authority (SEWA), commissioned an integrated solar street lighting project to bright up several roads across four low-cost housing areas.



The project has resulted in nearly 350 installations and there are further plans to replace all conventional street lights with solar.³⁰

Northern Emirates

FEWA, the utility over the Northern Emirates, announced in 2016 that it would install a 200MW solar power plant while upgrading the power grid to help meet increasing demand by 2025. In early 2018, Ras Al Khaimah is currently working toward the Energy Efficiency and Renewable Energy Strategy 2040. This plan has several aims including generating up to 30 percent of its energy through clean energy sources.³¹



Hydrocarbon meets Renewables

Further strides taken by Abu Dhabi include the November 2018 announcement that ADNOC Distribution had signed an agreement with the Japan Cooperation Center Petroleum to install a solar PV system at its Yas North service station.³²

ADNOC's Dubai counterpart, ENOC, has been rolling out solar powered petrol stations since 2017 when it added solar panels at its Dubai Internet City facility. The oil company later that year mandated that all future service stations will add solar panels to station roofs, which will be more than 23 gigawatt hours of solar energy generated powering the new stations by 2020.³³

²⁸ Dubai Electricity and Water Authority

²⁹ Dubai Electricity and Water Authority

³⁰ Sharjah Electricity and Water Authority

³¹ MOEI Enabling Energy Transition, Page 14

³² ADNOC Distribution

³³ ENOC



Business Driving Technology - Dolphin Energy's Integrated Approach

Background:

The fourth industrial revolution is reshaping the worldwide economy and disrupting all businesses. In the oil and gas industry, the digital era is bringing unprecedented opportunities to unlock higher efficiencies and enhance safety, integrity and reliability across the value chain. Put simply, the future is digital.

Having successfully implemented an extensive cost optimization program, Dolphin Energy then started to focus on process efficiencies and embark on an ambitious digital transformation project to positively impact its entire operations.

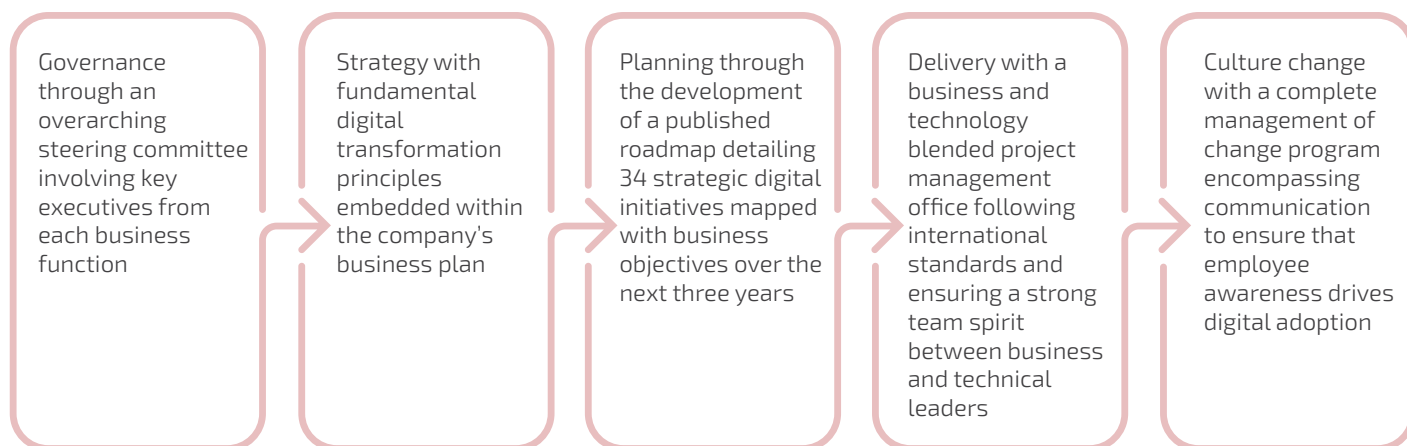
Scope:

Mindful of the saying "there is no such thing as a digital strategy, only a business strategy in a digital world", Dolphin Energy's senior management team agreed its digital transformation program, called Future Forward, should have business driving the use of technology.

Ensuring full alignment between business priorities and digital transformation, the Future Forward program is structured across five key areas:



FUTURE FORWARD
TRANSFORMING BUSINESS THROUGH DIGITAL INNOVATION



In addition, it was agreed that the company should interweave its digitization efforts with its process efficiency commitments.

Delivering both sides of the same coin the two programs are completely intertwined and are delivered under a fully aligned strategy. This blended approach has already proven successful with significant progress and improvements registered including:

- Close to 40,000 work permits issued and approved electronically with ATEX certified field mobility capabilities
- Introduction of risk-based inspection optimizing Dolphin Energy's inspections activities as well as enhancing the overall risk management capability – maximizing the life cycle of an asset
- Delivery of a shutdown and turnaround automation capability ensuring end to end integration from planning to execution powered with advanced analytics to return to full production after routine inspections
- Artificial intelligence based unsupervised machine learning for predictive asset maintenance
- Integrated planning including production, maintenance, inspections, reservoir across upstream and downstream

- Business adoption of cloud computing technologies (infrastructure as a service, software as a service, platform as a service) through secure hybrid integration with Dolphin Energy on-premise services

Some oil and gas companies are still finalizing their strategies to develop their digital ambitions while others focus on either improving process efficiency or digital innovation. Dolphin Energy's integrated approach will ensure future success by enhancing safety and security, maximizing asset reliability and availability and boosting productivity across the supply chain.

Impact:

Although the Future Forward program is in its early stages, there are many examples that highlight progress early success.

A strong governance framework is driving the program and ensuring commitment and buy-in from the most senior management members. In addition, a core team of Business and IT owners are providing support and implementing a clear roadmap.

Dolphin Energy has also been recognized by some of the leading research and advisory companies to be in the top quartile of worldwide oil and

“There is no such thing as a digital strategy, only a business strategy in a digital world.”

gas organizations in terms of digital transformation program roll out; and in terms of cultural change with close to 90 percent of its staff fully embracing digital initiatives.

The Future:

Digital transformation is a long journey and Future Forward is only starting to deliver the tremendous business value benefits that Dolphin Energy can expect from artificial intelligence, augmented reality, digital twin, robotic process automation and many other capabilities.

In the coming 24 months, the main challenge will be in shifting the digital transformation delivery arm from a project management office to a continuous digital service delivery process, encompassing business, technology, training, roles and responsibilities.



Turning waste to electricity

Emirates Waste to Energy Company, a joint venture between Masdar and Bee'ah to develop the UAE's first waste-to-energy plant in Sharjah.

The global waste crisis has reached a tipping point in the fight against climate change. In 2016, the world was generating around 2 billion tons of municipal solid waste annually. However, according to the World Bank's September 2018 report, this figure could increase by as much as 70 percent to 3.4 billion tons if the world fails to act now.

Driven by rapid urbanization and growing populations, the world's burgeoning waste problem is a critical challenge that must be shared by all stakeholders.

As the first oil-producing nation and OPEC member to sign the Paris Accord, the UAE's commitment to mitigating the

risks of climate change and reducing greenhouse gas emissions from 2020 is at the forefront of the country's long-term strategy as the region's sustainability leader.

Established in 2006, Masdar, the Abu Dhabi Future Energy Company, is committed to advancing the development, commercialization and deployment of clean energy technologies and solutions, including reducing greenhouse gas emissions from traditional waste landfilling.

While Masdar's focus remains on large-scale solar and wind projects, the company has pioneered new growth

opportunities in the UAE because of technological innovation. This is why the company, in partnership with Bee'ah, the Middle East's environmental management company, is developing a cutting-edge waste-to-energy plant in the emirate of Sharjah.

Under development by the joint venture Emirates Waste to Energy Company (EWEC), the Sharjah Waste-to-Energy Facility aims to divert more than 300,000 tons of solid municipal waste from landfill each year, not only contributing to Sharjah's effort to meet its "zero waste-to-landfill" target, but also helping the UAE to deliver on its 2021 goal of diverting 75% of solid waste away from landfills.

As the UAE's first waste-to-energy facility, the Sharjah Waste to Energy Facility is supporting the country's ambition of creating a low-carbon economy, displacing almost 450,000 tons of carbon dioxide emissions per year when it becomes operational in 2021.

The plant is located next to Bee'ah's existing Material Recovery Facility in Sharjah where the emirate's waste is collected, sorted and recycled, and will process more than 37.5 tons per hour of municipal solid waste to generate electricity.

The waste-to-energy process converts the waste into produced heat, which is then used to drive an electrical turbine. The net electrical power produced will be up to 30 megawatts – the equivalent of energizing 28,000 homes – and will be supplied directly to the Sharjah electricity grid. The flue gas of the waste processing will be environmentally treated before being released into the atmosphere, while the by-products, such as bottom ash and fly ash, have various potential uses, including as construction materials for roads and pavements.

The pioneering US\$220 million facility forms a core part of the UAE's roadmap for sustainable waste management, demonstrating that energy and waste challenges are interlinked and can, in fact, generate electricity more sustainably than alternative conventional power plants.

Designed to meet the strictest environmental standards and comply with the European Union's Best Available

Techniques, the facility will create a new and sustainable mix of power generation sources for the UAE and Sharjah, as well as reduce the reliance on landfills for traditional waste management.

The innovative project is a key contributor to the UAE's knowledge-based economic diversification plan that aims, in part, to attract foreign clean-tech investment and create a new sector for young Emiratis in the fields of power generation and waste management.

The Sharjah Waste to Energy Facility recently won Structured Loan Deal of the Year Award at the Bonds, Loans & Sukuk Middle East Awards, and was named Clean Energy Deal of the Year for the MEA region at the PFI Awards 2018.

The financing deal was the first of its kind in the region, bringing together a consortium of five local and international banks to finance the project on a non-recourse basis, illustrating the strength of the financial community's confidence in the commercial viability of sustainable waste management solutions in the UAE.

The commitment made by Masdar and Bee'ah to develop the Sharjah Waste to Energy Facility will have long-term direct and positive impacts on local communities. It will also pave the way for other waste-to-energy projects in the UAE and MENA region, as we continue to unlock further clean technology investments and expand our know-how.

Like any company, we have near- and long-term targets. We are delivering clean energy technologies and solutions in the UAE and international markets. Looking further forward, our aim is to double the size of our renewable energy portfolio in terms of capacity within five years. It is estimated that power demand in the MENA region alone will double in the next 20 years, which is just one indication of the size of the commercial opportunity in the renewable energy sector.

Quick Facts

1	First commercial waste-to-energy project in the Middle East
2	Shareholders: Masdar 50% & Bee'ah 50%
3	Processing more than 300,000 tons of waste per year
4	Net power: Up to 30MW (energizing 28,000 homes)
5	Project displaces almost 450,000 tons of CO ₂ emissions per year
6	Commercial operation date is set for Q3 2021





03

**ENERGY
EFFICIENCY &
DEMAND SIDE
MANAGEMENT**





Access to electricity is a critical driver of any nation's growth. An increase in electricity demand has been shown to directly correlate with economic development, improved standard of living, and longer life expectancy.¹ According to the World Bank's Doing Business Report, the UAE ranked first in the world for access to electricity in 2018, an achievement that reflects continued efforts by energy authorities to provide reliable and affordable electricity to fuel our nation's growth.

However, the UAE's demand for electricity had a 4 percent compound annual growth rate from 2012 to 2017 and is expected to rise to more than 100GW² by 2050.

Key to the achievement of the UAE 2050 Energy Plan's first phase is increasing supply through the expansion of new sources of clean energy to diversify its energy portfolio and accelerate efficient energy.

Energy used to power residential and commercial buildings account for more than 70 percent of the total electricity consumed in the UAE today,³ but the plan sets an ambitious target to reduce individual and corporate energy demand by 40 percent for total energy consumption which includes buildings, transportation and industries. Demand-side management (DSM) will be an important program encompassing initiatives across the UAE to deliver a variety of measures to increase energy efficiency and reduce electricity consumption.

In Abu Dhabi, the Regulation and Supervision Bureau (RSB), which is now under the Abu Dhabi Department of Energy, actively works with residents to reduce energy demand, and in 2017, a long-term strategy was launched aimed at cutting electricity consumption by 20 percent by 2030.⁴ This includes the establishment of Abu Dhabi's own DSM program, Tarsheed, designed to encourage consumers to rethink their

consumption habits. The umbrella program for all DSM activities in the emirate achieved a 36 percent brand recognition in the first six months after it launched with more than 85 percent of customers acting to reduce their water and electricity consumption.⁵

In 2013, the Dubai Supreme Council of Energy (DSCE) launched its DSM Strategy to reduce energy and water demand by 30 percent by 2030. The neighborhood campaign results in 2014 reduced electricity usage by 714 megawatt hours as well as 13 million imperial gallons of water, resulting in savings totalling AED829,000.⁶

A dedicated program management office, TAQATI, was also established in 2016 to coordinate all demand-side efforts; and together with the Dubai Electricity and Water Authority (DEWA), these entities are working to implement the strategy across the emirate today. The program achieved a reduction of 9 per cent and 11 per cent, respectively, in electricity and water usage through 2017.

¹ 'The Impact of Electricity on Economic Development', Stern, David IBurkes, Paul JBruns, Stephan, 2017

² UAE Ministry of Energy & Industry

³ Lin, M., Afshari, A., & Azar, E. (2018). A data-driven analysis of building energy use with emphasis on operation and maintenance: A case study from the UAE. *Journal of Cleaner Production*, 192, 169-178.

⁴ Tarsheed AD

⁵ MOEI Awareness Campaigns 2018, page 32

⁶ MOEI Awareness Campaigns 2018, page 29

Sharjah Electricity and Water Authority (SEWA) also aims to improve energy efficiency as part of its Vision 2020, and has prioritized several energy conservation and sustainable development strategies aimed at reducing power consumption by 30 percent.⁸ As the 'City of Conservation', SEWA has created a dedicated Conservation Department charged with overseeing the optimization of resources and hopes to establish Sharjah as an international model for power and water conservation.

In addition, SEWA began a drive targeting labourers to help increase awareness about saving water and energy in the workplace. This included lectures, competitions and awareness marathons. Each year participation increases and doubled to 500 labourers in 2018 compared to the year earlier.

The Federal Electricity and Water Authority (FEWA) has made similar commitments towards the rationalization of electricity. Specifically, the Ajman Municipality and

Planning Department has formed its own Green Building Committee to support energy conservation efforts, while Ras Al Khaimah Municipality set up a new Energy Efficiency and Renewables Office in early 2018 to improve energy efficiency by 40 percent by the middle of the century.⁹

Collectively, these authorities are working to reduce the UAE's energy demand through the application of key DSM initiatives that can be illustrated across the following focus areas:

- Building regulations and retrofits
- District cooling, price reform
- Demand response management
- Awareness and education
- Grid efficiency and smart technology

Dubai's cumulative investments in energy efficiency reached more than AED500 million in 2017, delivering energy savings totalling 21 percent.⁷

Building Regulations and Retrofits

As the largest consumer of electricity, the UAE's building sector has the greatest potential for energy savings. The MOEI works with both federal and local authorities to reduce energy intensity of their built environments and transition towards more sustainable infrastructure.

In 2017, the MOEI launched the UAE Federal Buildings Retrofit Program – a program to target energy efficiency in the building sector by developing a federal framework for the regulation and control of Energy Service Companies (ESCOs) in the market. The first phase of this initiative targets energy audits for federal government buildings across the country, using specialized ESCOs to identify energy conservation measures (ECMs).

A range of government buildings varying in age, use and location have been assessed with each building audited in line with the international ASHRAE Energy Auditing Guidelines for factors such as utility data, construction and design, building systems, operations

and maintenance. Results found the application of ECMs produced potential electricity consumption savings of between 15-55 percent across the sample.

Abu Dhabi is also targeting energy reductions from its building sector through the introduction of green building standards, retrofit programs and support

structures for energy service companies.

The framework of Abu Dhabi Urban Planning Council (UPC), known as Estidama, oversees all sustainable development in the Emirate and regulates the design, construction, and operation of buildings. Estidama's green building assessment scale, the Pearl Rating System (PRS) is used to



⁷ DEWA

⁸ Sharjah Electricity and Water Authority - <https://www.sewa.gov.ae/en/content.aspx?P=4JVpZ0gumWxxDeo5mu1mhQ%3D%3D>

⁹ ENABLING THE UAE'S ENERGY TRANSITION report, UAE Ministry of Energy and Industry and World Wildlife Fund, Page 15 / <https://www.thenational.ae/business/energy/ras-al-khaimah-mulls-clean-energy-targets-of-around-25-to-30-per-cent-by-2040-1.701428>

rate energy efficiency in buildings, encouraging the minimisation of waste, consumption reduction, and the use of sustainable materials. The PRS has been integrated into the building permit process with new buildings required to meet the minimum one Pearl rating, whilst all government funded buildings must achieve a minimum of two Pearls.

Abu Dhabi's DOE, in association with the Department of Economic Development (DED) and Ministry of Economy, opened registration for Energy Services Companies (ESCO) to facilitate the reduction of energy consumption by government, commercial and institutional buildings. As the Estidama program sets efficiency standards for new buildings, this program will enable existing non-residential buildings to reduce energy consumed for cooling,

lighting and other essential functions through the incorporation of efficient technologies.

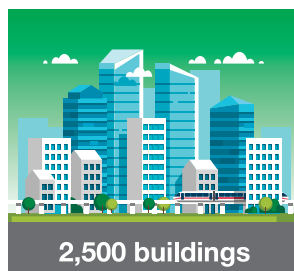
In Dubai, Green Building Regulations and Specifications became mandatory for all new buildings in 2014, and two years later the Dubai Municipality built on these standards by introducing the Al Sa'fat Dubai Green Building Evaluation System.

The system ranks all new buildings for their total energy efficiency, splitting the results into four classifications: platinum, gold, silver and bronze. In addition, it aims to reduce electricity consumption by 20 percent.¹⁰ All new buildings must adhere to the minimum bronze category requirements to receive a permit from the Dubai Municipality.

Dubai has also started rolling out standards to address this issue in older buildings, which consume the highest amount of energy. An extensive retrofitting program is underway to improve the energy performance of more than 30,000 existing buildings by 2030 led by the Dubai Municipality, DSCE and Etihad ESCO.¹¹

Etihad ESCO leads the execution of these building retrofits and aims to boost the creation of a thriving performance contracting market for local ESCOs in Dubai. The RSB Dubai was the first national government body to develop a regulatory framework intended to support the ESCO market, and the Dubai building retrofit sector has grown dramatically in recent years, with investment reaching more than AED450 million between 2014-2017.¹²

Dubai's Energy Efficiency Program¹³



In addition, the Ajman Municipality and Planning Department rolled out new green building standards in June 2018 for all villas requiring permits, undergoing maintenance or a change in license; and the standards will soon become mandatory for all buildings in the emirate. In addition, Ras Al Khaimah launched Barjeel Building Code in January 2019 which will require all new buildings to have a 30 percent cut in energy and water usage.

Price Reform

An important aspect of the UAE's approach to demand-side management has been the review of the country's energy tariff structure.

The UAE has been a leader among GCC countries in subsidy reform, having begun to reduce or eliminate subsidies for electricity, water, petrol and diesel in recent years.

Dubai implemented initial electricity reforms in 2008 to apply a slab tariff system and made further modest pricing reforms in 2011 – resulting in price increases ranging from 35-48 percent for government, industry and residents.

Assessments by DEWA showed that following the 2011 tariff review, a 4-5 percent reduction in consumption for electricity was observed across the residential, commercial and industrial sectors; but the impact of the tariff change has decreased with time, as witnessed in examples of price reform internationally.¹⁴ DEWA concluded that tariff reviews must be accompanied by prolonged communication efforts to ensure changes are sustained over time, and have implemented on-going consumer awareness initiatives to improve understanding of the tariff structure and potential energy savings long term.

Sharjah released a new tariff system was introduced in 2014 for the consumption of electricity for commercial and industrial entities, but residential prices were not increased.¹⁵ Electricity and water tariffs for the Northern Emirates were also revised upwards in 2015, but the primary focus was on prices charged to expatriates.

Then in January 2015, Abu Dhabi liberalized prices which increased electricity tariffs by 40 percent for residential expatriates while removing subsidies entirely for governmental entities.

Local authorities are now focused on monitoring the impacts of these initial reforms, and presently have no plans for further immediate changes to the tariffs. However, these revisions represent meaningful initial steps taken by UAE Governments in the effort to reflect the true cost of power generation and encourage rationalization.

Demand Response Management

UAE authorities have also been experimenting with demand response strategies to effectively manage energy consumption and balance supply and demand. Demand response allows

¹⁰ Dubai Municipality Report 2016, page 24,

¹¹ Dubai Supreme Energy Council -

¹² RSB Dubai -

¹³ RSB Dubai -

¹⁴ TAQATI Annual Report 2017, page 97

¹⁵ Reforming Energy Subsidies Initial Lessons from the United Arab Emirates - TIM BOERSMA AND STEVE GRIFFITHS, page 2 - report between Masdar and the Brookings Energy Security and Climate Initiative



consumers to engage in reducing demand on the electricity grid by limiting or shifting usage during peak periods in response to time-based rates or incentives.

As part of the emirate's overall DSM strategy, the Dubai Municipality and DEWA are collaborating to gradually introduce energy demand response programs to reduce peak load growth.

These include using time of use tariffs, curtailable load management strategies and direct load control programs which allow the utility to cycle high consumption systems such as cooling on or off during periods of peak demand in exchange for lower electricity bills. In Abu Dhabi, the RSB has also been running a 'Peak Shifting' AC Chiller Control Pilot project, trialling the use of remote devices to control large air conditioning chillers in high rise buildings to reduce demand during peak times. Initial trials have shown significant peak demand reduction and the RSB is considering different schemes to introduce this technology to manage summer demand more efficiently.

Awareness and Education

To support the application of their DSM initiatives, power authorities across the UAE are also focused on changing the energy consumption culture in the emirates through awareness and education campaigns.

In Abu Dhabi, Tarsheed has unveiled several energy awareness initiatives, including educational seminars at universities and schools, integration of energy conservation information into the curriculum with the Abu Dhabi Education Council (ADEC), and promotion of its interactive education portal that hosts a range of activities, quizzes and facts on energy conservation. The RSB has also launched its Powerwise Initiative, which aims to become a trusted source of knowledge for consumers, providing a wealth of knowledge online about reducing demand.

Promoting best-practice in electricity consumption and conservation, the DSCE unveiled its 'My Energy, My Responsibility' campaign in 2018 to encourage communities to take responsibility for their energy resources.

Sharjah's utility, SEWA, uses its annual 'Peak Hour' campaign to promote energy reduction and efficiency strategies for users by encouraging them to switch off for one hour from 2.30pm-30pm each July 1st – the peak hour of consumption at the height of summer. While in the Northern Emirates, FEWA has also rolled out a series of energy rationalization workshops across corporates and schools to reduce consumption.

Grid Efficiency and Smart Technology

Smart grids optimise supply and demand by using information

technology to provide a two-way flow of real time information between power generation, operators and consumers. The application of smart metering, transmission sensors and control appliances that can respond to price or demand signals can help consumers, including homes and businesses, to be more aware of their consumption and become active in demand-side flexibility.

Each emirate is swiftly moving to incorporate a smarter system. Abu Dhabi installed an advanced metering system that offers a wide range of functionalities and rates to encourage customers to reduce consumption or shift to off-peak hours. Abu Dhabi's smart bills allow utilities to provide feedback to customers based on their energy consumption, including a comparison to the national average and the level of subsidy on the bill, encouraging customers to understand the actual cost of energy consumption.

Next door, DEWA has provided an estimated AED7 billion in investments for smart grid development.¹⁶ The power utility has already installed 200,000 smart meters and aims to have deployed over one million by 2020.¹⁷

In Sharjah, SEWA has also recently partnered with US company Teleform to explore smart solutions and technologies in the development of SEWA's grid, including the development of smart grid monitoring systems and the modernization of the emirate's distribution network.¹⁸

¹⁶ DEWA,

¹⁷ DEWA

¹⁸ SEWA -

The Water-Energy Nexus - decoupling strategies

The UAE's energy and water industries have been developed hand-in-hand over the last 50 years, with desalination plants built almost exclusively in association with coastal power plants. While that approach was based on the most efficient use of individual power plants, the strategy is changing as water demand remains fairly consistent throughout the year whereas electricity demand is significantly lower in winter months than it is during the summer peak.¹⁹

Since the first desalination plants were commissioned in the 1970s to the present day, the country currently relies on 25 such desalination stations to provide 80 per cent of its non-agricultural water needs.

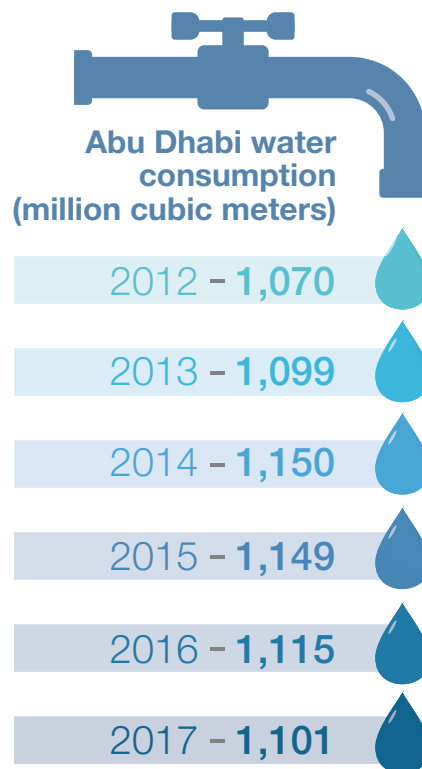
The UAE's new policy – developed in tandem with the clean energy strategy – is to decouple power generation from water generation, pursuing alternative technologies such as sea water reverse osmosis (RO), to improve energy and water efficiency and help meet other energy and water security goals.²⁰

The UAE's Water Security Strategy 2036, set out by the government at the end of 2017, established several targets for the water industry.²¹

- 1) Demand reduction for water resources by 21 per cent and average consumption per capita by half
- 2) Increase the water productivity index to \$110 per cubic meter²²
- 3) Reduce the water scarcity index by three degrees, from 6.58 in 2017²³
- 4) Increase the reuse of treated water to 95 per cent
- 5) Increase national water storage capacity up to two days
- 6) Establish six connecting networks between water and electricity entities across the UAE with capacity to provide 91 liters of water per person per day in cases of emergency, or 30 liters per person per day in cases of extreme emergencies

The UAE's water usage has long ranked as one of the highest in the world per capita, standing at about 477 cubic meters per day, or about 50 per cent above the world average.²⁴

Though per capita desalinated water usage declined in the decade through 2015, this was due in large part to the steep population increase and came amid a near doubling in outright water consumption. In Abu Dhabi, for example, total desalinated water consumption rose from 667 million cubic meters in 2005 to 1,170 million cubic meters in 2015, even while per capita consumption declined 14 per cent in the period. Overall consumption has declined slightly through 2017 through efficiency measures and a period of slower economic growth.²⁵



Energy and desalinated water production and consumption are inextricably linked – some 65 per cent of the UAE's energy output is consumed meeting two major demands: water provision and cooling for air conditioning.²⁶ The UAE energy strategy has been developed in tandem with the water strategy and sustainability goals for residential and commercial buildings, agriculture and industry.

¹⁹ A Review of the Water and Energy Sectors and the Use of a Nexus Approach in Abu Dhabi, International Journal of Environmental Research and Public Health

²⁰ MOEI

²¹ UAE Government

²² World Bank

²³ UAE Government

²⁴ UAE Water Security Strategy 2036

²⁵ Statistics Center Abu Dhabi

The move away from gas-fired power generation, especially with the introduction of the large-scale nuclear energy generation at the Barakah complex in the Western Region, will allow for a decoupling of water and power and the location of water desalination facilities closer to consumption centers.

In 2018, Abu Dhabi's Department of Energy (DoE) announced plans to build the world's largest desalination plant with the capacity to produce 900,000 cubic meters of water a day. The Taweelah power complex will use the RO process rather than thermal-powered distillation, meaning it will be more energy efficient and draw power from the national grid rather than rely on an adjacent power plant. It is slated to start production in 2022, when it would raise Abu Dhabi's RO output to 30 per cent of total desalinated water production from 13 per cent currently.

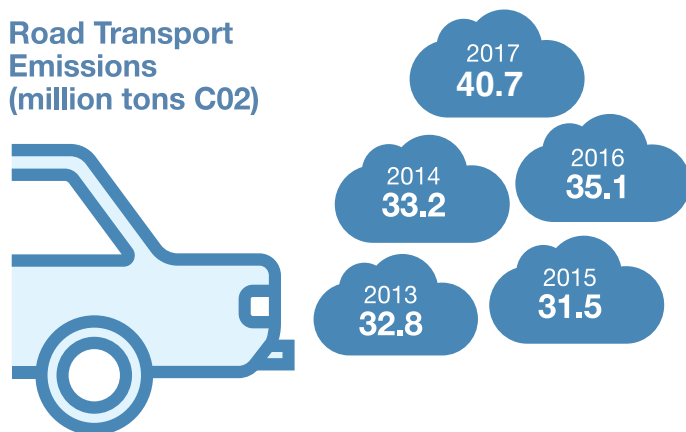
Also in 2018, the Dubai Electricity and Water Authority (DEWA) awarded an AED 871 million contract to a joint venture comprising ACCIONA Agua and Belhasa Six Construct (BeSIX) to build a 182,000 cubic meter per day RO desalination plant in the Jebel Ali industrial complex. The facility is part of Dubai's overall goal to produce 100 per cent of desalinated water using a mix of clean energy and waste heat by 2030. This includes a target to raise RO production from a current level of 5 per cent of Dubai's desalinated output to 41 per cent by 2030.²⁷

Dubai attributes about 26 per cent of the energy efficiency savings to its new market-based tariff rates for water and electricity, while nearly 60 per cent is attributed to new building regulations, retrofits and the introductions of standards and labels to improve energy management systems.

Transportation

The transportation sector in the UAE will play a pivotal role in decreasing carbon emissions, and as such, different programs have been rolled out across the country to encourage more sustainable, efficient alternatives.

Road Transport Emissions (million tons CO₂)



The Abu Dhabi Transportation Mobility Management Strategy was formed in 2011 out of the need to address future congestion issues because of a growing population. The emirate's Department of Transportation (DoT) expects Abu Dhabi's population to double every decade to 3.1 million residents in the municipality alone by 2030.²⁸

The strategy has several sub-categories targeting specific groups including:

- Workplace travel
- Education travel
- Visitor travel
- Residential travel

The goal is to discourage single-occupancy automobiles and one of the most recent pilot programs, which came out mid-2018, is a new free bus service dubbed the "Hail and Ride". The pilot project has started in Mussafah and will transport people from where fewer options exist for public transportation and shuttle them for free to nearby main bus stops.

Other moves are being made to introduce alternative fuel and electric vehicles (EV) as well as autonomous cars. The DoT, along with Masdar and French company NAVYA Group, has released the region's first fully autonomous electric vehicle with another soon to follow – which can carry up to 12 people at a speed of 25 kilometers an hour. The technology will be deployed at Masdar City, totaling seven cars, with the ambition to expand routes by mid-2019.²⁹

Masdar also saw its locally-manufactured, all-electric Eco Bus become operational in 2019. The net zero-emissions vehicle was developed by Masdar and Hafilat Industry in collaboration with Masdar Institute (part of Khalifa University of Science and Technology) and technology partner, Siemens. Designed to handle hot climates, the bus is able to reach 150 kilometers per charge when driven on a stop-start basis with enough seats to accommodate 27 passengers with additional standing room. The Eco Bus also has air conditioning as well as electrochromic windows to enhance shading.

Other initiatives by the clean energy company includes switching its CNG fleet vehicles to electric in addition to pursuing a ride sharing scheme.

Dubai launched its autonomous transportation strategy which the emirate hopes to transform 25 percent of the total transportation to automotous vehicles by 2030. For 5 million daily trips, this would save AED22 billion in annual economic costs.³⁰

In addition, the emirate's government entities will only purchase electric or hybrid cars through to 2020. Under the Green Mobility Initiative, electric and hybrid models will make up 2 percent of the cars on the streets by 2020 and 10 percent by 2030.³¹ To further this, the emirate installed more than 200 electric vehicle charging stations in 2018.³²

Electric Vehicles

Electric vehicles (EVs) are being adopted at a greater pace across the world, and the UAE is in the early stages of establishing a robust market.

The global market is expecting to see 55 new models driving through 2019, and a further increase through 2020.³³ The automotive dealers in the UAE, until 2018, featured two types of EVs: Renault Zoe and Tesla. In addition to increasing charging stations across the country, new models are also arriving such as the Nissan Leaf and Chevrolet Bolt.

²⁶ A Review of the Water and Energy Sectors and the Use of a Nexus Approach in Abu Dhabi, International Journal of Environmental Research and Public Health

²⁷ DEWA

²⁸ Abu Dhabi Department of Transportation

²⁹ Masdar

³⁰ Dubai Future Foundation

³¹ DEWA

³² DEWA

³³ Dubai Carbon



Dubai has more than 4,000 electric and hybrid vehicles with that number anticipated to grow as the DSCE holds further discussions with the entire value chain from dealers to manufacturers and banks. The emirate has also begun offering a variety of incentives to entice drivers.

- Free charging at public stations for registered users
- Free assigned parking
- RTA EV registration and renewable fees exemption
- Exemption from Salik's tag fee
- Special license plate

The emirate's Road and Transport Authority plans to transfer half of its fleet to hybrid cars by 2021 and currently operates 50 electric limousines at Dubai International Airport.³⁴

³⁴ Dubai Supreme Council of Energy

³⁵ Toyota Motor



Alternative Fuels

The UAE is also exploring the potential of hydrogen energy to encourage a low-carbon society. Masdar, ADNOC, Air Liquide, Toyota Motor and Toyota distributor Al Futtaim began a joint research program in 2017 placing the Toyota Mirai fuel cell vehicle (FCV) on the roads with a hydrogen fuel station under construction.³⁵

The UAE is well-placed to produce the hydrogen required for the FCVs, given that it has excess capacity at hydrogen production facilities located at oil refineries.

However, the first refueling station for FCVs opened in Dubai in 2017. Local Toyota distributor, Al Futtaim Motors, as well as Air Liquid began its Al Badia pilot station to test the technology.

UAE companies leading by example

Global Energy Management Leadership Awards are given each year at the Clean Energy Ministerial meeting. While individual organizations may submit case studies for the global achievement, the MOEI has also chosen to recognize top industries in the UAE for their commitment to energy efficiency programs.

These organizations are using international standards, called ISO 50001, to deploy energy efficiency measures via an energy management system.

ADNOC

In 2010, Abu Dhabi National Oil Company began its journey to become ISO 50001. Three years later the group began to establish an integrated energy management system. Operating companies have been receiving ISO certifications since that time with the corporate ADNOC energy management system being implemented in 2014 and certified in 2016.

It started with a plan that was selected for each business unit and operating companies. These plans analyze data which can then be used to determine ways to make processes more efficient. Adnoc spent \$55 million for all energy management related activities, and achieved savings of \$150 million in three years since implementation. However, one of the biggest accomplishments is that the investment payback period is less than five months.

Star Cement

Star Cement, as part of UltraTech Cement, became the first cement company in the UAE to implement a ISO 50001 energy management system. In 2016, the company established a system to monitor and conserve energy consumption with a focus on identification and prioritization of higher power consumption areas. Star Cement also added an alternative fuel handling system, using wood and tire chips as well as other solid fuels to replace the use of natural resources such as raw coal.

The system costs just under \$50,000 and saw nearly a 6 percent energy performance improvement in its first two months of inception. This technology was used at the Ras Al Khaimah-located clinkerization plant, which produces various types of cement totaling 3.3 million tons a year from all four of the cement grinding units present in Abu Dhabi, Ajman, Bahrain and Bangladesh.

Making Peaceful Nuclear Energy a Reality with Collaboration and Focused Companies

Over the last decade, the UAE has been establishing a new industry focused on peaceful nuclear energy. The cornerstone of that industry is the Barakah Nuclear Energy Plant, located in the Al Dhafra Region of Abu Dhabi. Once all four reactors are operational, the plant will provide abundant, low-carbon electricity and meet about a quarter of the country's energy demand.

Now, as the UAE prepares for the operation of the plant's first reactor, committed experts from three companies – the Emirates Nuclear Energy Corporation (ENEC), Nawah Energy Company (Nawah) and Barakah One Company (BOC) – are focused on the next phases of the project.

Each company brings its unique expertise to achieve the objectives of the UAE Peaceful Nuclear Energy Program. This approach creates efficiencies across the Barakah project with clear roles and responsibilities for achieving critical milestones in accordance with the highest international standards of quality, safety, security and operational transparency.

A Centralized Organization Evolves into a Leading Enterprise

A 2009 royal decree established ENEC to develop a peaceful nuclear energy program to meet the UAE's growing energy demands. The company's mission is to deliver safe, clean, efficient and reliable electricity to the UAE grid; develop its people and build sustainable nuclear sector capability; and ensure full alignment with the UAE energy strategy.

مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation



“ With the signature of the Joint Venture agreement, both organizations are establishing a new nuclear corporation designed to guide the Barakah project into new levels of performance. With KEPCO as our partner, we now have the right structure to ensure the long-term sustainability of the Barakah project well into the future.³⁶ ”

H.E. Eng. Mohamed Al Hammadi
CEO, Emirates Nuclear Energy Corporation



³⁶ <https://www.enec.gov.abudhabi/news/latest-news/enec-and-kepc-sign-joint-venture-for-uae-peaceful-nuclear-energy-program/>

As the centralized organization responsible for delivering the Barakah Nuclear Energy Plant, ENEC achieved significant milestones in its first seven years. This includes selecting and receiving approval of the plant site, applying for and receiving the construction license for all four units, establishing workforce development programs and adopting state-of-the-art training technologies, and submitting the operating license application on behalf of Nawah for the first two units.

Due to the team's unwavering commitment to the highest international standards since the early days of the project, the UAE rapidly emerged as an example for other nations considering the development of peaceful nuclear energy.

Today, construction is complete on the Barakah Nuclear Energy Plant's first unit and a team of experts is preparing it for operation, while all of the main concrete works and major components are installed in the remaining three units.

Effective Program Delivery Requires an Efficient Structure

A new governance structure based on the three companies – ENEC, Nawah and Barakah One Company – builds on the lessons learned since 2009. Each with its own area of focus and responsibility, these companies work together to support and deliver the Barakah project in accordance with the highest international standards.

Nawah was established in May 2016 with a mission to safely and reliably

generate electricity from nuclear energy to power the growth of the UAE. It will be responsible for operating and maintaining the four units at Barakah, making it the newest operator in the global nuclear energy industry.

Nawah is a multinational, multicultural company. It has a growing team of experts dedicated to supporting the UAE Nationals who are shaping the success of the nation's nuclear energy industry, and preparing these talented UAE Nationals to lead the company during the decades of operations ahead.

Nawah has already achieved several important milestones, including completing a comprehensive series of preoperational tests for Unit 1 that evaluate the plant systems to ensure that they operate as designed. These tests, as well as comprehensive reviews by the national regulator, the Federal Authority for Nuclear Regulation (FANR) and subsequent receipt of the Operating License, as well as endorsements from the World Association of Nuclear Operators (WANO) and the International Atomic Energy Agency (IAEA) are completed prior to the loading of the first nuclear fuel assemblies.

In October 2016, ENEC and the Korea Electric Power Corporation (KEPCO), the Barakah project's prime contractor, signed a Joint Venture agreement that builds on their successful relationship. The agreement establishes KEPCO as a long-term partner in the UAE's nuclear energy program and allows the nation to benefit from KEPCO's demonstrated performance as a safe and quality-driven nuclear constructor and operator, bringing over four decades of nuclear construction and operations expertise.

The Joint Venture agreement also established Barakah One Company and made KEPCO a minority shareholder in that company, owning 18%, as well as 18% of Nawah. ENEC is the majority shareholder with 82% of both companies. Barakah One Company is responsible for managing the Barakah project's financial and commercial interests, securing project financing from institutional and commercial lenders, and receiving funds for the electricity generated at the plant. Shortly after Barakah One Company was established, it signed a Power Purchase Agreement with the Abu Dhabi Water and Electricity Company, establishing a pricing structure for the electricity produced at the plant.

Competency and Focus Maximize Benefits

The governance structure with three focused companies is an efficient and effective way to grow the UAE's nuclear energy sector. While the companies work collaboratively to support the development of the Barakah plant, ENEC continues to oversee project delivery and Nawah and Barakah One Company focus on their respective areas of expertise and responsibility. This ensures that work focused on construction, testing, operations, maintenance and financing continues in a coordinated, efficient and quality and safety-led manner.

As the Barakah Nuclear Energy Plant nears completion and operations, this clear organizational structure provides the strong foundations for the UAE Peaceful Nuclear Energy Program's long-term growth, sustainability and success.





04

ENERGY AND ITS ROLE IN THE UAE'S SOFT POWER STRATEGY





In less than half a century, the UAE has transformed itself from a sleepy backwater to a global hub. It is the most competitive economy in the Arab World, according to the World Economic Forum, and has successfully diversified its GDP income from fossil fuels.^{1,2}

With its rise, the UAE has increased its importance on being a global soft power. This path will impact others to obtain attractive outcomes, rather than using coercion or monetary means. A country's soft power is directly linked to its resources of cultural values and policies and a successful strategy combines hard and soft power resources.³

The UAE formalized its commitment to soft power with the formation of the UAE Soft Power Council in 2017. Led by the Minister of Cabinet Affairs and the Future, Mohammad Abdullah Al Gergawi, the council was tasked with developing strategy to build on the UAE's already positive standing.⁴

The UAE Soft Council aims to "increase the country's global reputation abroad by highlighting its identity, heritage, culture and contributions of the UAE to the world."⁵ Leadership on how to successfully transition from fossil fuel dependency to clean energy could be the UAE's greatest and most enduring contribution to humanity.

“Our goal is to engrain the UAE's position in the world, and in people's hearts.”

HH Sheikh Mansour bin Zayed Al Nahyan
Deputy Prime Minister of the UAE and Minister of
Presidential Affairs

¹ World Economic Forum, pp. 32, 298

² CIA World Factbook

³ Public Diplomacy and Soft Power, Joseph S. Nye, The ANNALS of the American Academy of Political and Social Science, Vol 616, Issue 1, pp. 94 – 109, First Published March 1, 2008

⁴ UAE Government

⁵ UAE Government

Energy's role as a messenger

The UAE has extensive interests in energy and related projects around the world that help to achieve several of its strategic goals. These include access to markets, diversification (both of its overseas markets and its investments), adding value downstream, knowledge transfer, employee development, fostering the UAE's broader economic targets, and developing international bilateral relationships.

The pursuit of strategic international assets has grown in recent years, both in terms of their number and their level of sophistication as part of the long-term strategy to extract maximum value from the country's position as a leading energy provider.

ADNOC

Abu Dhabi National Oil Company (ADNOC) has had partnerships with major international oil companies since its inception to develop the emirate's onshore and offshore oil and gas fields, including those from countries where it has had long-standing relationships – such as Royal Dutch Shell, BP, Total, ExxonMobil – as well as from its oldest and still its largest market, Japan Oil Development Co. (JODCO), a subsidiary of INPEX Corp.

More recently, ADNOC added partnerships with China National Petroleum Corp., GS Energy of South Korea and a consortium of three of India's major state-owned oil companies (ONGC Videsh, Indian Oil Corp., and Bharat Petroleum) in more recent years. The expanded list of partners reflects the reality that the bulk of the UAE's crude and refined oil products is sold to customers in Asia, as well as the fact that future growth opportunities for ADNOC's expanding slate of refined products and petrochemicals – as well as many of its broader trading opportunities – also will be with Asia.

As part of ADNOC's 2030 Strategy, the company's leadership adopted an expanded partnership model, which broadened the scope of international investments that the company pursues across the entire value chain.⁶

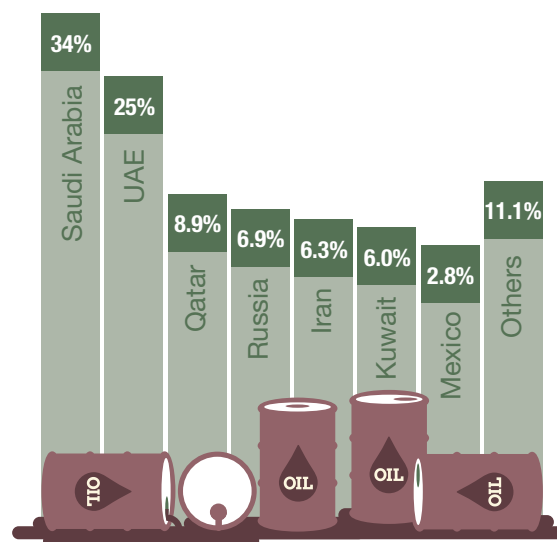
The first of these new partnerships were the deal struck with BP at the end of 2016, whereby Abu Dhabi (via strategic investment firm Mubadala Investment) acquired a 2 percent stake in BP in exchange for the British company acquiring a 10 percent stake in the ADNOC Onshore 40-year concession.⁷

As part of a broader UAE diplomatic effort that has included reciprocal state visits, ADNOC's leadership recently held a series of talks with national leaders in some of its main Asian markets to discuss expanded partnerships that will include major Abu Dhabi energy sector investment.

This has included Japan, where UAE Minister of State and ADNOC Chief Executive H.E. Dr. Sultan Ahmed Al Jaber met with Japan's Prime Minister Shinzo Abe as well as other senior ministers, business chiefs and finance leaders to discuss potential strategic energy partnerships.⁸ The UAE is the second-largest provider of crude to Japan, which equates to approximately one-third of Abu Dhabi's crude oil exports.

ADNOC recently extended through 2019 a long-standing deal with the Japanese government to store 6.29 million barrels of crude at Kiire Oil Terminal Strategic Reserve, helping Japan with its energy security needs and giving ADNOC marketing flexibility. ADNOC LNG also signed a deal in 2018 to expand LNG trade between the two countries, which diversifies Japan's gas sources and aids ADNOC's commercial flexibility in gas.⁹

Japan's Crude Imports, \$46.5 Billion (2016)



As part of the UAE's growing relationship with India, ADNOC signed a groundbreaking deal with the Indian Strategic Petroleum Reserve to store 5.86 million barrels of its crude at the underground facility in Karnataka.¹⁰ In November 2018, ADNOC also signed a Memorandum of Understanding (MoU) with the Indian Strategic Petroleum Reserves Ltd to explore the possibility of storing ADNOC crude oil at an underground oil storage facility at Padur in Karnataka, which has a 2.5 million ton (~17 million barrels) capacity. Under the MoU, ADNOC could store crude in two compartments at Padur. The company has a framework agreement to join Saudi Aramco to invest in India's proposed \$44 billion, 1.2 million barrels-per-day mega refinery and petrochemicals complex at Ratnagiri, the first such strategic deal between Arabian Gulf national oil companies.¹¹

⁶ ADNOC

⁷ BP

⁸ ADNOC

⁹ JERA

¹⁰ ADNOC

¹¹ Saudi Aramco



ADNOC's growing relationship with China and its major oil companies included the signing in 2018 of a wide-ranging framework agreement, whereby Abu Dhabi will explore deals that could include storing ADNOC crude oil in China; long-term crude supply arrangements; and a trading partnership for ADNOC's refined and petrochemical products.¹²

ADNOC is seeking international partners to co-invest in its \$45 billion expansion of the Ruwais refining and petrochemicals complex through 2023, with the aim of becoming "a leading global downstream player." The plan is to increase refining capacity by 65 percent to 1.5 million barrels per day, and triple petrochemicals capacity to 14.5 million tons per annum. The project has the additional goal of creating a Ruwais Derivatives Park and a Ruwais Conversion Park to attract international partners to use feedstocks from the complex to establish businesses aimed at export markets, especially plastics-based industries. The expansion of Ruwais is expected to create 15,000 jobs and knowledge-transfer that will benefit the broader economy.¹³

The Borouge petrochemicals joint venture at Ruwais, which has already established itself as a world-class polyolefins producer, is a partnership

between ADNOC and Vienna-based Borealis, which, in turn, is majority owned by Mubadala Investment Co. Borouge is a key part of Abu Dhabi's global petrochemicals strategy, which brings together many of the country's strategic partners and is integral to the UAE's plans to diversify its economy and international investments (see below under Mubadala Investment).

Other examples of ADNOC's "expanded partnership" model:

- ADNOC Drilling and Houston-based Baker Hughes, a subsidiary of GE, signed a strategic partnership whereby Baker Hughes will take a 5 percent stake for \$550 million, valuing ADNOC Drilling at \$11 billion. The deal aims to radically improve ADNOC Drilling's efficiency and grow its business internationally, leveraging Baker Hughes's position as the world's 3rd largest oil services group¹⁴
- ADNOC and OCP Group of Morocco are studying a joint venture fertilizer operation that would have hubs in Abu Dhabi and Morocco and expand their combined international marketing of fertilizers, leveraging Abu Dhabi's large and growing sulfur output¹⁵

Mubadala Investment and other international energy investments

Mubadala Investment Company is the main vehicle for Abu Dhabi's strategic international energy investments. The company's petroleum and petrochemicals division accounts for nearly a third of Mubadala's approximately \$125 billion of assets, and comprises an internationally diverse range of interests that link Abu Dhabi and the UAE to key markets.

In upstream, that includes Mubadala Petroleum's operatorship of three offshore fields in Thailand, making it the 2nd largest producer in the country. Also, through ownership of Compañía Española de Petróleos (CEPSA), a Spain-based integrated oil company, Mubadala has exposure to production in North Africa and South America, and through its nearly 25 percent share of OMV it also has exposure to oil and gas fields in the North Sea, eastern Europe and Australasia.¹⁶

Mubadala's downstream assets include CEPSA's refining interests which make

¹² WAM

¹³ ADNOC

¹⁴ ADNOC, Baker Hughes

¹⁵ OCP Group

¹⁶ In 2018, OMV acquired a 20 percent stake in ADNOC's offshore Satah Al Razboot oilfield (with the satellite fields



it, among other things, a world leader in production of linear alkylbenzenes (LABs), a key ingredient in detergents and other household products. Also, Mubadala's ownership of Calgary-based Nova Chemicals Corp. and controlling interest in Vienna-based Borealis position it as one of the world's leading petrochemicals groups. The plans for expansion at the Ruwais complex are increasingly tied to Abu Dhabi's international petrochemicals strategy, where combined interests already make it the world's 2nd largest olefins and polyolefins (two major petrochemicals categories). Borealis and Nova also have formed a joint venture, Novealis, to co-

invest with France's Total in a major new petrochemicals operation in the U.S.¹⁷

Through Mubadala's Masdar subsidiary, the company also has a range of international renewable energy interests, including a share in the London Array, one of the world's largest offshore wind energy operations.

Abu Dhabi also has international interests via Abu Dhabi National Energy Co. (TAQA) – the main power and water supplier in Abu Dhabi – which has upstream and energy infrastructure interests in North America, the North Sea, the Netherlands and the Kurdish region of Iraq. It also has

a share of electricity supply projects in Africa.

The Abu Dhabi Investment Authority (ADIA) also has a significant international portfolio of energy investments, which includes stakes in national electricity and infrastructure projects as well as renewable energy companies.

Other international expansion efforts include Emirates National Oil Company (ENOC). The Dubai-based company significantly increased its international exposure with the full acquisition of Dragon Oil in 2015, giving it upstream interests in Turkmenistan, Iraq and North Africa.¹⁸ ENOC has said it wants to expand its international upstream portfolio through Dragon Oil, and it has expanded downstream internationally with investments that include a jet fuel business in Nigeria, lubricants in Malta and a service station network in Saudi Arabia.¹⁹

Clean Energy

The UAE was one of the world's early adopters in the global energy transition. As a result, the UAE has a depth and breadth of renewable energy project references that have led the region.

The UAE also established an Overseas Renewable Energy Development Assistance Program, which has allocated \$700 million since 2013. The UAE has also established a \$50 million grant fund for renewable energy projects in 10 Pacific island countries, and has implemented or is implementing bilateral projects worth over 300 million in the Seychelles, Mauritania, Afghanistan, Egypt, and Morocco.

Location	Project	Status	Stakeholders
Mauritius	10,000 rooftop solar PV grids for households	Announced January 2018	ADFD, Central Electricity Board of Mauritius
Barbados, Bahamas, St Vincent & the Grenadines	2.35MW of solar power and 637kWh of battery storage projects	Inaugurated March 2019	Ministry of Foreign Affairs & International Cooperation, ADFD, Masdar
Rwanda	500,000 off-grid solar PV system	Announced January 2018	ADFD
Vojvodina, Serbia	Čibuk 1, 158 MW utility-scale wind farm	Due for completion in 2019	Masdar, DEG, Taaleri Energia
Al Quweira, Jordan	103 MW Solar PV Plant	Inaugurated in April 2018	ADFD, Jordanian government, Enviromena, TSK
Ile de Romainville, Seychelles	5 MW Solar PV Plant with battery storage to join existing wind farm	Announced Sept 2018	ADFD, Public Utilities Corporation of the Seychelles, Masdar

¹⁷ Total, Novealis
¹⁸ ENOC

¹⁹ ENOC
²⁰ International Energy Agency



The Abu Dhabi Government established the Masdar Initiative over a decade ago to develop and deploy clean energy solutions and sustainable urban planning. Since then, Masdar Clean Energy has become the region's largest exporter of renewable energy via projects spanning the globe, from the UK to the Pacific Islands, and ranging from huge, utility-scale grid-tied plants to off-grid solar home systems.

Domestically, the UAE is also making major strides. Dubai broke ground on the world's largest single-site concentrated solar power (CSP) plant – the fourth phase of the Mohammed bin Rashid Al Maktoum Solar Park – in March 2018. The plan has even been expanded from the original 700 megawatts to 950MW.

Ras Al Khaimah is drawing up renewable targets and retrofitting building to improve sustainability.²² These and other clean energy and carbon abatement initiatives across the seven emirates have created an ecosystem of experts and a groundswell of support.

The Government's Ministry of Foreign Affairs and International Cooperation (MoFAIC) sets out six main pillars to consolidate the UAE's reputation on the world stage.²³ Energy plays a significant and eloquent role in half of them: humanitarian diplomacy, scientific and academic diplomacy and economic diplomacy.

The UAE's renewable energy initiatives in the developing world embody all three of those. One powerful example is Abu Dhabi Fund for Development's (ADFD), partnership with IRENA, in a US\$350 million fund to support replicable, scalable and potentially transformative renewable energy projects in developing countries over seven yearly cycles.²⁴

The IRENA/ADFD Project Facility has a powerful multiplier effect: access to energy cascades into other routes out of poverty. At a primary level is the nexus between energy and food security. On a secondary level, energy sparks economic activity, and with greater energy access, a child can study after dusk, for example.

The recipients of the 2018 tranche of the IRENA/ADFD Project Facility reflected other aspects of the Government's development objectives. MoFAIC highlights that the United Nation's Sustainability Development Goal (SDG) 10 which calls for "financial flows, including foreign direct investment, to states where the need is greatest, in particular least developed countries, African countries, small island developing states and landlocked developing countries."²⁵

One example is Rwanda, a landlocked, developing country in Africa. The UAE has provided part-funding for off-grid solar PV systems for half a million homes, under the Rwandan government's rural

electrification scheme. The off-grid solar PV systems will provide some 2.5 million people with access to clean, sustainable energy. On top of that, the scheme aims to create up to 2,000 jobs.

The IRENA/ADFD Project Facility provides concessional loans for part of the initiative's cost and encourages recipients to seek co-financing from the private sector or other entities. This reflects another of MoFAIC's guiding principles.

On top of the IRENA/ADFD Project Facility, the ADFD and the MoFAIC ramped up renewable energy solutions to 16 Caribbean nations in 2018, via the \$50 million UAE-Caribbean Renewable Energy Fund (UAE-CREF). The fund aims to leverage the Caribbean region's strong potential for renewable energy solutions with Masdar as the project's delivery partner.²⁶

UAE-CREF also aims to leverage the success of the UAE's Pacific Partnership Fund (UAE-PPF). Through the UAE-PPF, 15 Pacific Island nations improved their energy security with the installation of solar and wind renewable energy capacity, as well as making annual savings of USD 3.7 million and averting some 8,500 tons of CO₂ emissions per year.^{23,24}

The UAE-PPF fund did not just provide the hardware, though. As noted, MoFAIC's soft power strategy to enhance the UAE's reputation also calls for scientific and academic diplomacy. In July, the UAE hosted the third of four modules of the Pacific Renewable Energy Integration training program in Auckland, New Zealand. The two-year program for sharing best practices in project implementation wraps up in January 2019 in Abu Dhabi.²⁵

UAE-Caribbean Renewable Energy Fund

Antigua and Barbuda Solar PV Plant AED 11 million 	Bahamas Solar PV Plant AED 11 million 	Dominica Station to store electric power batteries AED 11 million 	Barbados Solar PV Plant AED 11 million 	Saint Vincent and the Grenadines Solar PV Plant AED 11 million 
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²¹ ACWA Power
²² RAK Municipality

²³ UAE Ministry of Foreign Affairs
²⁴ International Renewable Energy Agency

²⁵ UAE Ministry of Foreign Affairs and MOFA Foreign Assistance Documents
²⁶ Abu Dhabi Fund for Development

Innovating Toward the Global Energy Transition

The UAE's energy-focused soft power initiatives reach far beyond the developing world, though. For example, Masdar partnered with Norwegian energy firm Equinor (formerly Statoil) to develop Hywind Scotland, the world's first floating offshore windfarm.²⁷ Hywind is located off the coast of Aberdeenshire – the heart of the UK's oil and gas industry – where it creates clean energy for some 22,000 homes.

In another first, Hywind started up the world's first battery storage unit connected to an offshore facility in mid-2018, dubbed Batwind. According to the World Energy Council, the North Sea will play a crucial role in the energy transition of northwest Europe, but inroads to bridge the gap between generated power and the end consumer need to

be addressed.²⁸ The Batwind battery storage unit could be one of the pieces in this puzzle.

The UK offshore windfarm is just one example of the UAE's commitment to ingenious, groundbreaking clean energy initiatives that accelerate climate action and enhance its profile worldwide.

For example, 2018 marked the tenth anniversary of Torresol Energy, Masdar's joint venture with Spain's SENER.²⁹ Torresol's Gemasolar project in southern Spain used innovative technology to become the world's first utility-scale solar energy plant to produce electricity 24 hours a day.³⁰ Gemasolar and its two sister plants paved the way for the 100 MW concentrated solar power (CSP) plant Shams 1 in Abu Dhabi, as well as

pioneering a new generation of solar plants.

And the world's eyes turned to the UAE when Solar Impulse, the only airplane able to fly day and night on solar power, returned safely to the UAE capital in July 2016, after circumnavigating the globe. Solar Impulse truly pushed the envelope by completing its epic journey without a single drop of fuel.

The UAE capital's role as host for the historic flight's departure and arrival reflects the UAE's welcoming culture and modern outlook, one of the mainstays in the UAE's Soft Power Strategy. The solar-powered plane's touchdown in Abu Dhabi also underscored the UAE's position as a meeting point and gateway to the region.

Masdar's International Projects

Tafila Wind Farm Jordan	Krnovo Wind Farm Montenegro	Baynounah Solar Farm Jordan	Dumat Al Jandal Wind Farm Saudi Arabia
Caribbean Renewable Fund Barbados Solar Farm Caribbean	Maeshall Islands-Solar Water Collection in Majuro Solar Farm South Pacific Island	Morocco Solar Home Systems Morocco	The Republic of Nauru-Nauru Solar South Pacific Island
Dudgeon Offshore Wind Farm UK	Cibuk 1 Wind Farm Serbia	Fiji: LaKaRo 525kW Solar PV South Pacific Islands	FSM-Solar in Pohnpei South Pacific Islands
Hywind Wind Farm Scotland	The Sheikh Zayed Solar Power Plant Mauritania	Dhofar Wind Project Oman	London Array Wind Farm UK
Gemasolar Solar Farm Spain	Al Wadi Al Jadeed Solar PV Plants Egypt	7000 Solar Home Systems Egypt	Kiribati: 500kW Solar PV & Water Protection South Pacific Islands
Red Sea Solar PV Plants Egypt	Palau-Solar Penetration And Water Access South Pacific Islands	Samoa Wind Farm South Pacific Islands	Port Victoria Wind Power Project Seychelles
Siwa Solar Farm Egypt	Solomon Islands-Solar PV Plant in Honiara South Pacific Islands	Solar Home Systems Afghanistan	Micro-grid Connectec PV Plant In Tonga South Pacific Islands
Tuvalu: 500kW Rooftop Solar PV South Pacific Islands	Valle 2&1 Spain	Vanuatu: Port Vila 767kW Solar PV South Pacific Islands	Noor Midelt I Hybrid Solar Project Morocco

²⁷ Masdar

²⁸ World Energy Council

²⁹ Masdar

³⁰ Masdar



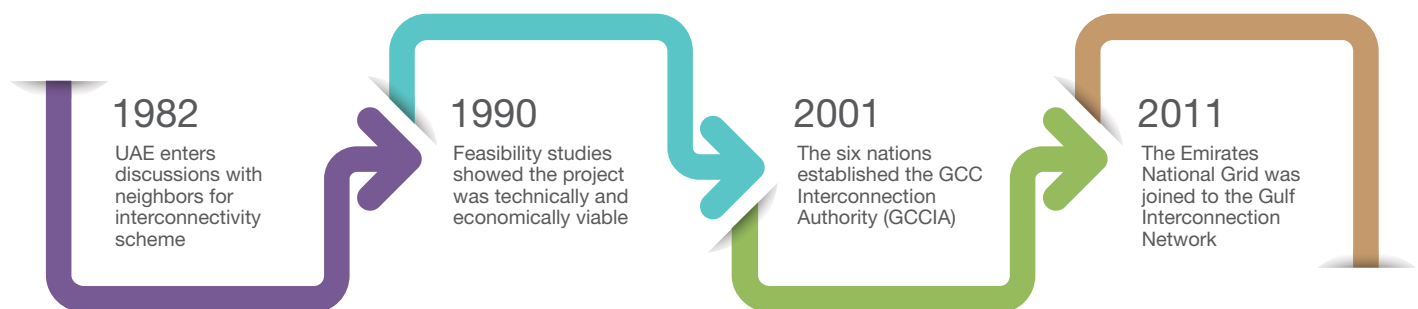
Strategic Importance of the GCC Electrical Grid

The stability of the UAE's electrical grid and the reliable supply of affordable electricity is vital for ensuring the continued growth of the nation and the long-term security of the UAE's energy sector. For this reason, enhancing energy interconnectivity with neighbouring Gulf Cooperation Council (GCC) nations

has long been a matter of strategic importance.

An interconnected electricity grid among the six GCC states (the UAE, Saudi Arabia, Qatar, Bahrain, Kuwait and Oman) improves the reliability of partner nation energy systems by lowering electricity

reserve requirements, increasing economic efficiency of energy systems, reducing outages, and ensuring greater security of supply. It also builds the foundations for future energy trading and a common GCC power market.



Today the network links the transmission networks of member states via one unified 'super-grid' which spans around 1,200 kilometers of overhead lines and submarine cables. The UAE contributed AED800 million towards the AED5.1 billion project, and estimates from the GCCIA put the economic savings for GCC countries at more than AED 8 billion since the start of full operations in 2011,³¹ with this figure expected to grow to more than AED110 billion over the next two decades.³²

The GCCIA is now looking to build on this success and move towards the next phase of development; aiming to maximize the network's potential by exploring options for further power trading possibilities between nations and the establishment of a common GCC energy market. Work is continuing to create the Gulf Common Market for power trade to launch by 2020.³³

The interconnected GCC grid has been used primarily to share generating reserves for emergency response. The direct and instantaneous transfer of power across the grid has prevented more than 1,300 potential outages in the region since 2009, benefitting critical industries and services immeasurably.³⁴ But studies show the potential value for power trading exceeds more than AED91 billion over the next 25 years,

and the GCCIA is keen to explore how a common power market could enhance low-cost generation, balance supply and demand, and optimize resources across the GCC.³⁵ Discussions are now underway with experienced power exchange experts from around the world to discuss opportunities for cross-border power trade.

A common market would ultimately provide several advantages for GCC countries. By providing trading services to the power sector, the GCCIA could become a launch pad for energy trading, not only between the GCC countries but also with Independent Power Projects (IPP's) and internationally with other grids, such as the Pan-Arab, North African, European and Mediterranean networks.³⁶

A common GCC electricity market would encourage local and international investors, resulting in lower power production costs and lower electricity prices. It would also create opportunities for IPPs to strategically select locations for power plants close to resources and encourage investors to develop on a larger scale, encouraged by the security of access to a larger potential market.

Wider interconnection of the grid would also allow the GCC countries to balance electricity demands across larger areas, taking advantage of the diversity of

different time zones and seasons. For example, smoothing seasonal load by exporting surplus power during the winter when GCC demand is low, to regions in Europe where demand is high during the same period. Strong transmission interconnection, supported using smart grids and ultra-high voltage grids, has been shown to facilitate the integration of renewable technologies, increasing the flexibility of the power system and helping generation profiles.

Surging energy demand worldwide continues to create considerable competition for energy resources, therefore the UAE and its Gulf neighbors have a unique opportunity to leverage their position to become a regional and global hub for energy trade and innovation.

Successful examples of this can be seen internationally, such as in China where interconnection has been used as a strong political tool. China has a unified national grid made up of two large-scale synchronized regional grids. These regional electricity systems have also been connected internationally with the Russian and Mongolian energy grids, with plans in the pipe-line for further expansion. As the largest power producer in the world, China has positioned itself as a leader in energy infrastructure investments across Asia and has utilized

³¹ GCCIA Annual Report 2017, page 26

³² GCCIA Annual Report 2017, page 26

³³ GCCIA Annual Report 2017, page 59

³⁴ THE POWER OF SIX A super grid in the Gulf - GCCIA Corporate Brochure 2015, Page 11

³⁵ GCCIA - http://www.gccia.com.sa/p/energy_trading/79

³⁶ GCC Power Grid: Transforming the GCC Power Sector into a major energy trading market

the soft power that interconnectivity delivers to fuel development and investment in its country.

The development of a strong national and regional energy sector, supported by key projects such as the GCC Interconnection Network, is vital in building the UAE's position and influence across the globe; and will provide the UAE with a platform on which to promote national interests, improve its global image, and complement hard power approaches to achieve results in diplomacy, improved trade and investment, political influence and regional stability.

The UAE Is Front and Center in the Global Energy Transition Debate

Promoting the UAE as a gateway to the region is another of the main pillars of the Government's soft power strategy. The country's position as a crossroads between the west and the east, along with its culture of openness, make it an ideal host for the 2019 World Energy Congress (WEC) which will be held from September 9-12 in Abu Dhabi.³⁷

The congress is the triennial meeting of the World Energy Council, an impartial UN-accredited energy body, and one of the largest global network of energy leaders dedicated to delivering a sustainable energy system.

The 24th World Energy Congress will bring together heads of state, business leaders, and practitioners to share best practices and solutions under the theme of Energy for Prosperity. The congress has been the premier event for the global energy community since its first edition over ninety years ago in 1924.

The UAE also hosts the international headquarters of IRENA and in September 2018, HE Dr Nawal Al-Hosany became the permanent representative of the UAE to IRENA.

On top of that, the UAE has a voice at other clean energy-focused intergovernmental institutions such as Clean Energy Ministerial and Mission Innovation. As a member of Mission Innovation, the UAE has pledged to double spending

on research and development in clean energy to put the pedal down on global clean energy innovation.

At these and other high-level meetings such as the UN General Assembly and the World Economic Forum, the Government's representatives present a unified direction on its commitment to the global energy transition.

Energy Is the Power Play in Soft Power

The UAE's Energy Strategy 2050 is a major plank in its contribution to the global energy transition. But few nations are better placed to weave policy with the pragmatism needed to drive that change. While Nordic countries have traditionally enjoyed a positive reputation for their

patchwork of sustainable energy practices, the global energy transition calls for top-down, root-and-branch changes to the 'Big Three' of energy use: cooling and heating, transportation and industry.³⁸

Weaning the country off fossil fuels will unquestionably be a huge challenge. But the work has already begun, and the UAE can count on internal resources such as Masdar, as well as external organizations, such as the International Energy Agency, which provides roadmaps and shares best practices.³⁹

The Energy Strategy 2050's successful execution could make the UAE the pre-eminent benchmark for policy makers and thought leaders on how to scale up renewables and decarbonize economies in the global energy transition.



³⁷ World Energy Congress

³⁸ World Energy Congress

³⁹ International Energy Agency

Atlantic Council: From the UAE to the World

Politics and energy go together around the world. Finding resources, distributing energy to consumers and creating markets to trade, whether it's crude oil, LNG, nuclear, wind or solar, poses enormous challenges for geologists, engineers and economists – but also for policymakers, statesmen and business leaders. And those challenges are shifting.

The Global Energy Forum has rapidly emerged as the go-to conference on the geopolitics of the energy transformation. Since 2017, an exclusive group of energy and foreign policy leaders has come together in Abu Dhabi to set the energy agenda for the year and examine the longer-term geopolitical and geo-economic implications of the changing energy system.

The forum is held every January under the patronage of His Highness Sheikh Mohammed Bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the United Arab Emirates Armed Forces; is convened in partnership with the Ministry of Energy of the United Arab Emirates, Abu Dhabi National Oil Company (ADNOC), and Mubadala Investment Company; and is part of Abu Dhabi Sustainability Week.

"The Global Energy Forum looks at the importance of all forms of energy: nuclear, oil, gas, renewable, and others. The diversity among its subjects and experts is what makes the Forum an important part of the energy calendar," said Eng. Suhail Al Mazrouei, Minister of Energy and Industry, United Arab Emirates.





Atlantic Council

Why Abu Dhabi? Frederick Kempe, president and CEO of the Atlantic Council, says: "Abu Dhabi is a leader in the international global energy sector through its foresight, innovation, and strategic planning, and has become a magnet for policymakers, experts and business leaders."

Attendees have included UAE Minister of Energy & Industry Eng. Suhail al Mazroui, ADNOC CEO Dr. Sultan al Jabar, Mubadala CEO Khaldoon Al Mubarak, CEO of Mubadala Petroleum & Petrochemicals Musabbeh al Kaabi, former US Secretary of Energy Ernst Moniz, former US National Security Advisors General James Jones and Steven Hadley, Senior Fellow for the Future of Diplomacy Project at Harvard University and former diplomat Ambassador Paula Dobriansky, IEA Executive Director Fatih Birol, Saudi Minister of Energy, Industry, and Mineral Resources Khalid Al-Falih, Omani Minister of Oil and Gas Dr. Mohammed bin Hamad Al Rumhi, Total CEO Patrick Pouyanne, Tellurian President and CEO Meg Gentle, Hunt Oil CEO Hunter Hunt, RBC Capital Markets Managing Director and Global Head of Commodity Strategy Helima Croft, International Renewable Energy Agency Director General Adnan Amin, Crescent Petroleum CEO Majid Jafar, founder and former CEO of Kuwait Energy Sara Akbar, and many more.

The forum is the flagship event for the Atlantic Council's Global Energy Center and is a crucial element in advancing the center's mission to promote energy security by working alongside government, industry, civil society,

and public stakeholders to devise pragmatic solutions to the geopolitical, sustainability, and economic challenges of the changing global energy landscape. Center researchers use the forum to launch papers; discuss, test, and advance ideas; and develop new work with key international stakeholders. It is the platform where the center's research becomes reality, where decisions are made, deals are done, and agendas are set.

The media has taken notice. CNN International served as the broadcast media partner for the first two years and segments from the forum ran in their Davos coverage as well as on top programs such as CNN Money with Maggie Lake. The event attracts journalists from the Financial Times, Wall Street Journal, Reuters, Dow Jones, The National, Al Ittihad, and Sky News Arabia. The 2019 forum has even more media partners, drawn from the fast-growing ranks of digital publications like Axios and Quartz.

In 2019, the forum expanded its remit by focusing on East and Southeast Asia, the region generating much energy demand growth and also a center of energy innovation.

Looking forward, the forum hopes to expand further in ambition by engaging South Asia, Africa, and beyond. The UAE may be the only place in the world that seems equally close to all these various regions, both from a geographic perspective and an intellectual perspective. It truly is the hub of the energy world.

UAE ENERGY LEADERS OUTLOOK REPORT 2019

The 2019 UAE Energy Leaders Outlook Report is the first of its kind in the UAE. An Initiative of the Emirates is the first of its kind in the UAE. An Initiative of the Emirates Nuclear Energy Corporation (ENEC), the report seeks opinion from some of the UAE energy industry's top professionals, from senior managers to CEOs, on the most pressing issues and opportunities facing the sector as it continues to diversify and innovate to meet the ambitious goals of the UAE Energy Strategy 2050.

In its first year, the report takes the opinions of 15 energy leaders in the UAE, with the aim of growing its scope, and ultimately its impact, in the years ahead.

The energy leaders surveyed as part of this first innovative survey represent some of the most important energy entities in the UAE including:

- Abu Dhabi Executive Affairs Authority
- Abu Dhabi National Oil Company
- Masdar
- Dolphin Energy
- Dubai Electricity and Water Authority
- Emirates National Oil Company
- Ministry of Energy and Industry
- Mubadala Investments

The UAE Builds on Success to Emerge as a Global Energy Leader



H.E. Eng. Mohamed Al Hammadi
CEO, Emirates Nuclear Energy Corporation

Our nation has been a critical player in global energy markets since our founding nearly 50 years ago. Historically, we owe much to our considerable oil and natural gas reserves.

With the launch of the UAE Energy Strategy 2050, our leadership has defined a proactive approach to energy diversification; outlining its commitment to clean energy to support future energy security and economic growth. Building on our success in oil and gas, the UAE is now emerging as a clean energy leader.

As we navigate this transformation, industry leaders are faced with new challenges and critical decisions. The UAE Energy Leaders Outlook Report, proudly sponsored by the Emirates Nuclear Energy Corporation (ENEC), seeks to gain insight into the perceptions of our industry's top professionals as they work to meet the government's ambitious and inspiring vision for our energy industry.

In its inaugural year, the UAE Energy Leaders Outlook Report finds that despite a backdrop of global economic uncertainty,

the UAE's energy leaders are confident in our ability to meet the challenges ahead. However, leaders also acknowledge that success can only be achieved with the right foundations in place, and there is clear consensus as to what these are: a highly skilled workforce, a commitment to continual innovation and rigorous governance.

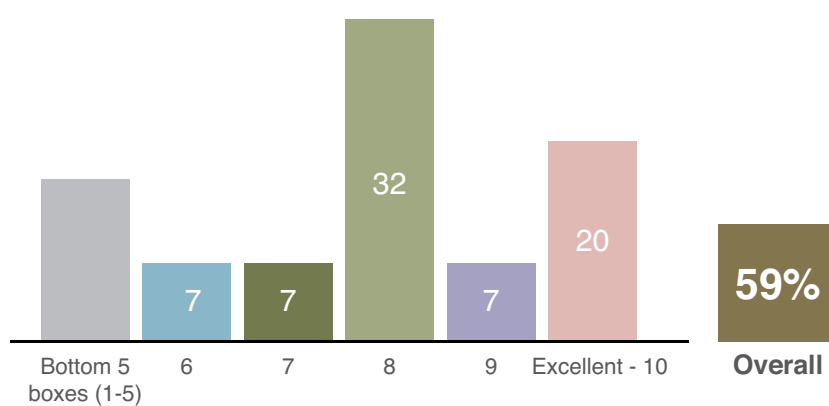
The growth of our nation's nuclear energy industry can offer some insight into how these elements can work together to deliver extraordinary results. Investing in Emirati talent has been one of our greatest challenges and also one of our greatest achievements. Today we have Emirati nuclear engineers and operators who have studied and trained here in the UAE – none of which would have been possible just 10 years ago. From the outset we have sought continual improvement and innovation, exploring new technologies and seeking international best practice to achieve business excellence and enhance operating efficiencies.

There are many such success stories across the UAE's energy sector, and we should all feel proud of the remarkable growth we have achieved. As we look positively to the future, energy leaders across the UAE acknowledge the great challenges we face, as well as the many opportunities available, as we work to ensure the UAE remains at the very forefront of energy development for decades to come.

Foundations Laid: The pillars of past success

Despite a challenging global backdrop of limited economic growth and fluctuating oil prices, energy leaders believe the UAE has performed well over the past five years. More than two-thirds of leaders rated the nation's past performance as 7/10 or higher, with 10 being 'Excellent'.

How do you rate the performance of the UAE energy sector over the past five years?



Performance of the UAE energy sector in the last 5 years

"The UAE has emerged as a leader in energy diversification... This development has brought significant new skills to the UAE economy, and positioned the UAE well to respond to the quick pace of technological development now being witnessed in the energy sector."

UAE Energy Leader



UAE Energy Leaders on the nation's energy success stories

Issuance of Green Buildings Policies	Peaceful UAE Nuclear Energy Program	The ability of the UAE to convene thought leaders in the global energy industry to debate and set the agenda for the future of the oil and gas and renewable energy industries	Demand Side Management Technology & Policies
The UAE Energy Strategy – the first future strategy in the UAE, the methodology and index developed was unique	UAE'S ENERGY SUCCESS STORIES	Delivering a reliable and secure energy supply	Resilience in Cybersecurity
Growth of Solar Energy Sector	Our ability to embrace renewables as early as possible	Masdar City	Energy Conservation Strategies
The contribution of the energy sector to the UAE's economy	Growth of UAE Energy Diversification	Emiratization Across Energy Sector	UAE Clean Energy Strategy 2050

Looking Ahead

Confidence high despite clear challenges for the nation's energy leaders

Energy leaders feel confident that the solid growth of the past is set to continue for the nation's energy sector, with 80% of leaders 'very confident' or 'completely confident' about the outlook for the industry's performance over the next five years.

The critical role of the Ministry of Energy and Industry to shape and support the sector is clearly valued by industry leaders, with 67% of leaders either 'completely confident' or 'very confident' in its outlook for the next three years.

When asked about specific performance objectives aligned to the UAE Energy Strategy 2050, energy leaders maintained high levels of confidence in the nation's ability to meet these targets. Seventy-three percent of leaders were either 'completely confident' or 'very confident' that the UAE would achieve the 2050 Energy Strategy.

Sixty percent of respondents were 'completely confident' or 'very confident' that the UAE will achieve the 50:50 ratio between fossil fuels and clean energy sources.

Meanwhile 40% of leaders showed high confidence in achieving the 40% reduction in electricity and water demand, indicating this may be the area of greatest challenge facing energy companies in the future, especially when considering the continued population and industrial growth predictions for the nation.

How confident do you feel about the performance of the UAE's energy sector in achieving its goals over the next five years?



How confident do you feel about the UAE achieving the 2050 Energy Strategy?



How confident do you feel about the UAE achieving a 50:50 ratio between fossil based and renewable energy sources?



How confident do you feel about the UAE achieving a 40% reduction in electricity and water demand?



Not very confident Somewhat confident Very confident

Behind the numbers

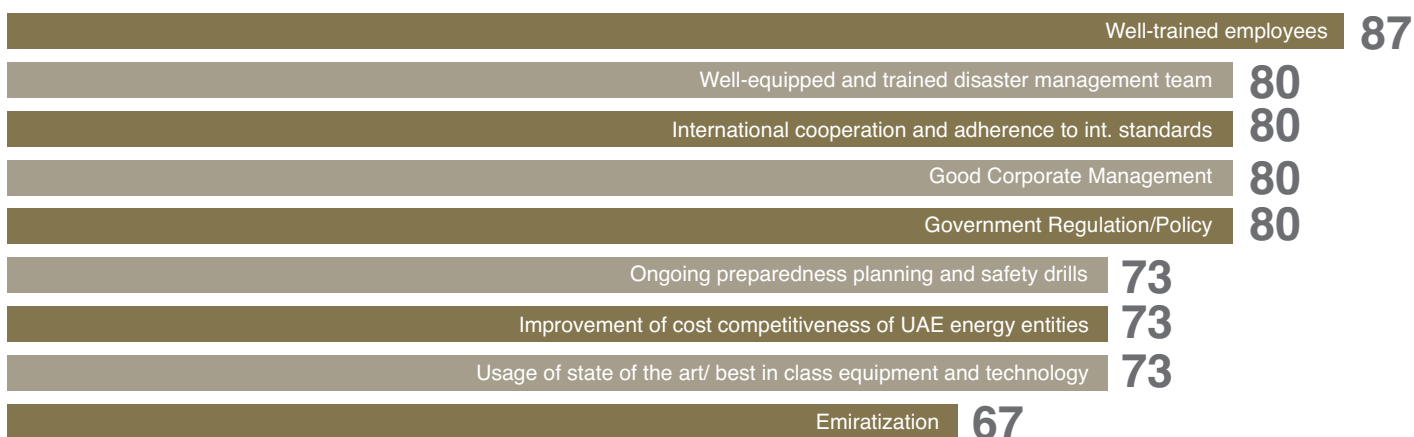
Energy leaders identify the key drivers to spur sector growth

We asked energy leaders to highlight some of the most critical factors behind the strong performance of the UAE's energy sector. At the top of the list came talent. Well-trained employees are believed to be the single most important factor by energy leaders.

Following closely behind were government regulation and policy, good corporate governance, international cooperation

and disaster management capability, with 80% of respondents citing these factors as either 'absolutely important' or 'very important'.

Other drivers listed by top energy professionals included Emiratization, improving cost competitiveness, preparedness planning and safety, and using state-of-the-art technology.

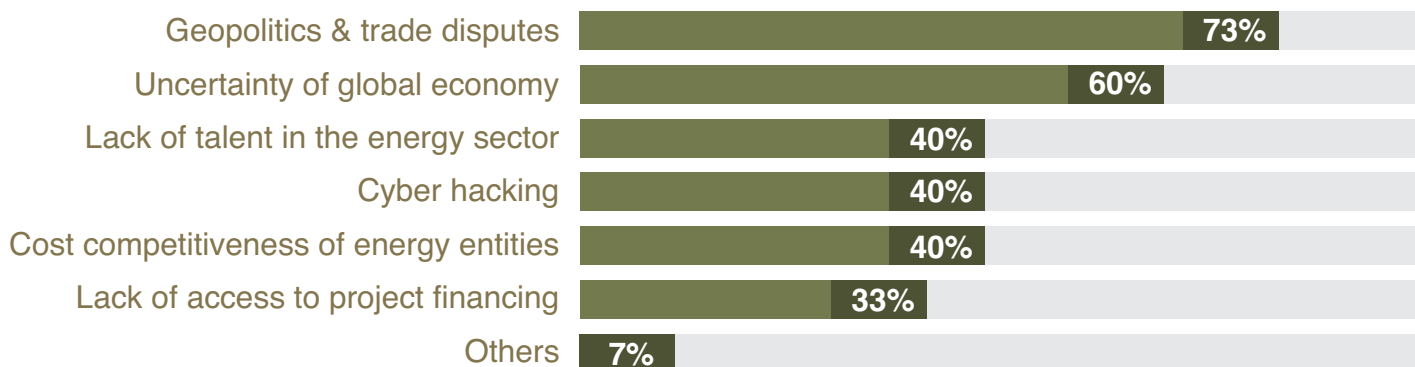
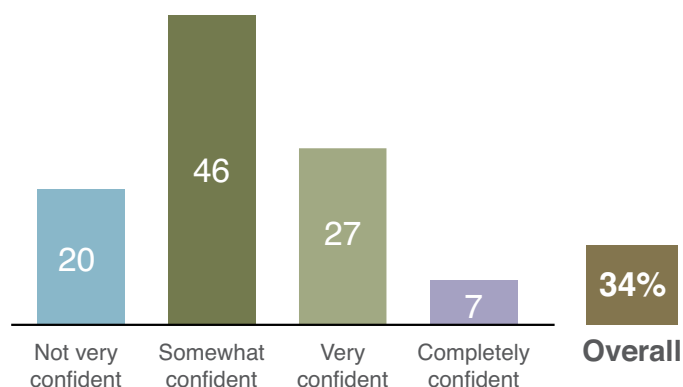


Global Outlook

UAE Leaders cautious about the global energy market

While confidence is high on the home front, our nation's energy leaders aren't looking to the global market with the same level of optimism this year. The majority of respondents (46%) were only 'somewhat confident' in future market performance, with just 34% of respondents indicating a higher level of confidence in global markets. The higher up the corporate ladder the energy leaders were, the less confidence they reported, with the most senior executives only 'somewhat confident' (67%) or 'not very confident' (33%).

How confident do you feel about the prosperity of the global energy market over the next 12 months?



All the numbers mentioned on the chart are in % base (No. of energy sector experts/leaders)



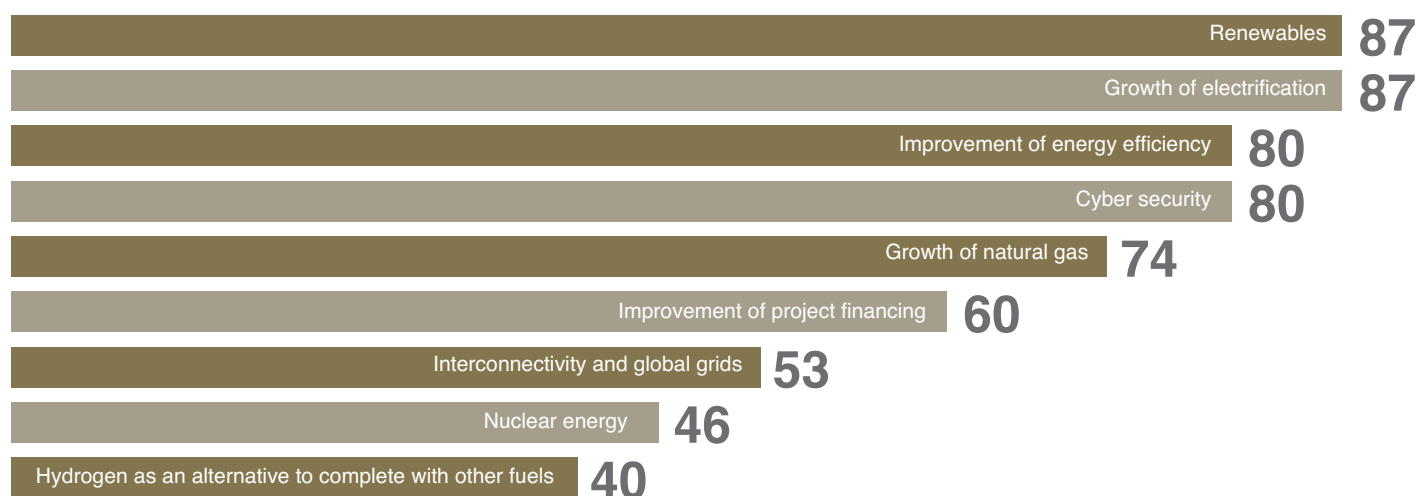
Tipped for Growth

Energy leaders' picks for the sectors and technologies with maximum growth potential

In an energy market that's undergoing rapid transformation and technological disruption, whilst striving to achieve ambitious clean energy targets, where do energy sector leaders see the greatest growth potential? Renewables and the growth of electrification are tipped to be the major watch areas for the

years ahead, with 87% of energy leaders singling these out for their high impact potential. Energy efficiency improvements, cybersecurity, and the growth of natural gas were also tipped to be key growth areas.

In your opinion, what are the biggest growth sectors in the global energy sector?



Innovate or Fall Behind

Leaders discuss the critical role of innovation in their organization's success

important' or 'very important' to the success of their business. This, perhaps more than any other factor, underpins the enduring success story that has been the UAE's energy leadership.

In a global context of unprecedented change and uncertainty, our energy leaders recognize that now more than ever before, the answers will be found in pushing the boundaries in every way, to deliver a new era of energy – and all that it provides – to the people of the nation.

"Innovation is the enabler of growth...it is the key element to maintain progress and growth"

"Technology plays an important role in my entity"

"Investing in the development of youth is an investment in leadership and innovation"

"Innovation helped us in reduce costs and increase profit"

"Innovation is the way operate ... and it's the future of our business to remain a strong contender in the market"







05

**ENERGY
INNOVATION
SHAPING
TOMORROW**

Energy innovation is key to a country's progress. The UAE is continuously exploring how to apply the latest technologies, as well as pilot emerging systems, across the board. Yet one of the greatest potentials is how technology is progressing the country's main artery: energy.



Artificial Intelligence: Changing the Face of the Global Energy Industry

Although still an emerging technology, artificial intelligence (AI) is poised to revolutionize the energy sector worldwide, changing the way we produce, distribute and consume energy across the globe.

Often referred to as the Fourth Industrial Revolution, digital technologies including AI have already transformed entire industries such as manufacturing and retail and finance. Now the world's energy sector is relying on these breakthrough technologies to re-define the industry and meet surging global energy demand.

AI is the collective term used to describe computer systems that can think, learn and act in response to their environment. The use of AI is set to be a game changer for the global economy, with a 2018 PWC report estimating that AI will likely contribute up to \$15.7 trillion to the global economy in 2030.¹ The Middle East is expected to accrue two percent (\$320 billion) of the global benefits, with the UAE witnessing the largest impact at close to 14 percent of 2030 GDP.²

With AI's unique capacity to evolve and learn, the technology can be applied to automate and re-define energy grids, streamline the integration of renewable sources into traditional energy systems, predict and manage power outages and improve demand-side flexibility.

In the wake of this technological revolution, governments and businesses across the region are realizing the shift towards AI. And the UAE is determined to be at the forefront of the global AI agenda, incorporating the application of the technologies across its strategic plans.

Demonstrating the UAE's commitment towards technological enhancement, the Government launched its Strategy

for Artificial Intelligence in 2017, which prioritizes investments in AI and its applications across multiple domains. The strategy is the first of its kind in the world, and seeks to establish the UAE as a major hub for the development of AI techniques and legislation to improve government performance and efficiency by 2031, while generating fresh revenue and growth for the national economy through the development of an innovative and high-value new industry.³

Alongside the strategy, the Government appointed a dedicated Minister of State for Artificial Intelligence, H.E Omar bin Sultan Al Olama, who also chairs the UAE Council for Artificial Intelligence. This special council was formed to oversee the integration of AI across various strategic fields, and works to identify key areas within the government sector where the technology could have the biggest impact. The goal is to implement the latest advancements to improve performance and efficiency in these areas.

The UAE has already implemented several mechanisms to promote the development of AI applications across this vital industry.

Most recently in September 2018, the Ministry of Climate Change and the Environment (MOCCAE) launched the Artificial Intelligence Laboratory in collaboration with Khalifa University of Science and Technology and the International Renewable Energy Agency (IRENA). This pioneering facility utilizes artificial intelligence to optimize the use of renewables in the UAE by mapping optimal solar power locations across the country, in addition to tracking air pollutants and monitoring the country's water quality.

The laboratory includes three main systems: real time maps of solar photovoltaic locations, an environmental monitoring system and a marine environment monitoring system.⁴ The solar mapping system will help the UAE determine the best locations for solar power projects across the Emirates and will contribute to an integrated system for the facilities across the UAE. While the environmental monitoring system uses real time monitoring and forecasting to provide satellite data on the concentrations of air pollutants and air quality index data.⁵ Lastly, the marine environment monitoring system uses data provided by NASA and the European Space Agency to produce a daily assessment of water quality conditions off the UAE's coast.

Dubai has been leading the regional shift towards the adoption transformative technology for several years now and has already embarked on its journey to become an AI enabled city. In line with the city's Smart Dubai Strategy, the Dubai Government has been transforming its energy sector using AI and in early 2018 announced its intention to establish the world's first automated, AI-powered renewable energy digital utility.

The utility, proposed by the Dubai Electricity and Water Authority (DEWA) as part of the Dubai 10X Initiative, is an ambitious venture overseen by the Dubai Future Foundation that seeks to place Dubai Government entities 10 years ahead of the rest of the world in all sectors. The Digital DEWA project reimagines operational procedures for service providers as well as disrupts the entire business model of a public utility by becoming the world's first autonomous, renewable-energy utility offering AI-powered digital services.⁶

¹ 'The Potential Impact of AI in the Middle East' a PWC report. <https://www.pwc.com/m1/en/publications/potential-impact-artificial-intelligence-middle-east.html>

² 'The Potential Impact of AI in the Middle East' a PWC report. <https://www.pwc.com/m1/en/publications/potential-impact-artificial-intelligence-middle-east.html>

³ UAE Government Portal - <https://government.ae/en/about-the-uae/uae-future>

⁴ Emirates News Agency - WAM <http://wam.ae/en/details/1395302706074>

⁵ Emirates News Agency - WAM <http://wam.ae/en/details/1395302706074>

⁶ Dubai10x - <http://dubai10x.ae/dewa-develops-worlds-1st-automated-renewable-energy-digital-utility-dubai-10x-initiative/>

This pioneering a new model of utility services leverages innovation across four key pillars:

- Renewable energy
- Energy storage
- Artificial intelligence
- Digital services

The target is to make Dubai a global model for clean energy and green economy, leveraging disruptive technologies including AI, unmanned aerial vehicles, blockchain, and the Internet of Things (IoT).

The autonomous services pillar embraces AI technology to make Dubai the first city to apply autonomous utility customer services. This includes the launch of Rammas - a virtual employee that makes use of AI technology to manage customer enquiries, complete with the ability to expand and self-learn through experience and interaction. Rammas responds to enquiries in both English and Arabic through a 24/7 chatbot available via DEWA's app and website or on DEWA's Facebook, through iOS and Android platforms, Amazon's Alexa service, and GoogleAI.⁷ This also expands the use of AI and machine learning across DEWA's entire value chain to enhance customer experience, improve productivity, support employee services, and optimize core grid operations.

The Dubai Autonomous Transportation Strategy also utilizes AI to explore the possibilities for autonomous experiences

within all aspects of the transportation sector in Dubai. The strategy aims to cut transportation costs by 44 percent, carbon emissions by 12 percent and accidents by 12 percent by transforming 25 percent of all transportation in the city to autonomous modes by 2030.⁸

The Dubai Municipality's 'Wastenizer' project also aims to convert the city's solid waste into a source of energy using AI.⁹ Developed as the Municipality's submission for the Dubai 10X Initiative, the project uses AI and smart technologies to sort all forms of solid waste, which can then be treated using cutting-edge technology developed by the Dubai Municipality. The decentralized units raise the temperature of the waste resulting in the breakdown of its chemical components, producing clean electrical energy that will be exported to the local electricity grid. The pilot phase of the project has been scheduled for the fourth quarter of 2018, with the system entering full implementation in several regions of the emirate just before the opening of Expo 2020.¹⁰

AI is also playing an important role in the transformation of Abu Dhabi National Oil Company (ADNOC) where the oil and gas producer is exploring how AI can help enhance efficiencies, improve agility, stimulate growth and drive performance.¹¹ In November 2017, the company launched the Panorama Digital Command Center and the Thamama

Subsurface Collaboration Center to utilize big data and AI to help extract maximum value from its assets and resources, as well as find new ways to improve performance and solve challenges.

ADNOC's Panorama Digital Command Center draws on data from across the company's surface operations across the upstream, downstream and global distribution networks, which is collated and visualized in real-time on a state-of-the-art 50-meter wide video wall. The Center utilizes smart analytical models, AI platforms and big data to aggregate real-time insights from across ADNOC's operations to recommend integrated pathways to optimize and enhance performance and add value.

The Thamama Subsurface Collaboration Center, which is integrated with Panorama, adopts smart analytics and AI platforms to solve ADNOC's subsurface challenges. The Center is helping to unlock resources and optimize field development plans, as well as reduce drilling costs and manage production capacity across ADNOC's onshore and offshore operations. It is equipped with all of Abu Dhabi's subsurface data, and smart visualization tools and analytics to use that data build dynamic models of the geology. These models help specialists develop a more detailed understanding of Abu Dhabi's reservoirs and how to best unlock their potential. It can also monitor up to 120 live drilling sites simultaneously, comparing performance against historical wells, plans and benchmarks to reduce costs, improve rig efficiencies, and increase productivity.¹²

These examples demonstrate the vast potential for AI to revolutionize the UAE's energy sector, and the critical role advanced and disruptive technologies will play in the advancing the global energy industry in the years and decades to come.

The UAE is committed to positioning itself at the forefront of the AI revolution and welcomes this new phase of development, working closely with Governments, international partners and the private sector to explore opportunities for investment, services and new business models that will harness the full power of AI technology to deliver a smarter, more integrated and responsive future.



⁷ Dubai10x - <http://dubai10x.ae/dewa-develops-worlds-1st-automated-renewable-energy-digital-utility-dubai-10x-initiative/>

⁸ Dubai Future Foundation - <http://www.dubaifuture.gov.ae/our-initiatives/dubais-autonomous-transportation-strategy/>

⁹ Dubai 10x - <http://dubai10x.ae/dubai-municipality-to-transform-citys-waste-into-sustainable-energy-source-for-dubai-10x-initiative/>

¹⁰ Dubai 10x - <http://dubai10x.ae/dubai-municipality-to-transform-citys-waste-into-sustainable-energy-source-for-dubai-10x-initiative/>

¹¹ Ministry of Cabinet Affairs and The Future - <https://www.mocaf.gov.ae/en/media/news/ai-minister-visits-adnoc-s-artificial-intelligence-big-data-centres>

¹² Ministry of Cabinet Affairs and The Future - <https://www.mocaf.gov.ae/en/media/news/ai-minister-visits-adnoc-s-artificial-intelligence-big-data-centres>

Creating Clean Drinking Water out of Thin Air

As one of the world's most scarce and precious resources, water security is one of the biggest challenges the UAE faces in securing a more sustainable future. As one of the most arid countries in the world, access to clean and safe drinking water is a top priority for our leadership, and in 2017, the Ministry of Energy and Industry (MOEI) launched the UAE Water Security Strategy 2036 to ensure sustainable water access in both normal and emergency conditions.¹³

The MOEI recognizes that the long-term stability of the UAE's future water supply relies on the application of innovative new water solutions, several strategic Government and private sector partnerships are working to develop advanced and adaptive technology that will help the UAE avoid a future water crisis.

One such partnership is with Veragon Water Solutions and private equity firm Eshara Capital, who together recently launched new technology in the Middle East that could create sustainable drinking water after mineralized by harnessing humidity from the air.

On its smallest scale, Veragon's innovative air-to-water system can produce up to 1,000 liters of potable water per day in hot or tropical environments at a comparative cost to bottled water.¹⁴ The technology is tried and tested at the highest global levels, and the water is certified to World Health Organization standards and approved for use in the UAE.

While the technology was originally developed to be utilized for humanitarian relief, Veragon's units have a multitude of uses from agriculture, remote operations, off-shore platforms, large events or can also be integrated directly into residential developments. Already the technology has been used by the UN World Food Program and other organizations in some of harshest climates in the world.

In the UAE, various industries stand to benefit from this unique technology, and

the air-to-water system has the potential to contribute to water resources of the country.

Veragon was one of 46 start-ups selected from over 1,000 applicants for Dubai Future Accelerators - a nine-week program that pairs entrepreneurs with cutting-edge technologies together with partners at with various government-run entities to further develop their products in the goal of solving global problems.¹⁵ Launched in 2016 by His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and the Chairman of Dubai Future Foundation, Dubai Future Accelerators aims to play a pivotal role in shaping the future of strategic sectors in cooperation with Dubai government and private sector entities.

As a part of the program, the startup will be working with Dubai Electricity and Water Authority (DEWA) on this technology. Together, DEWA and Veragon hope to develop an innovative new source of pure drinking water for the UAE, offering additional source for UAE water resource.

The company celebrated its official UAE launch in March 2018 with the opening of their Middle Eastern headquarters in Dubai. It now has one of their air-to-water units on trial at the Dubai Expo 2020 head office and a machine in test mode at the UN World Food Program HQ at the International Humanitarian City in Dubai, where it has been approved by UN refugee personnel.¹⁶ In addition, the company also has two pilot projects underway with DEWA and is also involved in a corporate social responsibility project with the Mai Dubai bottled water company, which is partially funding the cost of a Veragon unit that will be donated to the UAE Water Aid project in Sujia, Nigeria.

The company targeted the Middle Eastern market given the region's ideal conditions for the production levels of air-to-water technology - with average temperatures



around 30°C and humidity in the 60 to 70 per cent range.

The system requires a minimum of 10-20 percent relative humidity, at which levels the air-to-water system transforms the water vapor present in the air into water. The water produced is sterilized through treatment with ozone and UV light and then mineralized, to produce a continuous supply of pure mineral water. The system can be operated indefinitely without any impact on global water reserves, and the technology is environmentally friendly, helping to reduce CO₂ emissions.¹⁷

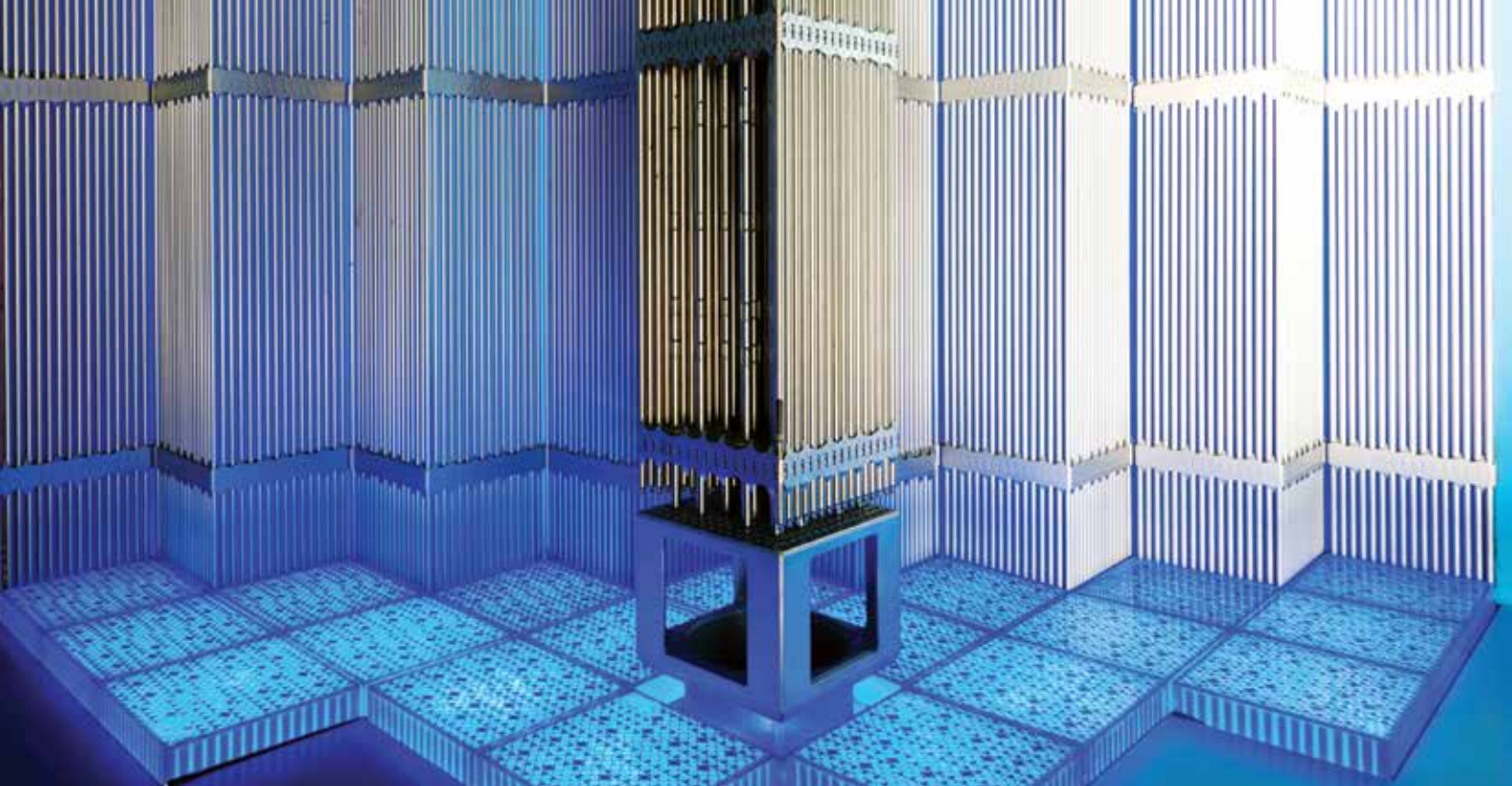
¹³ Government AE portal - <https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/the-uae-water-security-strategy-2036>

¹⁴ Veragon Water Solutions - <http://veragon.com/products/>

¹⁵ Dubai Future Accelerators

¹⁶ Veragon

¹⁷ Veragon



Cutting-edge Technology and Innovations Make Peaceful Nuclear Energy a Reality

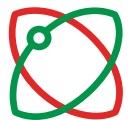
Over the course of its nearly 50-year history, the United Arab Emirates (UAE) has emerged as a leader in innovation, and more specifically, an innovator in clean energy technologies. Several cutting-edge sustainable energy projects across the UAE aim to diversify the Nation's energy sources and reduce carbon emissions. The UAE has set ambitious targets as part of the UAE Energy Strategy 2050, requiring 50% of the electricity required by the middle of the century to come from clean energy sources. Innovation in energy will be key to meeting this target. Already, Abu Dhabi and Dubai have achieved record-low solar prices that prove this source of electricity generation is a viable source for energy.

Soon, the UAE will proudly claim another historic first – it will be home to the first operating peaceful nuclear energy plant in the Arab world. The nation embarked on its peaceful nuclear energy program just a decade ago. In that short time, the UAE has emerged as a leader in new nuclear construction and development by adopting one of the world's most advanced energy technologies and using it as a catalyst to advance the nation's growth and prosperity for generations to come.

Deploying an Innovative Technology to Utilize Peaceful Nuclear Energy for the UAE

The Emirates Nuclear Energy Corporation (ENEC) is responsible for building the UAE's first nuclear energy plant with an important mission – to deliver safe, clean, efficient and reliable electricity to the UAE grid,

مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation



“ Considering the growing demand for energy, it has become a necessity for many countries around the world to innovate in renewable and clean energy; hence the global tendency towards diversifying energy sources and providing future generations with access to sustainable energy that ensures them a better way of life. ”

Excerpt from the UAE National Innovation Strategy

develop its people and build sustainable local nuclear sector capability, in full alignment with the UAE energy strategy.

The Barakah Nuclear Energy Plant, located in the Al Dhafra Region of Abu Dhabi, comprises four APR1400 reactors. The APR1400 is one of the most advanced reactor designs in the world today. It combines the latest developments in safety and performance with technology that has been proven over decades of operations. The Korea Electric Power Corporation (KEPCO), the Prime Contractor for the plant, and Joint Venture partner with ENEC, developed and enhanced this design over the last 40 years. As a result, the APR1400 achieves the highest industry standards of safety, operational performance, environmental protection and operating life.

When ENEC selected the APR1400 technology, after extensive research and evaluation, it was understood that differences between The Republic of Korea and the UAE required careful consideration and planning. Guided by global operating experience and KEPCO's experience with the APR1400 in South Korea, ENEC identified and implemented several modifications and adaptations to meet the UAE's unique climate and the national regulator's requirements. For example, design modifications help manage the higher seawater temperatures in the Arabian Gulf; counter the effects of higher temperatures, drier air and high volumes of sand and dust; and protect local fish populations during operation.

Once all four reactors are operational, the Barakah Nuclear Energy Plant will produce enough electricity to meet up to a quarter of the UAE's electricity demand. And it will accomplish this through the generation of efficient, reliable and low-carbon electricity. In fact, the plant will help to prevent 21 million tons of carbon emissions each year. This is equivalent to removing approximately 3.2 million cars from the roads annually.

Developing a Highly Skilled Nuclear Energy Workforce

ENEC and its subsidiary Nawah Energy Company, the company responsible for the plant's operations and maintenance, are also using unique and innovative methods to develop the workforce that will be responsible for operating and supporting the Barakah Nuclear Energy Plant.

ENEC has two full-scope APR1400 training simulators at its Simulator Training Center at Barakah. These simulators are among the most advanced nuclear training devices in the world and the first of their kind in the Middle East. Using complex modeling of the reactor core and advanced instrumentation and control systems, the simulators replicate the actual environment and conditions that operators in the plant's control room would experience in a real-world situation. These devices also provide the opportunity for reactor operators to experience and train for unplanned

events that they would not be exposed to during day-to-day operations.

Simulator training plays a critical role in preparing the UAE's workforce to operate the four reactors at the Barakah Nuclear Energy Plant. It also complements a comprehensive training program that supports personnel in attaining their reactor operator and senior reactor operator certifications, as well as their continuous training needs.

Emerging as a Leader in Peaceful Nuclear Energy Development Around the World

The Barakah Nuclear Energy Plant is one of today's most advanced nuclear energy facilities and sets the bar for new nuclear construction and development around the world. Recent milestones include the completion of all main concrete works and heavy equipment lifting for the project, signaling the beginning of the end of construction of the Barakah plant. At the same time, preparations are progressing steadily for the operation of Unit 1.

ENEC is proud to deliver a plant that meets the highest international standards for quality and safety while driving our nation's energy diversification and, as a result, supporting economic, social and environmental sustainability for generations to come.



IT'S TIME TO RETHINK OIL & GAS.

As we enter the fourth industrial age, the world's demand for energy-based products is increasing at an unprecedented rate. Our goal is not simply to keep up, but to stay ahead of the curve.

In practical terms this means fostering a dynamic, performance led, commercially minded corporate culture that applies the latest technology and optimizes our resources, including, most critically, our human resources.

We are giving this mission a simple name:

OIL AND GAS 4.0



TECHNOLOGY

We are applying AI, Big Data and block-chain to enhance our efficiency and maximize our performance.



PEOPLE

We are making ADNOC an employer of choice for a highly skilled, digitally native workforce.



SUSTAINABILITY

We are mitigating our environmental impact by embracing and scaling breakthrough technologies.



PARTNERSHIPS

We are expanding our partnership model to include new players from the public sector and private equity.

Convergence of Energy and Technology Delivering a Step-Change in Growth and Prosperity

The world is on the verge of an era of unprecedented prosperity.

As the global middle-class expands to five billion people by 2030, the world will see even greater demand for energy and the products derived from oil and gas. By 2040, oil consumption will rise by at least an additional 10 million barrels per day. Over the same period, demand for natural gas will see even more significant growth of around 40 percent, and petrochemicals and polymers – the building blocks of millions of every day products – will experience the strongest demand of all, growing at least an additional 60 percent by 2040.

As the middle-class population expands and consumer and commercial spending increases, another dynamic is simultaneously shaping the oil and gas industry: innovation and advanced technology.

Robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, the 'internet of things', big data—these are moving from science fiction to everyday reality at incredible speed. And the oil and gas industry – long-used to operating under 30-year planning models – is demonstrating its ability to adapt.

This industrial convergence of energy and technology has created a new reality, one that requires the oil and gas industry to think differently, embrace disruption and adapt to a world in which innovation is a fundamental enabler of growth and economic prosperity.

While some companies have been slow to adapt to this new era – or what is commonly called the 4th Industrial Age – others are whole-heartedly embracing it.

At the Abu Dhabi National Oil Company (ADNOC), we're doing just that. We call our mission Oil & Gas 4.0. This mission is our strategic response to the demands and opportunities posed by the 4th

Industrial Age. Value-add partnerships, the empowerment of our people, our commitment to sustainability and our environmental protection – these are core to our Oil & Gas 4.0 mission.

But central to all of it is our commitment to leveraging the most innovative, advanced technologies to drive efficiency and performance in all that we do.

Artificial intelligence, big data and blockchain have the potential to unlock 5-10 percent extra value in our upstream and downstream businesses. For example, blockchain technology can reduce the time it takes to execute transactions across our entire value chain. It will also improve the reliability of production data by enabling greater transparency in transactions.

Meanwhile, our use of big data and predictive analytics are significantly reducing operational costs as our state-of-the-art Panorama Digital Command Center monitors and measures terabytes of information across our operations. The center generates operational insights and aggregates accurate, real-time information, presenting data at an enterprise-wide level, but also providing access to detailed information from individual assets. Panorama hosts 125 dashboards, supporting decision-makers with reliable management and technical data. Digitization and automation have already cut more than 80 percent of the work needed for validating and updating well-models.

In parallel, ADNOC's Thamama Subsurface Collaboration Center enables us to build dynamic models of the subsurface that help us develop a more detailed understanding of Abu Dhabi's reservoirs to de-risk the opportunities they hold. It monitors live drilling sites simultaneously, comparing performance against historical wells, plans and benchmarks to reduce drilling costs, improve rig efficiencies and increase productivity. By the end of 2019, technology will help cut our drilling times by 30 percent.

And for the first time, the launch of the digital twin of ADNOC's value chain enables us to run techno-economic optimization scenarios to better support strategic decision-making and further identify market opportunities.

And yet, we are only scratching the surface of how innovative technology can transform our potential.

At ADNOC, our ambition is to extend the power of digitization across our entire value chain, from drilling platforms to trading platforms. By embedding innovation into every aspect of our business, we are determined to make ADNOC the destination of choice for a highly skilled, digitally native workforce, and a home for the best and brightest of the UAE's young people.





Dolphin Energy Introduces Unique Diverless Subsea Launcher & Receiver.

Background:

Dolphin Energy supplies around 30 percent of the UAE's energy requirements. Its pipeline system is therefore a major strategic asset for the country. To mitigate any accidental damage to the pipelines, the Pipeline Repair & Subsea Intervention (PRSI) System was developed as a comprehensive and long-term commitment, with particular attention to the 48-inch export pipeline taking into account its unique criticality, size and rating.

The System is designed to minimize disruption from any accidental damage (such as a ship sailing with its anchor deployed) and restore gas supply to the Emirates in the quickest possible manner.

Scope:

The PRSI System will reduce significantly the time required to repair the large subsea pipeline and resume operations and gas supply to the UAE. The repair strategy includes equipment, systems and processes to decommission and isolate the pipeline to create a safe working environment and then repair and recommission the pipeline to resume gas supply services. This includes large

bespoke subsea equipment to handle the pipeline on the seabed and carry out several repair welds in a hyperbaric condition – up to 300 feet below sea level.

Dolphin Energy took the decision to adopt the hyperbaric welded solution for the PRSI System because of the criticality of the export pipeline's role in helping maintain and support energy security for the UAE. This means that the pipeline will be welded back to its original condition rather than repaired by using a mechanical connection.

Impact:

The PRSI System also includes a unique diverless subsea launcher and receiver which can be installed on the seabed without the use of any foundations. The use of large valves on the launcher and receiver allows inline tools to be received and launched subsea without re-flooding the pipeline. The state of the art subsea tools were developed by Dolphin Energy in close cooperation with the Norwegian State Oil Company, Equinor (formerly Statoil), which has been running a large scale Emergency Pipeline Repair System in the North Sea region for the last 35 years.

The collaboration with Equinor has allowed Dolphin Energy to access the latest proven designs for subsea repair tools and processes; the cooperation will continue during the maintenance and intervention phases.

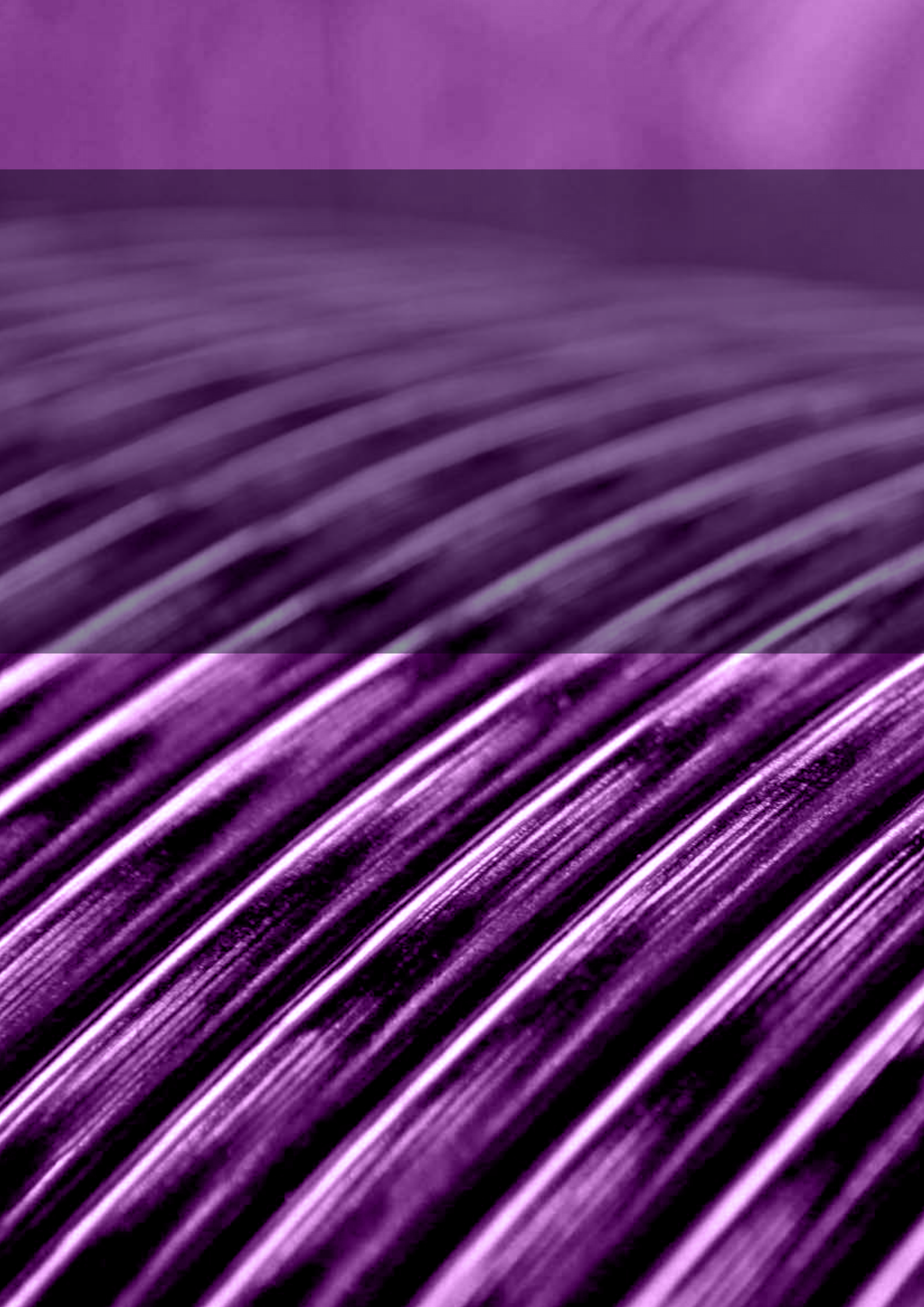
The Future:

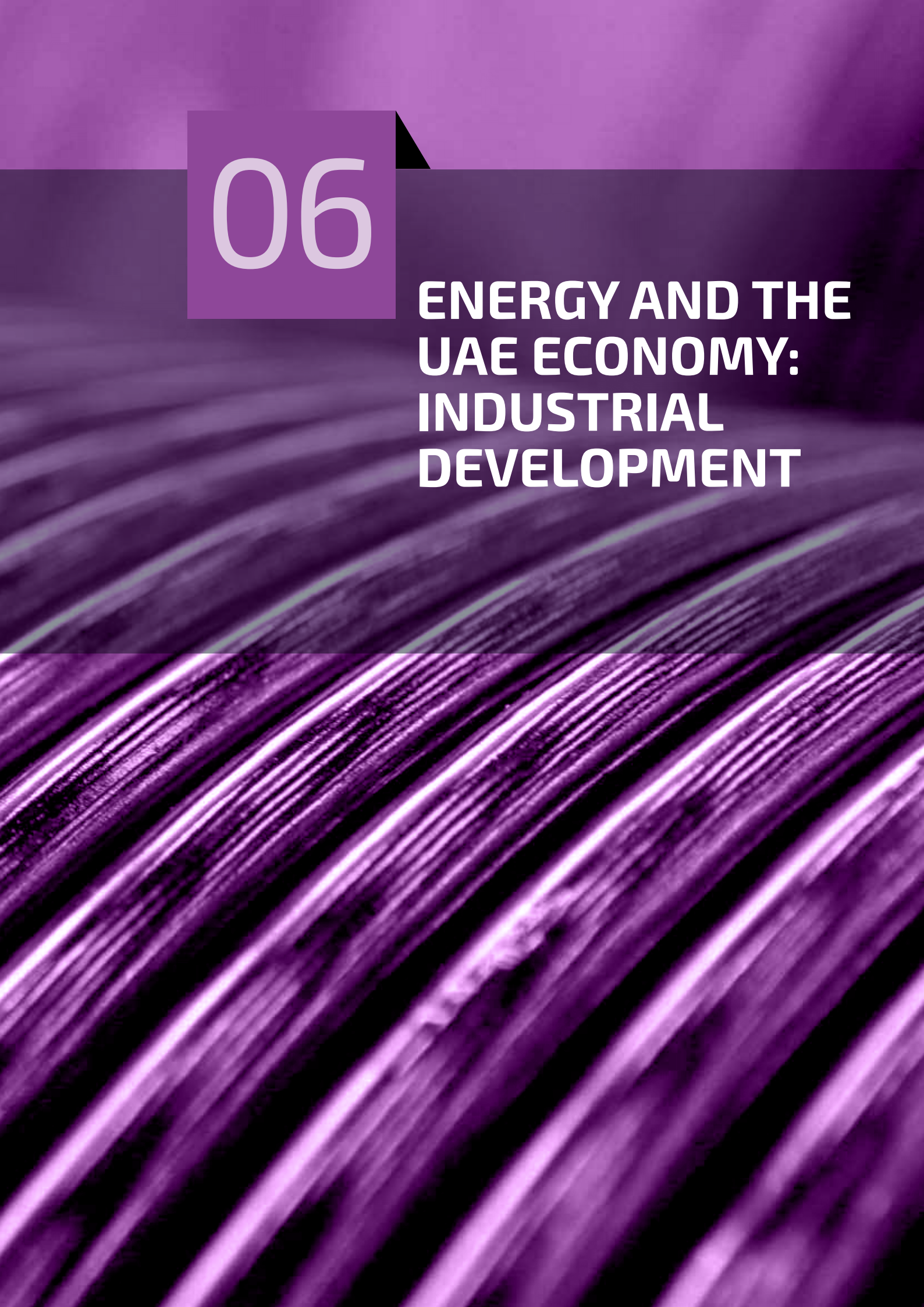
While the PRSI System covers Dolphin Energy's sealines and export pipeline system, it can also be utilized on all pipelines ranging from 10-inch to 48-inch. Furthermore, the subsea tools can be used for a wide range of underwater works such as pipeline repair, tie-ins and tie-backs, hot tap and major inspections such as concrete coating removal. Most tools are designed to work remotely without the use of divers which is safe and cost efficient.

To support the PRSI System, Dolphin Energy has entered into a strategic agreement with KIZAD Industrial Zone and Khalifa Port and constructed a custom made Marine Base at KIZAD's facilities that will serve as a hub for the subsea repair tools and offshore mobilization.

The PRSI System will be fully set-up by the second quarter in 2019 with all tools and systems ready for an emergency repair or any other subsea work.







06

ENERGY AND THE UAE ECONOMY: INDUSTRIAL DEVELOPMENT

The energy industry is a vital engine of growth for developing nations, and a steady supply of affordable electricity is crucial to sustained economic prosperity. The buoyancy of a country's energy sector influences the sustainability and performance of the entire economy. Not only does the energy sector contribute directly to GDP through the transformation and distribution of energy goods and services, but also through the delivery of reliable energy at competitive prices, which helps to stimulate the economy by reducing expenses and increasing resource efficiency for consumers, businesses and industry. It also helps increase disposable income and reducing input costs for nearly all goods and services.

The available supply of abundant energy has played a critical role in enabling the rapid modernization and vast industrial development that the UAE has experienced in recent years, and is vital to the country's continued industrial expansion plans.

Industry is the driving force of development in the UAE and a cornerstone of the country's strategic plans to deliver a healthy economy and on-going stability for the nation. The UAE leadership has demonstrated its commitment to the growth of its industrial sector in a multi-layered strategic process lead by the National Industrial Coordination Council and a dedicated Industrial Development Bureau (IDB); and outlined its goals for the sector in the Abu Dhabi Industrial Strategy 2016–2020 and Dubai Industrial Strategy, which support and draw focus from the Abu Dhabi Economic Vision 2030, Dubai Vision 2021, and UAE Vision 2021.¹⁸

Together these strategies aim to lay the foundation for the UAE's industrial future, boosting the economic impact of the industrial sector and continuing to diversify the nation's income, with the goal to increase industry's contribution to GDP by 25 percent by 2025.¹⁹ The country seeks to broaden its industrial base and position itself as an incubator for a variety of new growth industries, including technology, aerospace, manufacturing, petrochemicals, metals and clean energy technologies; and is working to establish the 'Made in the UAE' label as a global mark of quality and excellence.

The availability of reliable, sustainable and relatively cheap electricity has enabled the continued growth and increased productivity of vital parallel industries across the UAE, including large-scale industrial energy users such as smelters, refineries and extraction platforms which have delivered solid economic growth for the nation built on sustained industrial output. For example, the global success and rapid expansion of the UAE's two key metals industries, led by Emirates Steel and Emirates Global Aluminum (EGA), has been fueled by ready and affordable access to energy; and today EGA is one of the five largest aluminum producers in the world.²⁰

The development of a strong clean energy sector is also an important part in the UAE's overall post-oil strategy. While oil and gas will continue to play a strategic role in the Emirates' development, diversifying the economy away from hydrocarbons has been a central ambition for the UAE for several years, and widening the country's industrial base and diversifying its energy sector is a key element of this process.

The UAE is committed to becoming a hub for green economy and a global center for the export of green products and technologies – marking a new phase of industrial growth that will establish a diversified and globally competitive economy for the nation based on knowledge and innovation.

The transition to an energy system based on clean energy is a unique opportunity for the country to balance its demand for sufficient energy to power economic growth and development with its urgent need to reduce impact on the

environment, and brings with it a vital new sector for the strategic development in the UAE. Investment in cleantech will deliver greater energy security for the nation while creating new sources of economic growth, broader industrial development and increased employment and investment opportunities through a diversified and high-value energy sector.

In 2017, global investments in renewable energy reached almost \$265 billion, resulting in an increase in renewable power generation capacity of a record 161 gigawatts (GW).²¹ This unprecedented scale-up is being driven by a combination of falling costs, advances in technology and attractive policies that mean renewable energy is now cost competitive with conventional fueled power generation in much of the world. A recent report from the International Renewable Energy Agency (IRENA) found that doubling the share of renewables in the global energy mix by 2030 would bring a range of positive impacts including an increase in global GDP up to 1.1 percent (equivalent to \$1.3 trillion), in addition to the emergence of new industry, improved global welfare and increased employment.²²

The UAE government plans to invest more than AED600 billion over the next three decades to support the growth of its clean energy market, resulting in expected savings of more than AED700 billion. Funding mechanisms such as the AED100 billion Dubai Green Fund also plan to attract investors towards the country's green energy future, with the private sector set to play an increasingly important role in accelerating the deployment. Investors are already seizing the opportunities from the UAE's public-private partnership (PPP) model, which also helps alleviate some of the government's financial burden to execute large-scale projects.

The UAE's transition towards a more sustainable energy future also presents unique opportunities for new complementary value-added industries to emerge, diversifying the local industrial base to develop new sectors for clean and renewable energy manufacturing, supply chain and support services. Using the country's existing expertise and resources acquired from decades of experience in conventional energy, the UAE is creating new opportunities for



¹⁸ UAE Cabinet

¹⁹ UAE Annual Economic Report, 2017, page 64 – http://www.economy.gov.ae/EconomicalReportsEn/MOE%20Annual%20Report%202017_English.pdf

²⁰ Oxford Business Group, UAE Abu Dhabi Report, Abu Dhabi Focuses on driving sustained industrial growth and diversification. <https://oxfordbusinessgroup.com/overview/dynamic-approach-continued-focus-industry-driving-sustained-growth-and-diversification>

²¹ Green Economy Report 2018, page 166 –

²² IRENA – Measuring Economics Report 2016 –

localizing various segments of the green energy value chain - bringing knowledge, skills, and infrastructure to spur economic development and diversification.

An example of this impact can be seen in the growth of new high-tech industries developing across the Emirates today in support of the country's Peaceful Nuclear Energy Program. An important factor in the UAE's decision to pursue nuclear as part of its clean energy mix was the opportunity to develop a new industrial sector to support the nation's economic growth and diversification strategy. Since its inception, the Emirates Nuclear Energy Corporation (ENEC) has been working to support this vision by facilitating the development of a local nuclear energy supply chain.

The nuclear energy industry has some of the most stringent quality and technical standards in the world. Therefore, ENEC's dedicated Industrial Development Team works alongside UAE companies to raise their standards to meet the unique requirements of the nuclear industry for them to tender for ENEC's contracts. This process allows Emirati companies to not only contribute to the success of the country's nuclear energy program, but to also gain a competitive advantage in providing nuclear-quality services and materials to the world.

To date more than 1,400 UAE companies have successfully secured contracts totaling more than US\$3.3 billion for a range of products and services to support the completion of the UAE's first nuclear energy plants. Through its work with local companies, ENEC is not only supporting existing UAE businesses but also contributing to the development of the local economy while stimulating the growth of industry here in the UAE.

Contracts with local companies have been awarded through collaboration between ENEC and the Korea Electric Power Corporation (KEPCO), ENEC's Prime Contractor. Together, ENEC and KEPCO work with local companies to upgrade their systems to become American Society of Mechanical Engineers (ASME) Nuclear Component certified entities, which is the key certification required to become nuclear-approved suppliers. So far, contracts have been awarded to local companies including DESCON



Engineering, Bin Asheer, National Marine Dredging Company, the Western Bainoon Group, Emirates Steel and Dubai Cable Company (Ducab).

Emirates Steel has entered into a strategic partnership for the supply of high-value steel products for ENEC's nuclear plants, and around 100,000 tons of steel has already been delivered for the construction of the project.²³ With the support of ENEC and KEPCO, Emirates Steel is now the only steelmaker in

the MENA region qualified to produce Q-class (nuclear quality) reinforcing steel, and the fourth company in the world to be qualified by the American Society of Mechanical Engineers to produce Nuclear Qualified reinforcing rebar.

Ducab is also benefiting from the development of the nation's nuclear energy program, supplying nuclear-grade cable for the Barakah Nuclear Energy Plant. The company was the first cable manufacturer in the Middle

²³ Oxford Business Group -



East to introduce and qualify 60-year, sustainable, halogen-free cables that meet the most rigorous testing standards; and because of the company's success in supplying cables for Barakah, Ducab signed its first international export contract in early 2016 – taking its local business global.

Over the last few years, the UAE has demonstrated its unique capacity for developing world-class solar energy projects. According to the International Renewable Energy Agency (IRENA), the country now leads our region in renewable energy production. The UAE is committed to being at the forefront of economic, environmental and technological practices in this sector, and the array of world-class solar projects underway in the UAE has spurred the development of several important supply and support industries, servicing the country's burgeoning solar industry.

This includes the launch of Maysun Solar in 2018, the first photovoltaic panel producer to set up a manufacturing facility in DP World's Jebel Ali Free Zone

(Jafza). Maysun currently manufactures 5,000 solar panels a month from its Jebel Ali facility, with a capacity to generate 40 MW of electricity, and has plans to raise production capacity to 200 MW over the next three years. The company manufactures and exports its solar panels to the world under the 'Made in UAE' brand, with 30 percent of its orders coming from European markets and 10 percent from the Saudi market. The manufacturer is already running at full capacity, but intends to expand their operations and sales in the local market, having obtained accreditation from the DEWA to become a certified supplier of solar panels.

Other key players in the energy industry have also made their commitment to the development of a local industry supply chain clear, including DEWA who are focused on building local capacity and fostering economic growth in the UAE by involving local businesses in all aspects of their operations and supply chain. The organization aims to increase its utilization of local products and services, and has established a Local Purchase

Committee to oversee this goal, ensuring a list of local supplier development criteria are met before purchasing products and services. In 2016, DEWA's purchases from local suppliers included a net order of AED17.76 million with 70 small and medium enterprises (SMEs) included in the procurement process.²⁴

Innovation is a focal point across the UAE's ongoing strategic development plans, and a strong energy sector, based on smart policy, sustainable energy strategy, strategic investments and advanced research and development (R&D) is vital for encouraging innovation and attracting new industry to the UAE. The country has a long history of pioneering new energy solutions and as the world transitions towards a brighter green energy future, the UAE has a vision to establish itself as an energy innovation hub - building on the country's existing financial and commercial trading hubs to connect industries, people and ideas in the energy sector.

A strategic area of focus is across the energy R&D space, where the Khalifa University is spearheading some of the

²⁴ DEWA Sustainability Report 2016, page 28 – print out provided.

world's most advanced research and education in the fields of renewable and alternative technologies. The university is a result of Khalifa University of Science, Technology and Research, Masdar Institute and the Petroleum Institute merging to develop world leaders and thinkers in the STEM sector.

The higher learning institution will be key to the country's goal to establish itself as a true center of innovation, and since its establishment has attracted world-class talent to the region – with 14 U.S patents secured by graduates of the university to date.²⁵ In addition to investment and research, Masdar has built local capacity and contributed to the development of technologies such as water desalination and solar heat storage, and has supported the overall growth of the energy and industry sectors through its free zone – which has seen more than 400 international companies including General Electric and Siemens, as well as IRENA, set up their headquarters.

Dubai has also geared its economic free zones toward encouraging the advancement of clean and renewable technologies to boost the growth of this vital sector, with the Dubai Green Zone and Dubai Science Park aiming to attract world-leading energy companies and expertise to the country by offering support for entrepreneurs, investors and established businesses. DEWA's new AED500 million state-of-the-art R&D center, under construction within the Mohamed Bin Rashid Solar Park, aims to lead research and advancement of green energy solutions for the region. Dubai hopes these initiatives will not only encourage development of its domestic energy capacity toward more sustainable sources, but will also create opportunities for the UAE to become a destination for clean energy innovation and investment.

The announcement that the UAE will be hosting both the World Energy Congress in 2019 and the Dubai World Expo in 2020, a main part of which will be sustainability, has added momentum to the UAE's green energy projects both locally and abroad, setting the scene for the rapid growth of a vibrant new green energy sector that will bring sustained industrial and economic growth for the nation for years to come, while cementing the UAE's position as a hub for new green industry, innovation and business.



²⁵ Double checking with Masdar



Nuclear Energy Powers Economic Growth and Diversification

As our nation's economy grows, the United Arab Emirates (UAE) requires more electricity to power new sectors – from manufacturing and construction to healthcare and information and communications technology. With the growth of new industry comes an increased population and use of energy and water to power the economy. In our country's arid climate, even water production requires energy as desalination plants provide most of our drinking water.

To prepare to meet our growing need for energy, in 2007 the UAE Government conducted an extensive study into increasing demand, as well as existing electricity generation capacity. Nuclear energy emerged as the right choice for the UAE because it is a clean, safe and proven technology. It is commercially viable and delivers reliable baseload electricity – the electricity needed to satisfy the minimum level of demand on an electrical grid – 24 hours a day, seven days a week with nearly zero carbon emissions. The government also recognized that investment in nuclear energy would drive the growth of a major high-tech industry in the UAE and provide high-value jobs for decades to come.

“ In 50 years, when we might have the last barrel of oil, the question is: when it is shipped abroad, will we be sad? If we are investing today in the right sectors, I can tell you we will celebrate at that moment. ”

His Highness Sheikh Mohamed bin Zayed Al Nahyan
Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces, in his address at the 2015 Government Summit.

National Investments, Global Opportunities

The nuclear energy industry has some of the most stringent quality and safety standards in the world. The Emirates Nuclear Energy Corporation's (ENEC) dedicated Industrial Development Team has supported UAE companies in bringing their products and services in line with these requirements so they can support the nuclear energy sector both domestically and internationally.

For example, ENEC works with local companies to upgrade their systems to become American Society of Mechanical Engineers Nuclear Component certified. This certification includes a rigorous review to verify the adequacy and effective implementation of a quality assurance program, and is the key certification required to supply components to the nuclear energy sector.

As a result of these efforts, a growing number of domestic companies have and continue to contribute to the success of the UAE Peaceful Nuclear Energy Program. These companies also now have a unique competitive advantage in providing nuclear-quality services and materials to the estimated US\$67 billion global nuclear energy marketplace.

To date, more than 1,500 UAE companies have secured contracts totaling more

than AED14 billion for a range of products and services for the Barakah Nuclear Energy Plant. Supplier companies include Bin Asheer, DESCON Engineering, Dubai Cable Company Ltd. (Ducab), Emirates Steel, National Marine Dredging Company and the Western Baidoon Group.

Growth through Jobs, Skills and Education

ENEC is developing and supporting UAE Nationals who will be responsible for managing and leading the nation's new and flourishing nuclear energy sector. ENEC's Energy Pioneers program has been a key part of these efforts since the early days of the nuclear energy program. In 2018, 195 energy pioneers graduated. These professionals are now supporting the nation's nuclear energy program as we prepare for the operation of the first unit at Barakah.

Today, ENEC leads an enterprise that includes two joint venture companies responsible for the plant's operations and maintenance, as well as its commercial interests. ENEC and the joint venture companies have grown to a combined enterprise workforce of more than 2,900 people. Approximately 60 percent of that workforce is UAE Nationals and 20 percent is female. The nuclear energy industry also provides high-value jobs and career opportunities for young professionals as more than 65 percent of

the UAE Nationals who work at ENEC and the joint venture companies are younger than 30 years of age.

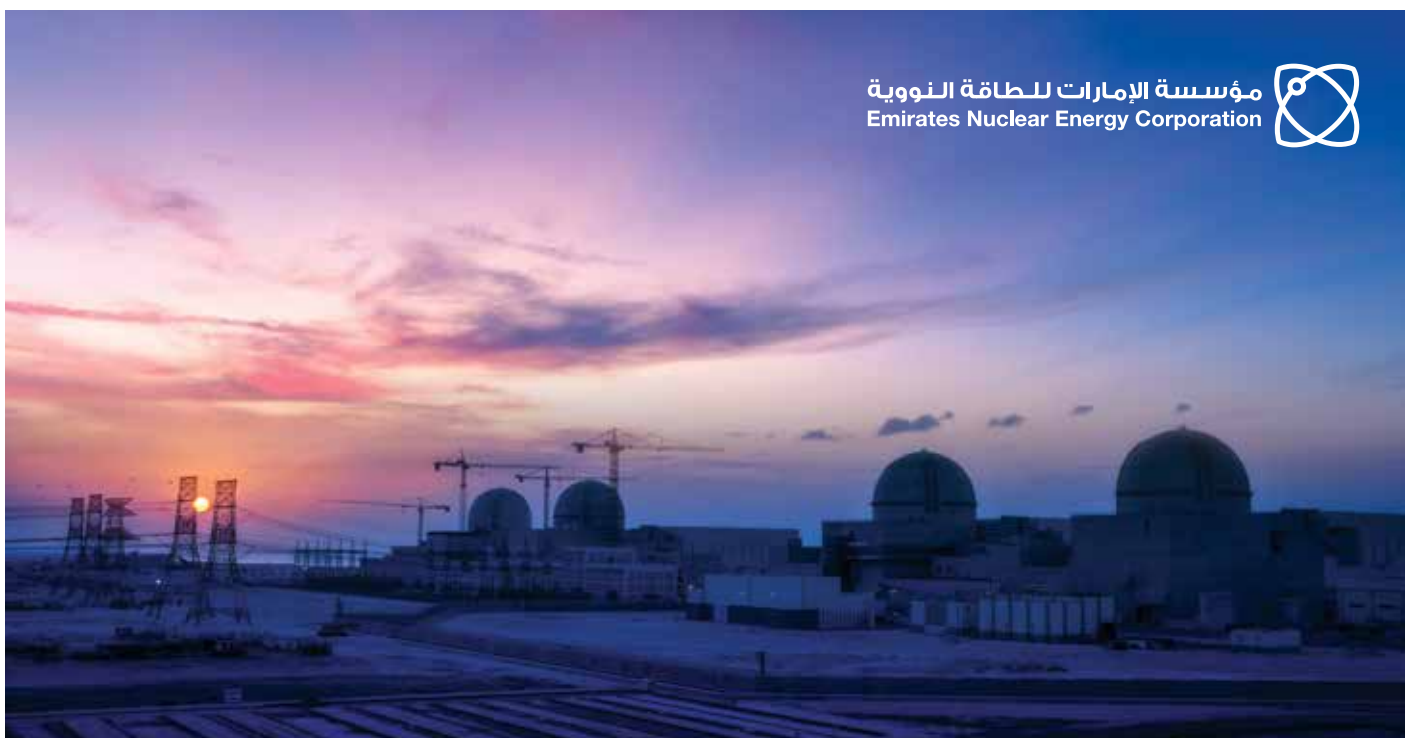
These are the talents, skills and opportunities that truly power the UAE's economic diversification and future development.

Nuclear Energy is a Powerful Investment at Home and Abroad

In developing its peaceful nuclear energy program, the UAE aimed to create a model that other nations could follow as they work to diversify and strengthen their own energy infrastructure. The UAE engaged extensively with the international community as it developed its policy and the foundations for its program. To this day, international collaboration is one of the key pillars of the UAE program, ensuring transparency, knowledge transfer and a high level of support.

From the very beginning, the UAE Peaceful Nuclear Energy Program was conceived, managed and expanded as an investment in the nation's people and growth, in collaboration with the global nuclear energy sector and its development continues with these principles.

مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation





ADNOC's Transformation to Further Drive the UAE's Economic Growth and Prosperity

For nearly 50 years, the Abu Dhabi National Oil Company (ADNOC), has been the backbone of the Abu Dhabi and United Arab Emirates (UAE) economies. Throughout that time ADNOC has been inextricably linked with the Abu Dhabi and the UAE's rapid rise, and we intend to remain a primary catalyst for growth, development and diversification. To ensure ADNOC continues to thrive in a changing world, we continue to deliver against our 2030 growth strategy, which will ensure ADNOC maximizes value from all its resources, remains the UAE's engine of growth and prosperity for decades to come.

As part of the effort, ADNOC received approval from the Abu Dhabi Supreme Petroleum Council to implement our integrated gas strategy, which will have a fundamental impact on the UAE economy. Not only will it enable the UAE to achieve gas self-sufficiency, with the aim of potentially transitioning to a net gas exporter, it will also ensure ADNOC can competitively meet the UAE's growing demand for gas, which is used for power generation and industrial use.

In parallel, ADNOC's implementation of our 2019-2023 business plan and capital investment growth of AED 486 billion, will help drive domestic growth and diversification over an extended period, particularly through our In-Country Value (ICV) program, which will increase the company's contribution to the continued development of the UAE economy and strengthen our relationship with the UAE's private sector.

Introduced in 2018, ADNOC's ICV program is aligned with, and supports, the economic objectives of 'Tomorrow 21', the Abu Dhabi blueprint for economic growth, announced by His Highness Sheikh Mohammed bin Zayed, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces. The benefits include encouraging private sector partnerships,

improving knowledge transfer, creating employment opportunities for Emiratis, and localizing critical parts of the supply chain using local products, manufacturing and assembly facilities, services and infrastructure. Our ICV program is already delivering significant benefits, with a spend of more than AED 18 billion in its first year. With ICV included as part of all tender evaluations and award processes, the value created will continue to increase as planned projects are implemented, delivering yet more new businesses and employment opportunities.

Equally important in supporting sustainable domestic economic growth are our AED 165 billion downstream investment plans, which will create the world's largest and most advanced integrated refining and petrochemicals complex, in Ruwais. As part of our downstream strategy, announced in May 2018, we will develop a new, large-scale, manufacturing ecosystem through the creation of petrochemical Derivatives and Conversion Parks, which will support the UAE's economic diversification, create high-skilled jobs and enhance the country's status as a globally attractive destination for energy investments.

The Ruwais Derivatives Park will be a prime catalyst for the next stage of petrochemical transformation and enable the creation of numerous new petrochemical activities and value chains, in such fields as construction chemicals, oil and gas chemicals, surfactants and detergents. Meanwhile, the Ruwais Conversion Park will spur new business creation even further down the value chain, including packaging materials, coatings, high voltage insulation and automotive composites. Both parks will also act as catalysts for the creation of focused industry clusters, which can not only supply products, but also leverage the proximity of such an interconnected ecosystem to drive expertise, innovation and entrepreneurship.

But it is not just in the commercial sector that ADNOC seeks an impact on the UAE's economy. Our people are our most precious resource and, in line with the vision of the nation's leadership, we have a duty to nurture and develop our most promising Emiratis to create a talent pool that will ensure the UAE remains one of the world's leading economies.

The ADNOC Future Leaders Program is an example of an elite program designed to identify the brightest and best employees, both men and women, who will ensure that ADNOC continues to be an integral part of the country's economy and its prosperity. ADNOC is also delivering programs that support the country's Accelerators Program "Ghadan21" and future economic development plans (Vision 2071). Through our STEM-focused activities, we are developing the next generation of skilled workers who will be the driving force of the economy. We believe that investing in young people today prepares us for tomorrow and leads to a more competitive global position for our company and for the UAE.

ADNOC has set a path for continued success, with its ambitious 2030 growth strategy, to ensure we remain a resilient and reliable cornerstone of the UAE economy. We will do so by remaining committed to creating opportunities for both international and local businesses to further participate in ADNOC project and by enabling more collaboration between local and global suppliers and enhancing employment and development opportunities for Emiratis.

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The Ministry's will continue its path to support the UAE's journey to excellence by continuously improving the state of the energy, water, and industry sectors.

Our focus is to ensure that these strategic UAE engines of growth are represented internationally and continue to improve the Nation's contribution to sustainable development, while assuring that their resources are utilized to support the national economy in a pioneering and exemplary manner in collaboration with our partners and stakeholders.

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HE Eng. Suhail Al Mazrouei

UAE Minister of Energy and Industry

Find out more about the progress of the UAE Ministry of Energy and Industry and its team, the UAE State of Energy Report 2019, the UAE Greenhouse Gas inventory and much more at www.moei.gov.ae



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