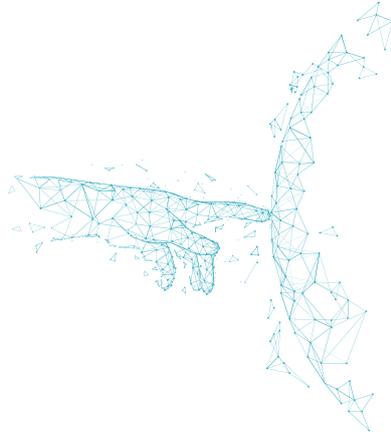


THE POWER OF DIGITALISATION

Transforming energy for a sustainable future



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FOREWORD

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Driving sustainability from the top down

Specific energy-focused policies and strategies, such as the UAE Energy Strategy 2050, are driving efficiencies in production in the legacy oil and gas sectors, as well as in renewables, to build long-term energy sustainability. Thanks to policy guidance, since 2011 renewable technologies have accounted for at least half of total new power generation globally.

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Leading the sustainable energy charge

Alongside governments and regulatory agencies, energy companies play a critical role in supplying the power for modern lives. As leaders, these enterprises must balance the competing forces of supply, demand, regulation and competition to build a truly sustainable future.

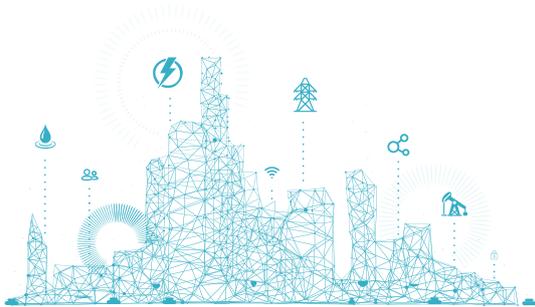
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The energy revolution is now

Industry 4.0 is driving end-to-end efficiencies along the energy value chain, which is transforming the entire industry. The average growth rate of demand is, for the first time, expected to decrease thanks to energy-efficiency improvements and the digitalisation that is accelerating growth in the renewables sector.

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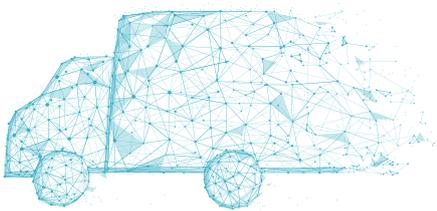


4

Powering sustainable urban mobility

Efficient transportation is a key driver of economic development, and transportation is heavily dependent on energy use – especially fossil fuels. This ties the energy industry inextricably to transport, to the pressures of increasing demand for mobility, and to calls for modernisation.

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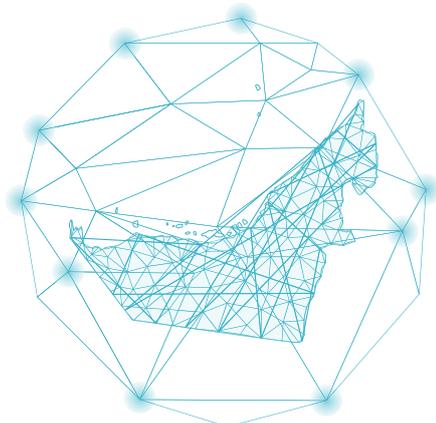


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Where next for sustainable investment?

Transformation of global energy – from dependence on fossil fuels to more renewable sources – is lagging. Real change, in terms of both energy generation and consumption, requires significant financial investment.

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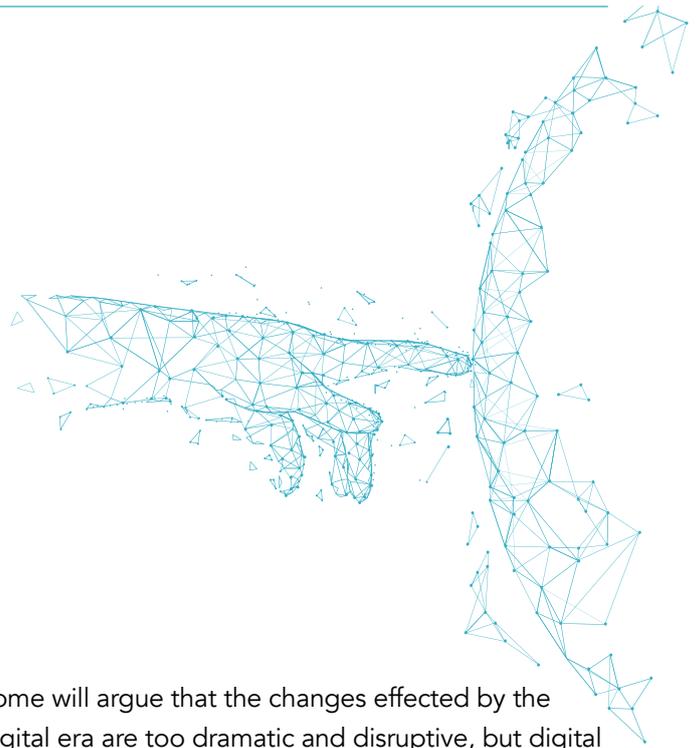
FOREWORD



Mohamed Jameel Al Ramahi
CEO, Masdar

The Fourth Industrial Revolution is picking up pace, transforming every sector and revolutionising the way we live and work. Businesses are rapidly adopting technologies such as artificial intelligence, the Internet of Things and big data, and we are definitely seeing their impact in the energy sector. Now, the challenge is how best to exploit those emerging technologies to drive sustainable development.

This report contains future-focused perspectives on the impact of digital leadership, technology investment and innovation, government policy, and more. It examines the key trends, such as sustainable mobility, clean energy investment models and cross-industry collaboration, that will unleash the true potential of Industry 4.0.



Some will argue that the changes effected by the digital era are too dramatic and disruptive, but digital solutions create opportunities, allowing our industries to drive greater efficiencies, reduce costs and accelerate to a more sustainable future.

We are launching *The Power of Digitalisation* at Abu Dhabi Sustainability Week (ADSW), one of the world's largest sustainability gatherings. ADSW brings together global leaders and experts from fields such as energy, mobility, finance and policymaking to address sustainability challenges and examine how best to harness the global digital transformation.

Hosted by Masdar, ADSW is dedicated to advancing sustainable development and furthering our understanding of the major social, economic and technological trends that are shaping it worldwide.

Over the past 13 years, Masdar has pioneered the development of innovative and sustainable solutions that mitigate the impact of climate change and provide access to clean energy. ADSW is the perfect platform to bring together key sustainable development stakeholders and put sustainability at the top of the global agenda.

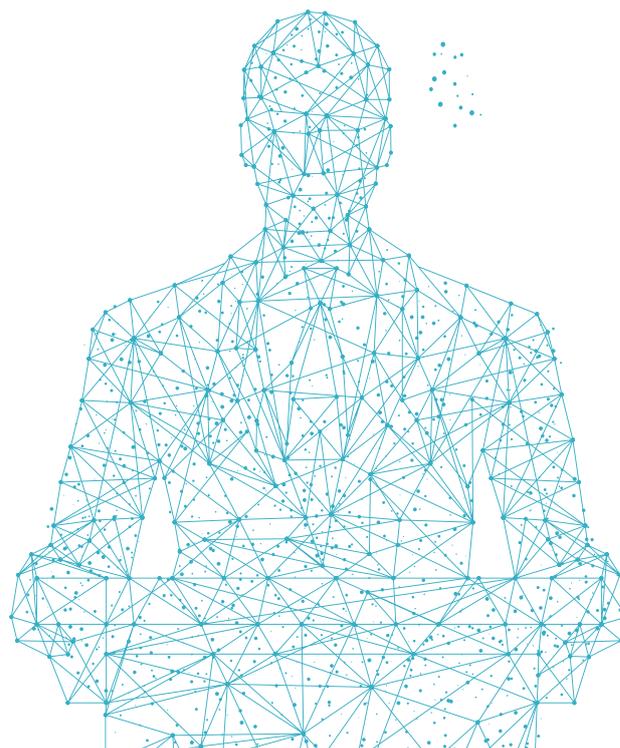
The sustainability challenges we face are daunting, but the opportunities of digital transformation offer a better future for all of us. This report provides vital insight into how we can work together to deliver that better future. Enjoy reading!

1

DRIVING SUSTAINABILITY FROM THE TOP DOWN

How UAE policies are empowering
a clean energy future

“In contributing to a sustainable energy future, policymakers globally face the classic trilemma,” says H.E. Awaidha Al Marar, Chairman of UAE Department of Energy. “They must drive the development of a cleaner energy mix; ensure reliable and secure supply to meet burgeoning needs; and create an energy value chain that is economically viable.”



The central components of a sustainable future are renewable energy sources and greater energy efficiency. As countries embrace Industry 4.0 across sectors, they are developing energy policies and strategies to encourage the critical first steps towards building sustainability.

It is making an impact. Since 2011, renewable technologies have accounted for at least half of total new power generation globally and, in 2015, a record high of 148 GW of renewable power was added.¹ And more efficient energy inputs have reduced primary energy demand – from a 3% average growth rate to a forecast rate of only 1% growth per year through 2040.²

POLICY THAT DRIVES PRODUCTIVITY

Digitalisation in the energy sector, whether it is improving operations and production or driving more effective use of the energy already available, is going to be a pillar of true sustainability. Yet, as industry and energy companies adopt smart Industry 4.0 technologies, energy and resource efficiency have simply been welcome side-effects for companies that are still primarily driven by the desire to optimise production and increase competitiveness.³

Meanwhile, oil and gas companies have been slower than others in the industrial sector to turn to digital solutions, although the tide is turning – in large part due to the volatility of oil prices over the past decade.⁴

¹ The power to change: Solar and wind cost reduction potential to 2025, IRENA, <https://www.irena.org/publications/2016/Jun/The-Power-to-Change-Solar-and-Wind-Cost-Reduction-Potential-to-2025>

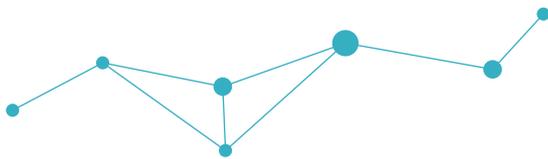
² The global energy transformation, Global Commission on the Geopolitics of Energy Transformation, <https://geopoliticsofrenewables.org/report/the-global-energy-transformation>

³ Accelerating clean energy through industry 4.0, UN Industrial Development Organization, https://www.unido.org/sites/default/files/2017-08/REPORT_Accelerating_clean_energy_through_Industry_4.0.Final_0.pdf

⁴ Towards a reskilling revolution, World Economic Forum, http://www3.weforum.org/docs/WEF_Towards_a_Reskilling_Revolution.pdf

From a national perspective, governments recognise that they must take the lead in adapting new technologies for use with sustainable energy solutions. Specific energy-focused policies, such as those encouraging the electrification of transportation or tightening building energy performance standards, are being combined with investment in smart technologies to deliver the benefits vital for driving productivity and efficiency.

The UAE, for example, has adopted a comprehensive and integrated approach to developing the industrial sector.



“To support efforts to build a sustainable, advanced industrial base, in 2017 the UAE launched a Strategy for the Fourth Industrial Revolution,” says H.E. Eng Suhail Mohamed Faraj Al Mazrouei, UAE Minister of Energy and Industry. “This aims to strengthen the country’s position as a global hub for the Fourth Industrial Revolution and contribute to a competitive national economy based on knowledge, innovation and future technological applications that integrate physical, digital and dynamic technologies.”

PILLARS SUPPORTING SUSTAINABLE DEVELOPMENT IN THE UAE



Supporting innovation and research and development



Efforts to promote sustainable manufacturing and reduce carbon emissions



Support for small and medium enterprises



Adoption of Industry 4.0 technologies



Developing advanced skills



Establishing public-private partnerships (PPP)



Integrating local businesses into global value chains to increase our export prospects

Source: H.E. Eng Suhail Mohamed Faraj Al Mazrouei, UAE Minister of Energy and Industry

The UAE has also enacted Energy Strategy 2050, which calls for a two-pronged approach. “Optimisation of traditional energy sources with unprecedented levels of efficiency and productivity,” says H.E. Al Marar. “And investing in clean (low-carbon) energy sources, including nuclear and solar, both currently top priorities for Abu Dhabi.”

UAE ENERGY STRATEGY 2050

Targeting an energy mix combining renewable, nuclear, and clean energy

Achieve 50% clean energy capacity



Decarbonise power and water sector by 70%



Increase consumption efficiency of individuals and corporations by 40%



Supported by US\$163 billion investment in energy sector



Source: H.E. Awaidha Al Marar, Chairman of UAE Department of Energy

LEADING THE CHARGE FOR GLOBAL SUSTAINABLE ENERGY

Diversification and the shift to renewables and clean energy have long been a focus in Abu Dhabi, and mobility electrification – through a roll-out of electric vehicles – is an example of the far-reaching policies it is adopting.

“This sustainable development agenda positions the emirate to contribute to the global effort to reduce the impact of climate change, while benefiting from the health and social wellbeing from a cleaner, more sustainable environment,” says H.E. Al Marar. “In addition, a more sustainable energy system would create an opportunity for Abu Dhabi to leverage and optimise its natural resources, including solar irradiation, to support non-petroleum-dependent industries, which are vital for economic growth.”

As shown by the UAE’s approach to technology as a driver of change, Industry 4.0 and the transition to sustainable energy share important characteristics: both are highly influenced by technological innovations and are dependent on the development of suitable infrastructures and appropriate regulations. With both of these in place, industry and energy companies will be empowered to develop and deploy new business models.⁵

With steady growth over the past several years, the industrial sector in the UAE is a main economic engine and plays a pivotal role in driving the diversification of the GDP and the country’s rankings as a competitive economy, says H.E. Al Mazrouei. “It’s clear that the country’s economy is moving in the right direction, towards greater economic diversification and a future based on knowledge and leadership in non-oil sectors.”

If the UAE’s energy leaders can maintain the balance between the three key elements of cleaner energy, secure supply and economic viability as they develop the new, innovative and diversified energy frameworks they are tasked with, it could be a future that holds as many opportunities as fears for the energy sector.

⁵ Accelerating clean energy through Industry 4.0, UN Industrial Development Organization, https://www.unido.org/sites/default/files/2017-08/REPORT_Accelerating_clean_energy_through_Industry_4.0.Final_0.pdf

2

LEADING THE SUSTAINABLE ENERGY CHARGE

How strong leadership will drive transformation in the Energy 4.0 era

Powering the world is a complex undertaking. Energy is a key force in every economy and, owing to digital innovation and Industry 4.0, demand for it is increasing – by an expected 25% in the next 20 years.¹ Alongside governments and regulatory agencies, energy companies play a critical role in supplying the power for modern life. The big question is, how can leaders within the sector enable this rapid economic growth and do so sustainably and responsibly, while ensuring universal access to affordable, reliable energy supplies?



SUSTAINABLE ENERGY FOR A NEW GLOBAL REALITY

Energy leaders must balance the competing forces that are reshaping the sector – supply, demand, regulation and competition – to build a truly sustainable future. Oil and gas remain essential elements in the global energy system: fossil fuels drive close to 80% of global final energy consumption,² and even with increasing investments in renewables will continue to lead the supply chain for the foreseeable future.

On the supply side, the ever-changing geopolitical climate and the growth of economical renewable sources are disrupting the existing, hydrocarbon-heavy, geographically concentrated value chain. In parallel, changes in consumption – including smart grids, new utility models, the rise of the sharing economy, and climate regulations – are creating a need for more flexibility and greater collaboration within the sector to fulfil these new demands.

“Today’s energy landscape is being fundamentally reshaped by the need to deliver more energy with fewer emissions,” says H.E. Dr. Sultan Ahmed Al Jaber, UAE Minister of State and ADNOC Group CEO. “To meet global demand, we will need an inclusive response that integrates and optimises a fully diversified energy mix. The leadership of the United Arab Emirates has created an ecosystem that supports all forms of energy from oil and gas, to renewables and nuclear.”

^{1,2} Accelerating clean energy through Industry 4.0, UN Industrial Development Organization, https://www.unido.org/sites/default/files/2017-08/REPORT_Accelerating_clean_energy_through_Industry_4.0.Final_0.pdf

PRIORITISING DIGITAL CHANGE

Digital innovations underpin many of the consumer changes that impact energy demand across the globe – increased expectations of personalisation and real-time transactions, priority given to environmental issues and climate change, and demands for more transparency across all industries. Energy leaders are embracing disruptive and emerging digital technologies, such as artificial intelligence (AI), the Internet of Things (IoT) and blockchain, to overcome the challenges affecting almost every aspect of supply, demand and operations.

Strong leadership – in the form of mandates and regulations – will accelerate the shift to digital. All EU countries, for example, are bound to create national energy and climate plans with goals for 2030, to transition the continent to a low-carbon and fully digital society. And there is recognition that digitalising the energy sector is a key step – illustrated by efforts such as a smart grid taskforce advising on policy, infrastructure and implementation.

Realising digital's full potential will be critical to building a sustainable model to meet increasing demand in the short term and positioning the energy sector for change when demand stabilises (expected in about 2030)³ owing to the increase in renewable sources.

The World Economic Forum⁴ has identified four themes central to the digital transformation of oil and gas:



1. Digital asset life-cycle management

Combines new digital technologies with data-driven insights to transform operations, improve strategic decision-making and build new business models.



2. Circular collaborative ecosystems

Applies integrated digital platforms to enhance collaboration, fast-track innovation, reduce costs and provide operational transparency.



3. Beyond the barrel

Innovative customer-engagement models offer flexibility and a personalised experience, opening up new revenue opportunities for operators and new services for customers.



4. Digitalising new energies

The digitalisation of energy systems promotes new energy sources and carriers and supports innovative models for optimising and marketing energy. To remain relevant to customers, the energy sector must understand the full impact of these changes on the broader energy system.

³ Global Energy Perspective 2019, McKinsey, <https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-energy-perspective-2019>

⁴ Digital Transformation Initiative: Oil and Gas, World Economic Forum, <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-oil-and-gas-industry-white-paper.pdf>

DIGITALISATION IN THE OIL AND GAS SECTOR

Source: A test of resilience: The outlook for the oil and gas industry in 2019, DNV-GL, <https://www.dnvgl.com/publications/a-test-of-resilience-the-outlook-for-the-oil-and-gas-industry-in-2019-137687>

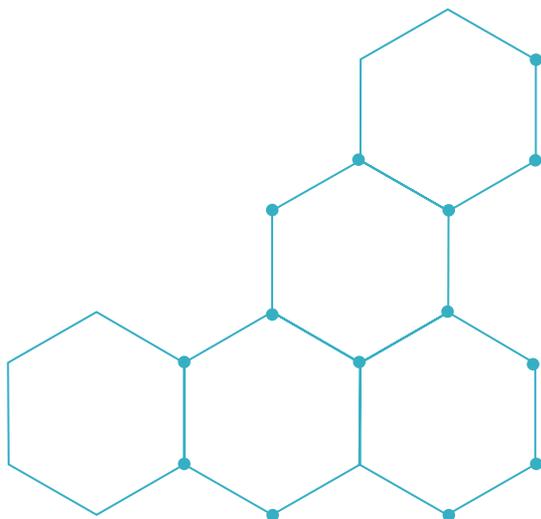
Digitalisation is a research and development priority



Expecting to increase spending on digitalisation



In the Middle East, harnessing these new technologies is a particular focus. Upstream digitalisation allows for analysis of data to enhance environmental performance and is used to increase worker safety and production and cut costs; midstream digital technologies power drones and sensors to keep pipelines safe and operational; and downstream digital initiatives improve operational aspects such as refinery production schedules and reliability.⁵ In the UAE specifically, developing partnerships with technology companies, supply-chain partners and policymakers are already having a significant impact.



“In an era where the oil and gas sector is being disrupted on multiple levels, ADNOC is harnessing state-of-the-art digital technologies to improve performance and unlock greater value from our assets and resources. Our partnership with leading technology companies is generating valuable efficiencies throughout our operations,” says H.E. Dr. Al Jaber. “Every day, we analyse terabytes of information in our Panorama Digital Command Centre, to enable our people to make smarter and quicker business-critical decisions.”

⁵ Digitalization top priority for oil, gas decision-makers, Saudi Gazette, <http://saudigazette.com.sa/article/547273>

ON THE ENERGY HORIZON

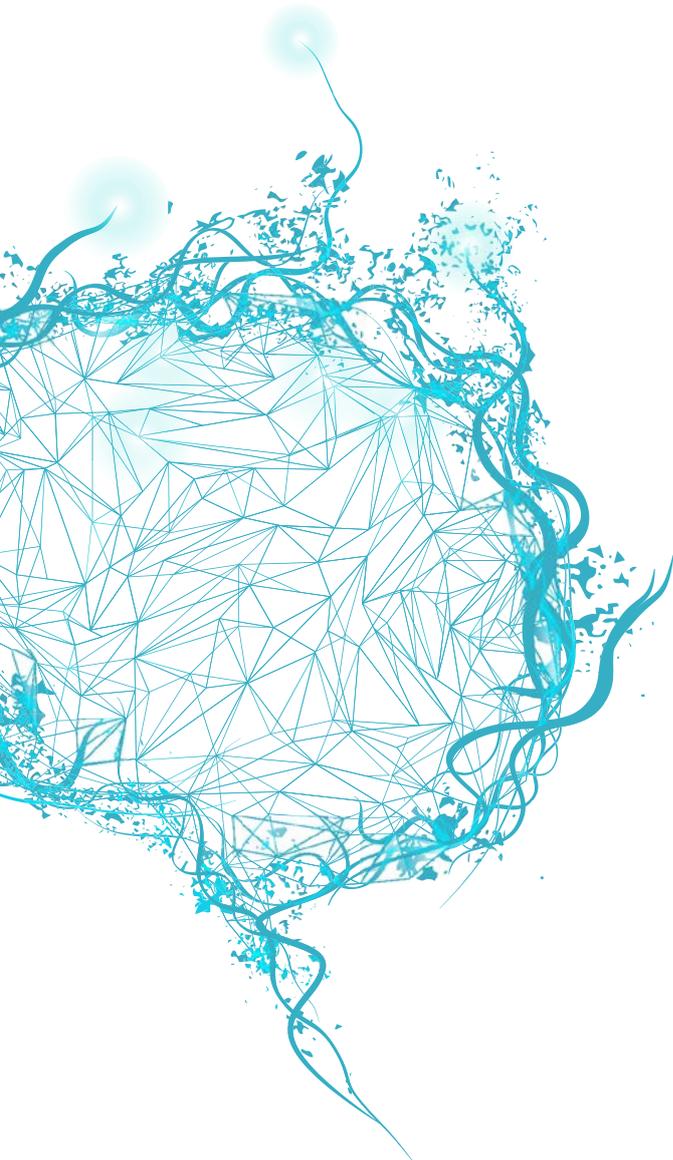
To create and sustain real change towards Energy 4.0 requires government and industry decision-makers to think differently and embrace disruption at all levels. The World Economic Forum recommends that energy leaders:

1. **Make digital a priority and develop a digital strategy roadmap**
2. **Develop a culture of innovation and adoption of technology**
3. **Continue to develop digital capabilities.**

"We need to look first at government-stated policies as the main driver towards the energy transition," says Abdelmajid Iraqui, Managing Director of TAQA Africa and acting Executive Officer of TAQA Group Power & Water.

"Country-mandated targets would create a new energy mix, with more than 50% coming from renewable energy sources, 35% from natural gas and oil, and coal making up only 15%, according to the International Energy Agency. Energy companies have no choice but to diversify; otherwise, they will risk [losing] potential market growth."

Those energy leaders that understand digital's potential to reduce costs and create and sustain partnerships will be the ones leading the way as we move deeper into the 21st century.



3

THE ENERGY REVOLUTION IS NOW

How Industry 4.0 innovation is
transforming the future of energy

Innovation is impacting the energy supply chain. With the rise of Industry 4.0 technologies, including automation and machine learning, advanced analytics and the Industrial Internet of Things (IIoT), increasing digitalisation is delivering transformative efficiencies along the energy value chain. In the 20th century, the average annual growth rate of energy demand was 3%. With efficiency improvements in recent decades, primary energy demand is now forecast to grow at only 1% a year through 2040,¹ even as urban populations continue to increase.

Nevertheless, all energy sectors are under pressure to present a cleaner, more efficient energy value chain, from production through to distribution and the end consumer. To do this, each must look to develop its own innovative framework.

MOVING TOWARDS A MORE SUSTAINABLE ENERGY MIX

The more traditional energy sectors of oil and gas are starting to recognise the potential of the digital revolution to address the challenges they face, particularly within supply and production.



THE THREE DS OF ENERGY INNOVATION



Decarbonisation – renewable sources will account for 60% of new power generation in the next 20 years²



Decentralisation – standalone, mini-grids such as solar panels on buildings



Digitalisation – tracking the grid, measuring power use and efficiency

“Oil and gas 4.0 technologies are revolutionising the industry,” says Norm Gilsdorf, President of High Growth Regions, Middle East, Russia and Customs Union at Honeywell.

“But there is a lot of untapped opportunity. It varies from customer to customer, but I think we’re only seeing something in the order of 10–15% implementation of IIoT technologies at this stage.”

¹ The global energy transformation, Global Commission on the Geopolitics of Energy Transformation, <https://geopoliticsofrenewables.org/report/the-global-energy-transformation>

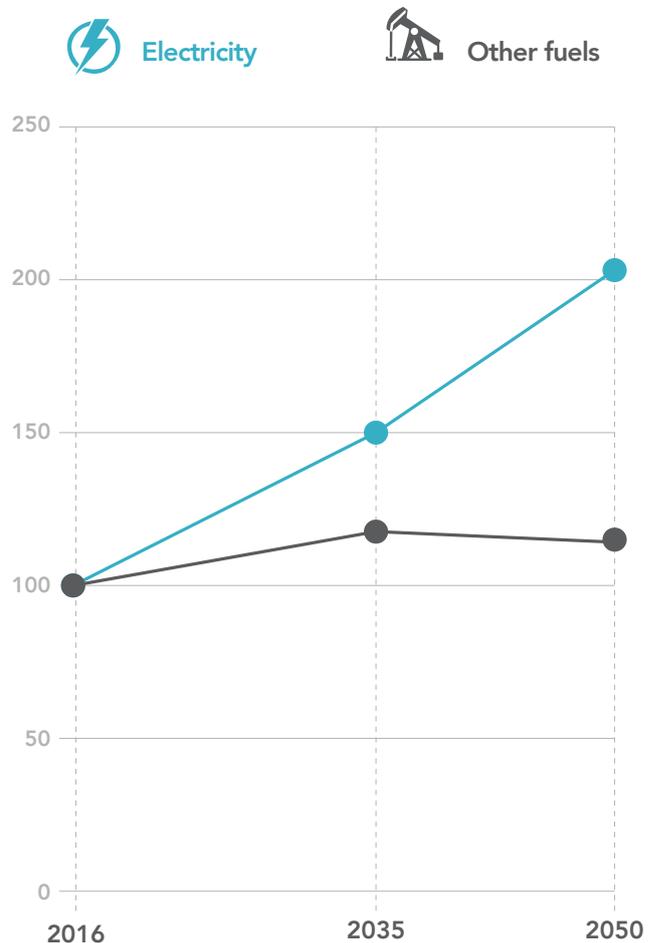
² Caspar Herzberg, President, Middle East and Africa, Schneider Electric

Digitalisation of energy distribution – and smart grids in particular – is driving change on the electricity grid, and managing demand in factories, office buildings and in the power plant itself is one of the biggest opportunities to save energy.

“Everything is connected,” says Caspar Herzberg, President, Middle East and Africa at Schneider Electric. “Because it’s possible to analyse data collected from the grid, [producers] can make real-time decisions on simple things, like turning power on or off, or measuring power loss. Using digital technologies like machine learning and analytics is what enables this efficiency.”

As a driver of innovation throughout the sector, digitalisation is also accelerating the growth of renewable energy sources such as biofuels, renewable hydrogen, wind and solar. The maturation of clean power generation and distribution enables a more renewable – and more efficient – energy mix. “The move to cleaner energies is already well established,” says Francesco La Camera, Director-General of the International Renewable Energy Agency (IRENA). “For each of the last seven years, renewable energy capacity growth has systematically outpaced the growth of all traditional fossil fuel sources combined.”

The growth rate for electricity exceeds those for oil, gas and coal and, by 2050, it is expected to be seven times higher than the average for other fuels.



Source: Fueling the energy transition: Opportunities for financial institutions, McKinsey, <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/fueling-the-energy-transition-opportunities-for-financial-institutions>

TECHNOLOGIES DRIVING INNOVATION IN RENEWABLE ENERGY

Smart grids



Big data



Internet of Things



Energy storage technology

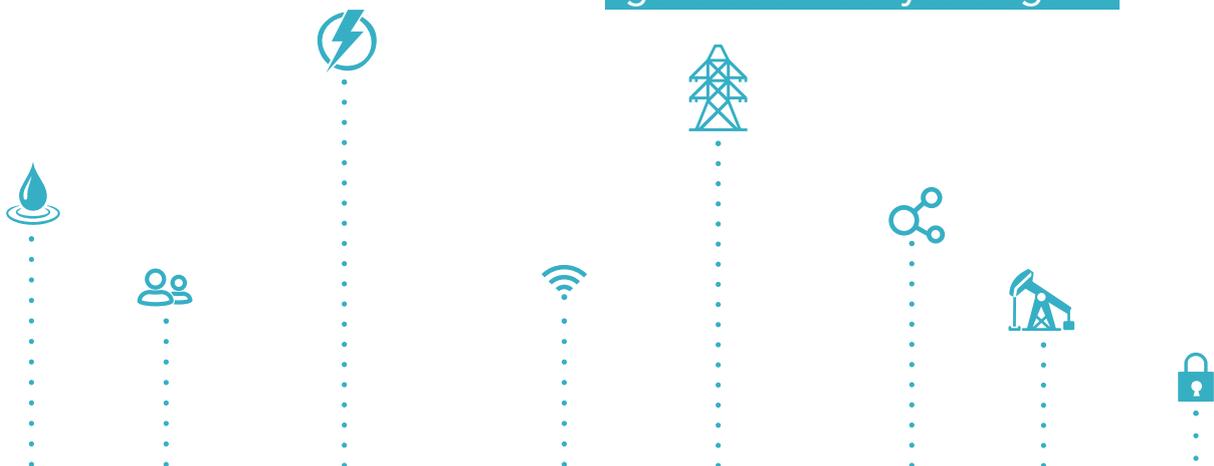


Source: The Global Energy Transformation, Global Commission on the Geopolitics of Energy Transformation, <https://geopoliticsof Renewables.org/report/the-global-energy-transformation>

DEVELOPING AN INNOVATION FRAMEWORK

We are already seeing a big impact from technology all along the energy value chain – in oil and gas, electricity and, increasingly, in the use of renewables. A strong regulatory framework, stable political environment and defined government targets play a significant role in a digitalised, distributed energy model, and form the foundation of an optimally efficient global system.

“With so many different entities and players, what you don’t have, with few exceptions, is an organised national plan of what the tariffs will be, and how that should work,” says Caspar Herzberg. “That’s missing in most markets, including Africa and the Middle East. The one exception to note is Egypt, which is quite advanced and focused on digitising power, after investing heavily in generation four years ago.”



ENERGY SYSTEM PERFORMANCE IMPERATIVES



Security and access



**Environmental
sustainability**



**Economic growth and
development**

“Energy transition is not restricted to shifts in the fuel mix or dominant technologies used in energy extraction, conversion or consumption... Accelerating energy transition will require coordinated efforts that address the interconnections of the energy system with different elements of the economy and society.”

Source: Fostering Effective Energy Transition 2019, World Economic Forum, March 2019, <https://www.weforum.org/reports/fostering-effective-energy-transition-2019>

Creating a roadmap is critical to driving change at a national level, and is an area where IRENA works closely with governments. “We assist countries in assessing the potential for renewables in their energy system,” says Francesco La Camera. “Many countries need support in setting their priorities both in terms of the energy mix and in building regional investment platforms that will attract the financial backing needed to meet their future goals.”

Developing such frameworks encourages collaborations with private organisations that have the potential to reshape the future of energy. Saudi Aramco,³ for example, is partnering with Power Systems Renewables Department to deploy renewable energy technology – such as solar photovoltaics and off-the-grid solar photovoltaic-energy storage systems – across applications in its often-remote facilities, including office buildings and oil and gas production wells. This is reducing life-cycle costs and greenhouse emissions, thereby meeting sustainability goals.

Such collaboration is critical to accelerating digitalisation and innovation across the energy sector. Building a sustainable and affordable global energy system requires collaboration and innovation across industries and political and geographic boundaries. It requires the resources, know-how and will to implement new solutions. And it requires leadership that is ready to build the energy supply chain of the future.

“Energy is a conservative industry,” says Norm Gilsdorf. “Leadership and senior staff are used to one thing, and they’ve worked in the Industry for 20, 30, 40 years. Digitalisation can be a challenge, but it’s bringing dramatic change to the industry and hasn’t been fully embraced yet.”

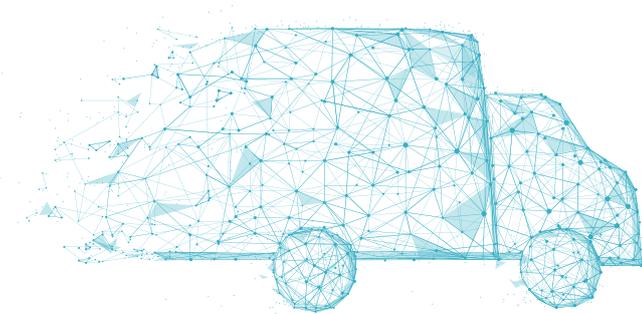
³ Using renewables to power unconventional gas wells in Wa’ad Al-Shamal, <https://www.saudiaramco.com/en/news-media/news/2019/renewables-powering-gas-wells-waad-al-shamal>

4

POWERING SUSTAINABLE URBAN MOBILITY

How are modern cities designing transport networks for the long haul?

Moving people and goods is a foundation of our global economy, and transportation is highly dependent on energy use – especially fossil fuels. This dependency binds transportation and increasing demand for mobility to the energy industry, environmental concerns and global prosperity. By 2030, passenger traffic will exceed 80,000 billion passenger-kilometres (a 50% increase), and freight volume will grow by 70% globally.¹ That demands a lot of new capacity and creates considerable environmental pressures.

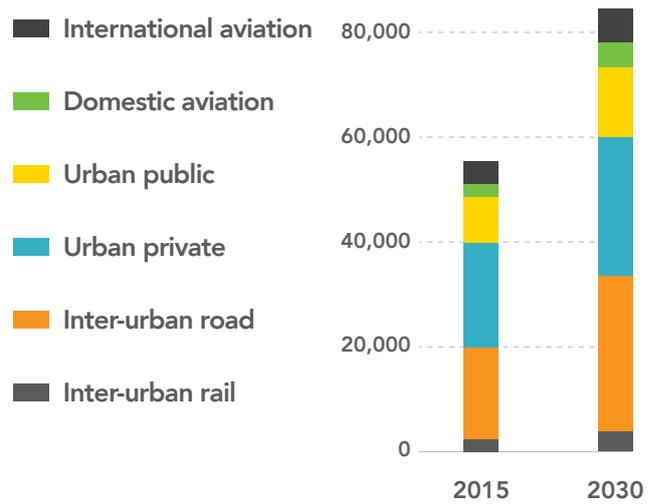


Efficient transportation of both passengers and freight is not only a key driver of economic development, but it is also a vital component of the UN sustainability goals of building resilient infrastructure, creating safe, inclusive, and sustainable cities and communities, and access to affordable, reliable, sustainable and modern energy for all. And it is digital innovation that will play a critical role in accelerating efficiencies in transportation.

GROWTH IN PASSENGER VOLUMES DEMANDS HIGHLY EFFICIENT URBAN TRANSPORT NETWORKS

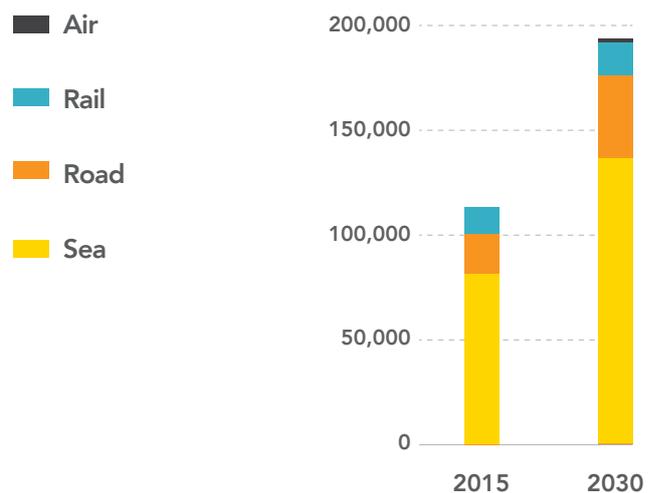
Passenger transport volumes

(Billion passenger-kilometres)



Freight transport volumes

(Billion tonne-kilometres)



Source: Global Mobility Report 2017, Sustainable Mobility for All, <https://www.icao.int/Meetings/iwaf2018/Documents/Global%20Mobility%20Report2017.pdf>

¹ Sustainable Mobility for the 21st Century, The World Bank, <https://www.worldbank.org/en/news/feature/2017/07/10/sustainable-mobility-for-the-21st-century>

SMART CONSTRUCTION, LOWER CONSUMPTION

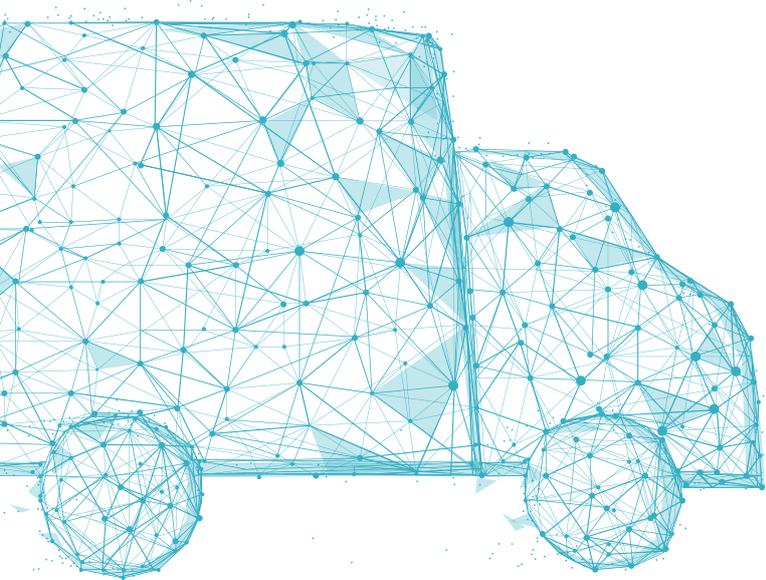
In many economies, it is urban networks that are the transport industry's most visible presence. With growing populations and increasing pressure to cut transport emissions, cities are seeking new mobility models amid legacy infrastructure and sometimes resistant policies.

Sustainable urban transport uses physical infrastructure that will last for decades and is designed with environmental and energy implications in mind, says Mu Ramanathan, Director-Structures, Transit and Railways at AECOM. "All the design assumptions and construction techniques should take into account the design life," he says. "It's not only about the strength of the material, but also its serviceability. And it's about using renewable energy, such as using solar panels, and making the structures green, with LEED certifications."

Building that sustainable future also means considering energy consumption, which is what Hyundai is doing in Australia.

"We're designing a train with enhanced regenerative braking," says Brandt Clifford, Human Factors Manager – New Intercity Fleet Project at Hyundai Rotem in Sydney.

"They don't draw as much power, and they put energy back into the grid. The key feature is the driver advisory system with real-time feedback to support the driver to adopt energy-efficient driving styles while still meeting operational timetable and safety requirements."



DIGITALISING FOR PASSENGER EFFICIENCY – AND A BETTER EXPERIENCE

Any calculations about energy consumption and sustainable transport design must be based on human behaviour: an underused transport system is not energy efficient. Here, digitalisation helps

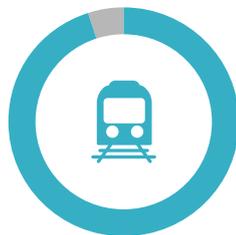
to show how individuals use different modes of transport, which in turn enables effective collaboration among transportation types – cars, bicycles, buses, pedestrians, and transport such as metros or urban rail.

PUBLIC TRANSPORT RAIL USER SURVEY

96% believe transport innovation is an important part of modern cities



95% would be more likely to use rail if it deployed technology-driven solutions



83% think innovative transport systems are features of a smart city



81% report that digital technology is changing the way they use public transport

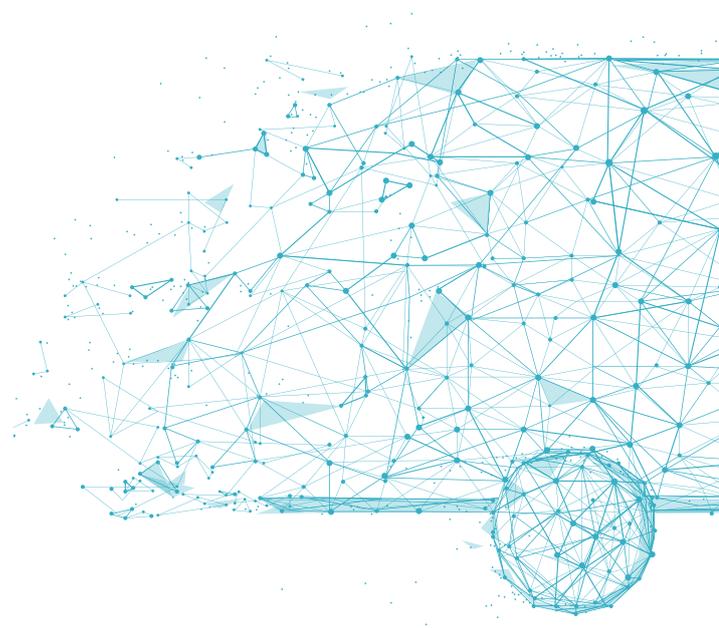


Source: Public transport and continuous connectivity: building smarter cities, BAI Communications, April 2019, <https://www.baicomunications.com/news-views/report/continuousconnectivityreport/>

Digitalisation is already making a difference to the passenger experience in Sydney.

“The digital aspects of monitoring train carriage capacity, or of providing updates on what time the next bus is due to arrive and how many available seats there are is already helping to manage passenger numbers,” says Brandt Clifford. “We’re continuing to improve accessibility and sustainability for everyone. The ultimate vision is to deliver a digital hub that connects across the entire transport network: users could go from door to door without looking up a timetable – just pull out the phone, see that a seat is available, and hop on.”

Dubai, meanwhile, recognises that modernising its transport will be key to becoming a more sustainable city. The Roads and Transport Authority is undertaking a digital strategic project that looks into using artificial intelligence for functions such as traffic management, security and customer experience, projects such as autonomous mobility systems, and ways to increase public transport ridership.²



² Sustainable urban mobility to aid economic growth, Gulf News, March 2019, <https://gulfnews.com/uae/transport/sustainable-urban-mobility-to-aid-economic-growth-1.1551862439626>

SUPPORT FROM THE TOP

Government support, at all levels, is crucial to sustainable mobility. And nowhere is that support more important than in innovative energy strategies – governments have a vital role to play in helping cities to find the right mix of technologies and energy sources, both traditional and renewable, to shape the most energy-efficient transport solutions.

“A good example of government-supported innovation is in hydrogen electric vehicles,” says Brandt Clifford. “For a large population like Australia that’s quite spread out, you can’t afford to electrify rail networks everywhere. You could use hybrid vehicles that might run on electric power once they hit the city and on very cheap and efficient hydrogen when they’re running into regional areas and remote communities. Not only does this provide low-cost equivalent access to regional communities, the hydrogen fuel cell can reduce CO₂ by up to 361 tons per year compared to diesel locomotives.”

MAKING A DIFFERENCE

Progressive cities are taking steps towards innovative mobility to create efficiencies and build sustainable and resilient infrastructure – transportation systems that work now and will continue to work in the future.

They do this by paying close attention to infrastructure development and finding innovative approaches to transport design and energy use; turning to digital technologies to first build infrastructure and then to understand – and improve – how passengers interact with different transport modes; and ultimately by creating systems to capture and re-use energy.

These steps will be critical for cities seeking to make transportation more efficient while also addressing the competing demands of exploding passenger and freight growth.

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WHERE NEXT FOR SUSTAINABLE INVESTMENT?

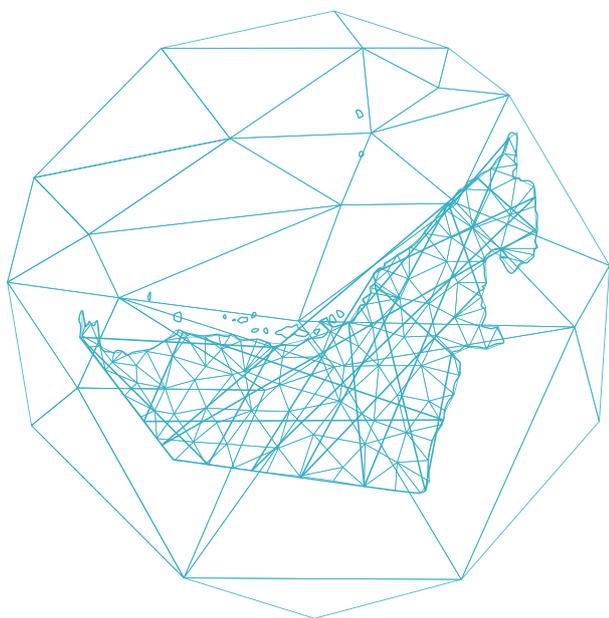
How clean energy funding creates
a virtuous circle

Global energy transformation is not happening quickly enough. Even with impressive uptake of renewable energy sources, meaningful progress to prevent global climate disaster is lagging behind the inexorable rise in CO₂ emissions levels.

Innovation in policies and technologies is driven by direct investment in renewable energy coupled with financing that encourages every industry to invest in sustainability. But it is not quite enough. What more can the industry do to create the clean energy system of the future?

THE RIGHT PATH: A SUSTAINABLE TRAJECTORY

According to the International Renewable Energy Agency (IRENA), the total investment needed by 2050 to decarbonise the energy system is US\$110 trillion, including US\$15 trillion on top of the energy investments that are already planned.¹



Integrating environmental criteria into investment decisions will be critical for meeting the shortfall, according to Francesco La Camera, Director-General of IRENA. “The shift toward renewables makes economic sense,” he says. “Scaling up renewable energy, combined with electrification, could deliver more than three-quarters of the energy-related emissions reductions needed to meet global climate goals. Electricity needs to become the main energy carrier by 2050 if we are to have any chance of meeting the Paris Agreement goals, and renewable energy must produce 86% of that electricity.”

Investments to date have put the industry on the right path. Over the decade to 2025, for instance, the average levelised cost of electricity² generated by solar photovoltaics and onshore wind energy is expected to have come down by 59% and 35% respectively.³ In fact, renewable energy is predicted to be the fastest-growing primary energy source over the next 20 years, representing about two-thirds of global investment in power plants.⁴

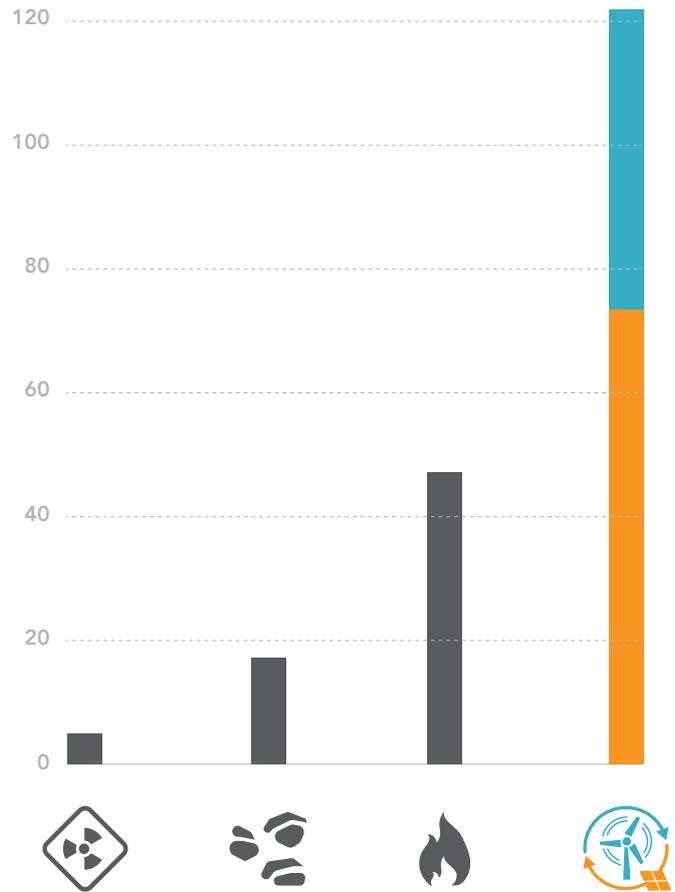
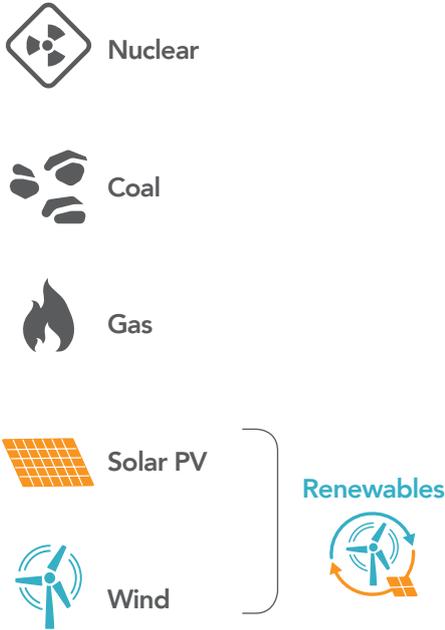
¹ How to Transform the Energy System and Reduce Carbon Emissions, IRENA, <https://www.irena.org/DigitalArticles/2019/Apr/How-To-Transform-Energy-System-And-Reduce-Carbon-Emissions>

² https://en.wikipedia.org/wiki/Cost_of_electricity_by_source#Levelized_cost_of_electricity

³ Digital Transformation Initiative: Oil and Gas Industry, World Economic Forum white paper, January 2017, <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-oil-and-gas-industry-white-paper.pdf>

⁴ Matthias J. Pickl, ‘The renewable energy strategies of oil majors – From oil to energy?’, Energy Strategy Reviews, volume 26, November 2019, <https://www.sciencedirect.com/science/article/pii/S2211467X19300574>

RENEWABLES CAPACITY GROWTH OUTPACES OTHER ENERGY TYPES



Source: Matthias J. Pickl, The renewable energy strategies of oil majors – From oil to energy?, Energy Strategy Reviews, volume 26, November 2019, <https://www.sciencedirect.com/science/article/pii/S2211467X19300574>

A TWO-PRONGED APPROACH TO A LOW-CARBON ECONOMY

The focus of investment in the energy sector has been on two fronts: decarbonising the industry by using renewable sources for power generation, as we have seen above; and addressing demand with sustainable financing – for example by encouraging companies to consider environmental impact as they seek economic value.

DECARBONISATION THROUGH RENEWABLES INVESTMENT

Expected energy investment by 2040



Source: Digital Transformation Initiative: Oil and Gas Industry, World Economic Forum white paper, January 2017, <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-oil-and-gas-industry-white-paper.pdf>

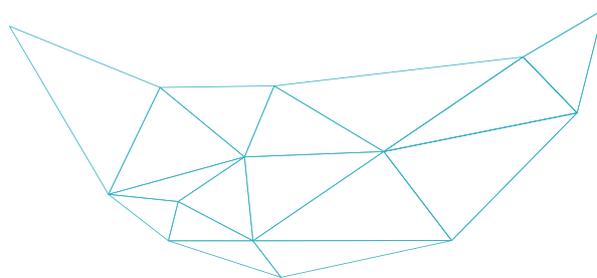
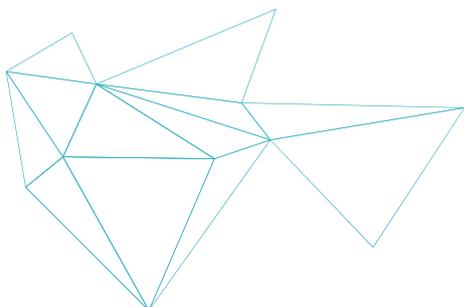
According to Richard Teng, CEO of the Financial Services Regulatory Authority (FSRA) of Abu Dhabi Global Market (ADGM), the sustainable financing approach has gained significant momentum. The socially responsible investing market has grown by 200% over the past decade to a value of almost US\$23 trillion.

“As investor awareness around climate risk builds up, the sustainable finance market expands,” says Richard Teng. “Financial centres and policymakers have a key role in shaping and facilitating access and growth of green and sustainable financing for businesses, infrastructure and technologies. Financing these projects will not only help the economy and businesses, but also drives sustainable investment decisions and creates an ethical circle of economic growth.”

DRIVING RENEWABLES GROWTH THROUGH TECH INVESTMENT

Investment in technologies is creating mature renewable energy sources that are improving all the time. In solar, for example, photovoltaic cell architecture and storage equipment are evolving and becoming more efficient and cheaper. Each time the global solar-panel capacity has doubled, the cost of the panels has fallen by 26%, and solar capacity increased sevenfold in the 15 years to 2017.⁵ At scale, on- and off-grid solar is one of the most dynamic energy sources, thanks to investment and ongoing innovations.

At Softbank Energy, one investment priority is to accelerate how existing suppliers bring next-generation solar products to the market and look at technologies that are currently unbankable. “We’ll look at a thousand [technologies], intensively review a hundred, and pick 10 to test,” says CEO Raman Nanda. “We’ll test them for a year, and then we’ll help to commercialise them.”

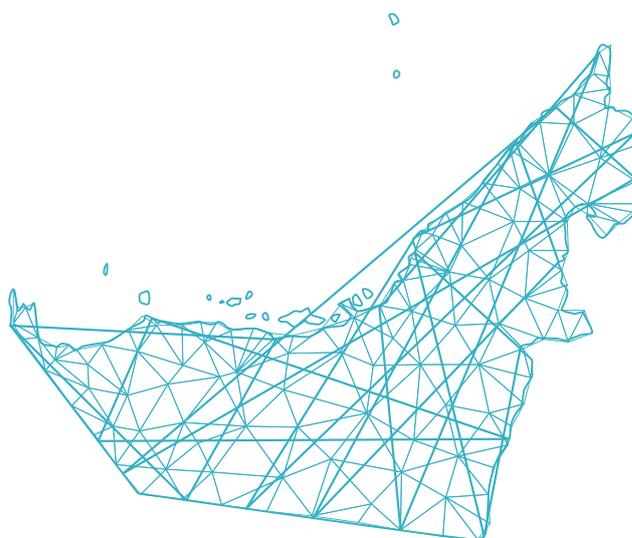


⁵ Digital Transformation Initiative: Oil and Gas Industry, World Economic Forum white paper, January 2017, <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-oil-and-gas-industry-white-paper.pdf>

A CLEANER, COLLABORATIVE FUTURE

Global CO₂ emissions were expected to increase by more than 2% in 2018 – the biggest rise in recent times.⁶ Reaching the goals of the Paris Agreement⁷ and truly transforming the global energy landscape requires more investment focused on electrification and decentralisation.⁸ Making those investments in good time demands that the global energy players collaborate.

Better industry collaboration is a goal that Softbank Energy is already working towards. “As well as tech investment, we also make ‘soft investments’ – investing in our team and practices,” says Raman Nanda. Effective collaboration, however, requires a collaborative environment to function seamlessly and productively for every stakeholder. That includes the policymaker and regulator involvement.



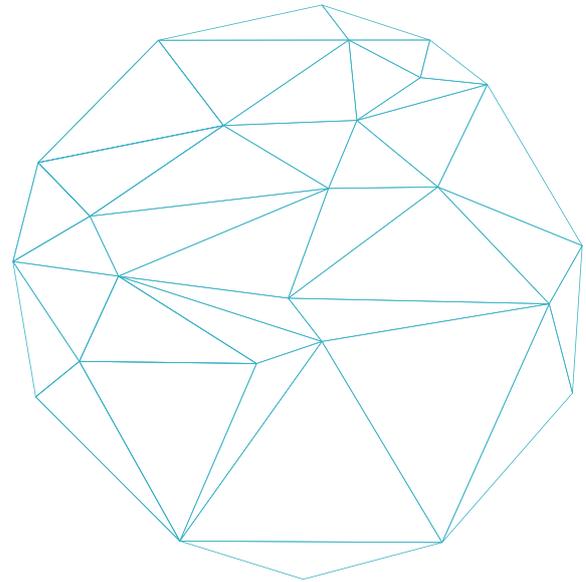
“Along with the industry, we engage policymakers to develop fair, transparent and robust regulation. This not only eases execution obstacles, but builds global investor confidence, unlocking new pools of capital. We also invest in building external relationships to better understand what our customers truly want and how best to meet their needs,” says Nanda.

⁶ Fostering Effective Energy Transition 2019, World Economic Forum, March 2019, <https://www.weforum.org/reports/fostering-effective-energy-transition-2019>

⁷ <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

⁸ Global energy transformation: A roadmap to 2050, IRENA, April 2019, <https://www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition>

“It is of fundamental importance that policymakers and governments set up an open, transparent and well-regulated environment with clear rules and guidance,” says ADGM’s Richard Teng. “It needs to enable all the various different players and stakeholders to operate, and the urgent sustainable projects like clean energy and many other vital industries need to be suitably financed and funded.”



Transforming global energy to reach the levels of sustainability demanded by the Paris Agreement and ever-rising temperatures demands significant attention from the industry.

Investments that build generation capacity in the renewables sector and encourage reduced demand are already making inroads. Now, a smart mix of investment and innovation is set to build on that progress and create the clean energy system we need.

GLOBAL ENERGY INVESTMENTS



US\$95 trillion: cumulative investments until 2050



US\$15 trillion: required scale-up of investments (16%) by 2050 in order to build a truly decarbonised global energy system

Source: Global energy transformation: A roadmap to 2050, IRENA, April 2019, <https://www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition>



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