

OMAN ENERGY MASTER PLAN 2040

FIVE YEAR CAMPAIGN SERIES

2016-2021 FINAL REPORT



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Contents

- P.05** The Water-Food-Energy Nexus 2022
- P.25** Turning Climate Change Challenges into Opportunities 2020
- P.35** How to Accelerate Oman's Energy Transition? 2019
- P.51** Future of Work & Work of the Future? 2018
- P.71** Narrowing the Gap Between Industry & Academia R&D 2017
- P.94** Oman Energy Master Plan 2040 Draft Report 2016



A Gulf Intelligence Special Report



Oman Energy Master Plan 2040



شركة تنمية نفط عُمان
Petroleum Development Oman



OMAN ENERGY MASTER PLAN 2040
Special Report Part V

Whitepaper

2022

The Water-Food-Energy Nexus *How to find Sustainable & Holistic Solutions for Oman?*



الجمعية العمومية للخدمات النفطية
Oman Society for Petroleum Services



شركة تنمية نفط عمان
Petroleum Development Oman



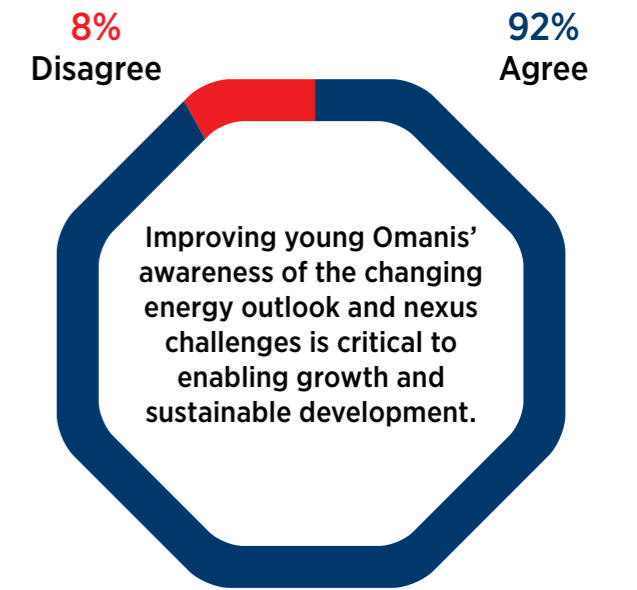
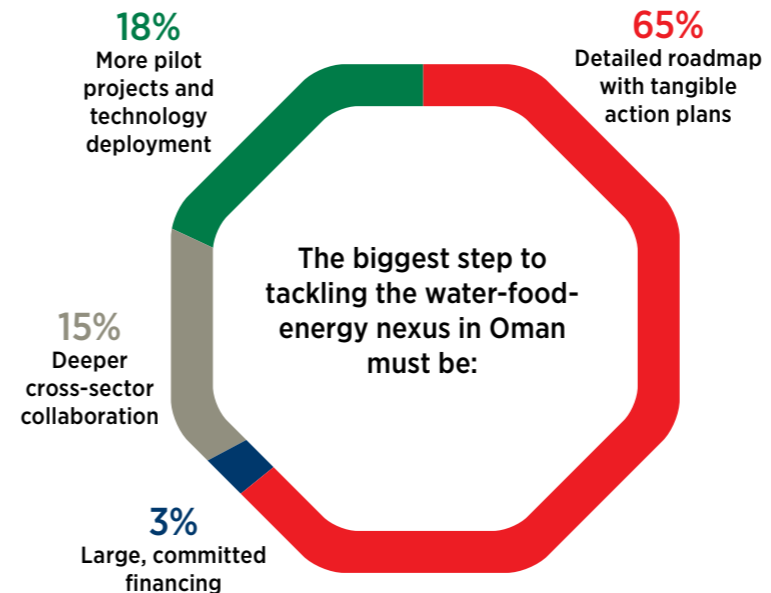
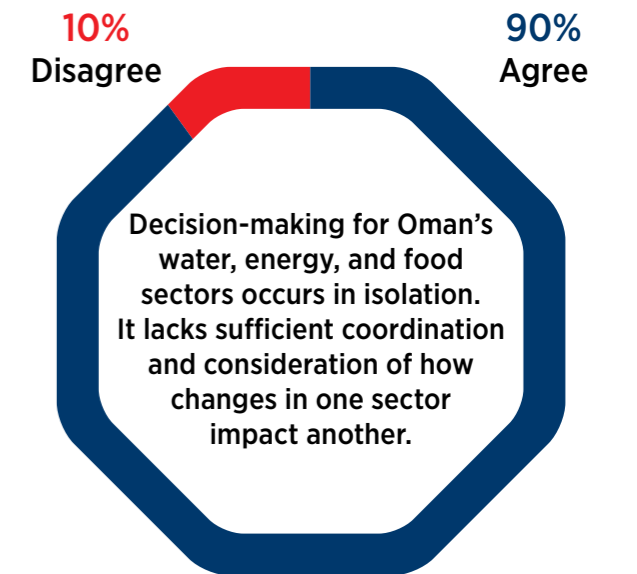
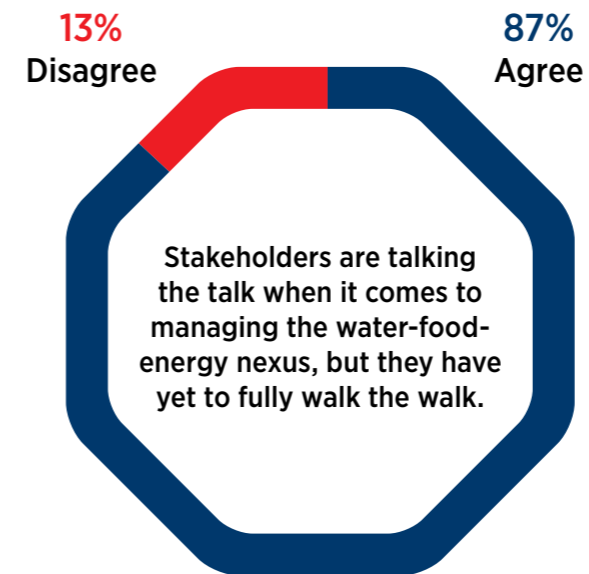
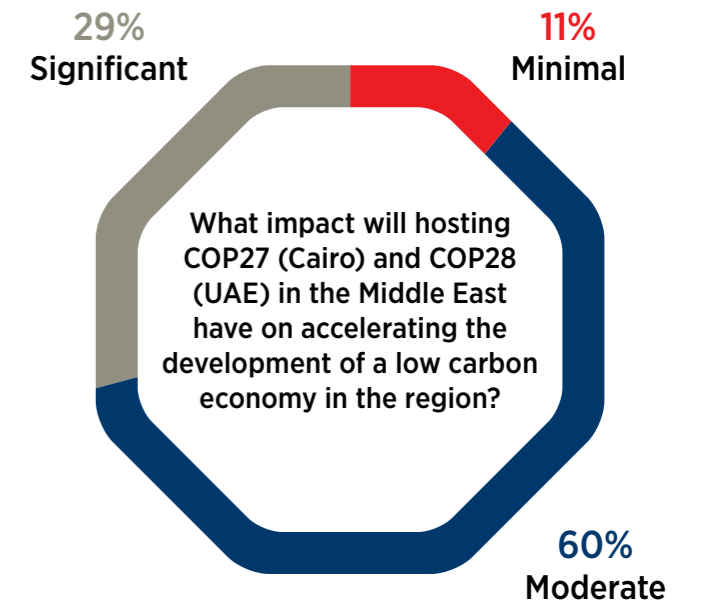
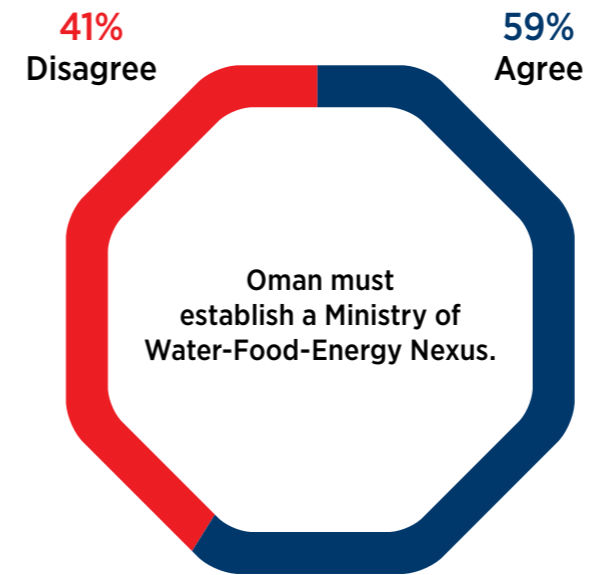
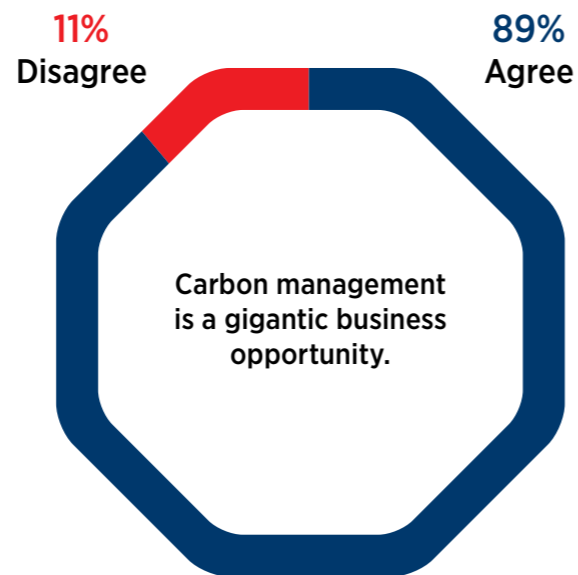
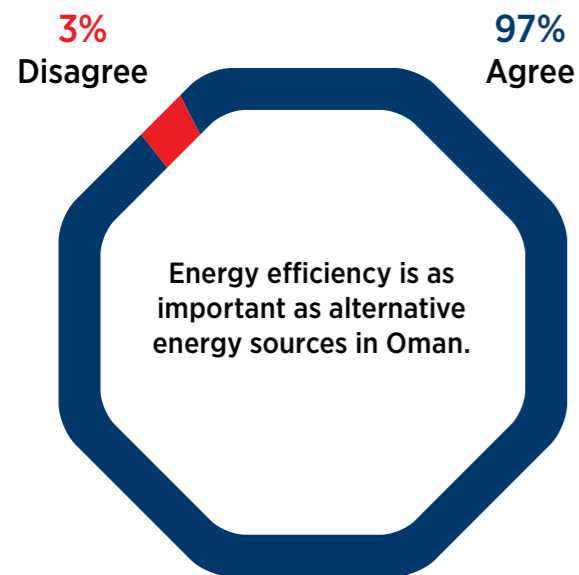
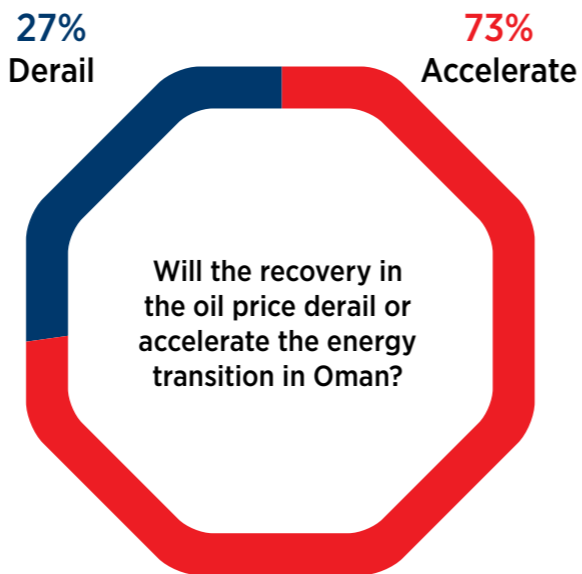
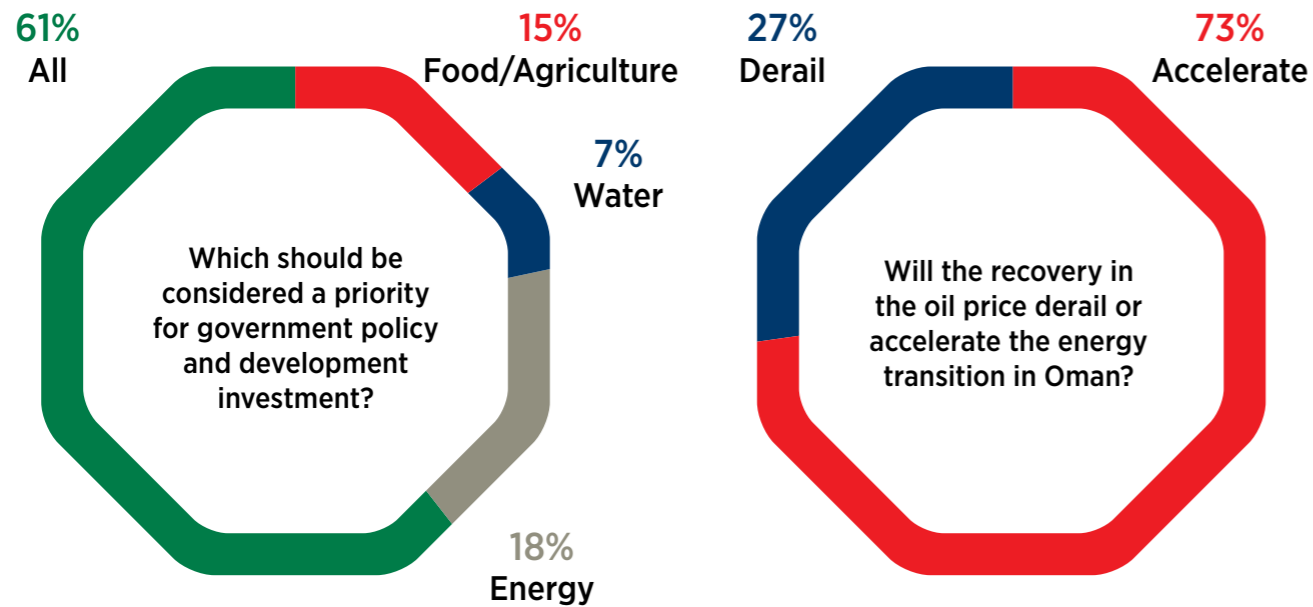
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WHITEPAPER REPORT - OMAN NATIONAL SURVEY

What is the Status of Oman's Nexus?



INSIGHTS

People, Planet, Profit

How can the energy industry swiftly adopt a sustainable strategy to cater to this triple bottom line?

People, planet and profit: the new bottom line of the 21st century. Achieving this new balance will take time and effort from all quarters in Oman, but it is certainly achievable. Necessity is the mother of innovation – a premise often proven true in the Sultanate’s fossil fuel industry and one that must again come into play. A penchant for innovation has enabled Oman to leverage its particularly challenging and mature oil fields, including ground-breaking solar-powered EOR projects. That same spirit must be applied to

hitting this new bottom line in the 2020s in order to achieve social, climate, and economic security by 2040 and beyond. We must acknowledge how vastly complex and interconnected this nexus is; it touches upon every area of society, environment, and businesses. Absolute application will take time and novel thinking. Equally, all actors must remember that time is short, as encapsulated by one roundtable participant: “We are now one minute from the clock striking midnight.”

“We must recognize that responding to the “people and planet” part of this nexus may mean compromising the profit part. Equally, remember that alternative markets – hydrogen, solar, circularity, and more – bring their own long-term economic opportunities and very importantly, job creation.”

65%

carbon pricing initiatives exist worldwide,¹ representing a “very big piece of the glue that holds the people-planet-profit nexus together,” one roundtable participant said. Oman is exploring a tradeable energy credit plan.²

\$50trn

of global assets will be for environmental, social, and governance (ESG) purposes by 2025, reshaping the world’s \$140.5trn assets under management.³ Accordingly, Omani stakeholders must embrace ESG quickly, for such credentials will start to directly impact their ability to lock in competitively priced financing.

8.6%

of the world’s operations are currently circular. Clearly all nations, including Oman, have a long way to go – but the reward is worth it. Having a circular economy can yield up to \$4.5trn in economic benefits by 2030.⁴

¹World Bank; ²PwC; ³Bloomberg Intelligence; ⁴World Economic Forum

TOP TAKEAWAYS

Circularity works

The colossal importance of designing a circular economy cannot be overlooked: it plays a central role in achieving the people-planet-profit equilibrium. For one, the current level of waste in the global system can grind progress on this nexus to a halt all on its own, regardless of other pressures. The good news is that Oman is making meaningful inroads, with its journey so far including the opening of six investment opportunities linked to waste-to-energy (WTE) and waste reprocessing – with investments totalling OMR580mn (\$1.5bn).¹ Plus, PDO has installed thousands of solar photovoltaic (PV) panels at its car parks at Mina Al Fahal to supplement the power used in its headquarters at Muscat. The 5.92 MWp (megawatt peak) solar car park project will generate around 9,500,000 kWh/yr of solar electricity and save 42,000 m³/d of gas that would otherwise be burned to generate the same electricity. The solar electricity generated from the rooftops of the car parks will be connected to three of the main office buildings and feed into the domestic grid at off-peak time.² Other efforts in Oman include rethinking waste when drilling with oil-based mud (OBM). These wet cuttings are transported by BDHL subcontractors to PDO’s waste management yards, where they are stored and dried before being treated in a traditional process that is both expensive and energy intensive. In 2016, BDHL said it wanted to transport semidried OBM drill cuttings to the coast near Muscat to be turned into cement for use in Oman.³

Build food-water alliances

Plans must put a far stronger spotlight on water and food security – both fundamental building blocks to a circular economy and in turn, the people-planet-profit nexus. According to one ranking, Oman ranks 40th out of 113 nations in terms of strong food security,⁴ and it is one of the world’s most water-stressed nations. Water and food security are sometimes seen as a hindrance to the broader goal of decreasing CO₂ footprints, roundtable participants said. This attitude must change. Gas was long seen as a waste product. Now it is one of the world’s biggest commodity markets and a critical “bridge” between fossil fuels and renewables in the global

“Combined, industries’ knowledge stretches into thousands of years’ worth: it should be leading the development of this people-planet-profit nexus, not following it.”

energy transition. There is no reason why the water-food nexus cannot follow a similarly positive track, thereby supporting the broader people-planet-profit nexus. Some progress is already underway. For one, PDO agreed with the Agriculture Production and Marketing Company (APMC) in September to plant crops and 500,000 trees over the next decade, focusing on a 35km² tract of land at Rahab in the south of PDO’s concession area.⁵

Leverage industry’s know-how

Rethinking the role of industry is essential: they are allies, not culprits. Oman’s industries hold vast knowledge when it comes to energy management, environmental initiatives, talent management, nationalization efforts, safety management, and a plethora of other areas. Combined, industries’ knowledge stretches into thousands of years’ worth: it should be leading the development of this people-planet-profit nexus, not following it. Those who move quickly can hugely benefit, diversifying their energy baskets to lock in more revenue streams over the long-term. Those who do not risk being alienated. One roundtable participant said a major aluminum smelter in the UAE has already had their product excluded from certain markets due to its large carbon footprint.

Everyone, together

Part of achieving this nexus means “looking beyond the government’s role” in the Paris Agreement (ratified by Oman on April 22, 2016⁶). Instead, holistic efforts are pivotal to driving progress, notably a stronger public-private-society nexus. Looking ahead, far greater political support is needed to reinforce this regulatory framework and in turn, boost investors’ visibility and appetite. This feeds into bolstering the talent pool and more effective R&D to scale-up existing technologies and explore new innovations.

¹Oman Observer, Zawya; ²DHL; ³DHL; ⁴Global Food Security Index; ⁵Petroleum Development Oman (PDO); ⁶United Nations Framework Convention on Climate Change (UNFCCC)

INSIGHTS

Water Technologies

What technologies have the potential to change the face of renewable desalination and water reuse?

Oman faces an increasingly worrying water shortage – and it is not alone. Up to 70% of the Middle East and North Africa (MENA) is exposed to high or very high water stress and water scarcity. This could affect up to 14% of the region’s GDP by 2050.¹

As a nation partly formed by a desert landscape, Oman must balance high water consumption and a growing population and prospering industry with a natural water shortage, unsustainable groundwater use, and historical subsidies. It is a challenging blend. Therein lies the ally of technology: helping balance these intensifying pressure points to safeguard both water and economic security.

But it is equally important to remember that investing in technologies to create greater water supplies can “give a false sense of abundance and, paradoxically, this can encourage unnecessary water use,” a roundtable participant warned. Therefore, instilling new technologies alone will not work. Deep-rooted change must run in parallel with technological deployments. This includes reshaping society and industries’ view of water consumption. Amid the current unknowns, one point is undeniably clear: the complexity of upgrading renewable desalination and water reuse is matched by its urgency.

“We survived millennia without electricity, but we can only survive seven days or so without water. We must take its protection more seriously.”



16,000

desalination plants operate in 177 countries, producing a volume of freshwater equivalent to almost half the average flow over the Niagara Falls.¹ Improving the environmental credentials of these – i.e., via renewably powered desalination – will be increasingly key in the 2020s.

2021

is the first time the Omani government started reducing water subsidies, supporting a much-needed rise in awareness. In the country’s 2020 budget, subsidies for water and electricity totalled \$1.95bn.²

72%

of all water withdrawals worldwide are used by agriculture, 16% by municipalities for households and services, and 12% by industries.³ Therein lies the importance of holistic efforts to address the challenge.

2.3bn

people live in water-stressed countries, of which 733mn live in high and critically water-stressed nations.⁴ Lessons learned in Oman can be exported to others in need, thus supporting the Sultanate’s National Vision to become a knowledge-based economy and exporter.

3

liters a day of water can be saved by simply fixing a leaky tap.⁵ Consider that all the taps in the Sultanate – an average of three per person – amount to 15mn taps saving 3 liters of water every day, which means up to 45mn liters of water could be saved every day in Oman alone. To put that into context, that is the equivalent to the water used to fill 18 Olympic-sized swimming pools⁶ every day – and 6,570 pools over the year.⁷

225

liters of water can be saved in just 15 minutes when you use a watering can to water your garden instead of a hosepipe.⁸

90%

less water can be used by leveraging aquaponics versus traditional farming.⁹

95%

less water is used in vertical farming than in traditional farming practices.¹⁰

¹ United Nations (UN); ² Bloomberg Intelligence; ³ UN-Water 2021; ⁴ UN-Water 2021; ⁵ Anglian Water; ⁶ Phinizy Center for Water Services; ⁷ Gulf Intelligence; ⁸ Anglian Water; ⁹ Farming Aquaponics; ¹⁰ EIT Food

TOP TAKEAWAYS

Knowledge is power

Oman must use technology to better account for its water: to understand where it is, how much there is, how it can best be used, who is using it, and so on. Only then can the Sultanate create measures to reuse wastewater and invest the right resources – finances, time, talent – into more renewable desalination technologies. Part of building transparency means leveraging the digital toolbox of the 4th Industrial Revolution (4IR), such as sensors, predictive analytics, big data, Internet of Things (IoT), and digital twins. Such aids can also be applied to modernizing agricultural navigation and better mapping groundwater reserves, for example.

Utilize the sun

Solar-powered desalination systems have the potential to sustainably create freshwater from seawater on an industrial scale with a carbon neutral offering² – arguably making it well-suited to Oman’s 1,700km coastline.³ For one, Oman has launched a pilot project at a farm in the Suwaiq wilayat in the North Al Batinah Governorate to desalinate seawater with the use of solar power in a project sponsored by the Korean Ministry of Environment, within the framework of the Korean-Omani cooperation.⁴ Usually the reverse osmosis process utilizes a large amount of electricity, but this device can reduce the cost of electricity to be cost effective, producing 32 tons of fresh water per day (8 hours) using just 56 KWts of electricity. The system has the capacity to produce PV energy of 350KW in 8 hours, so the excess electricity can be used for other purposes – which also supports Oman’s circularity principles.⁵ Many more efforts of this like are needed across the Sultanate – home to strong sun and winds – as many desalination processes carry an environmental toll. In most desalination processes across the globe, every liter of potable water creates about 1.5 liters of liquid polluted with chlorine and copper. This wastewater is twice as saline as ocean water and if not properly diluted and dispersed, it may form a dense plume of toxic brine which can degrade coastal and marine ecosystems.⁶ Consequently, Oman must not only make its desalination production processes more renewable, but its entire value chain.

“Public awareness is extremely important. Even just turning the tap off when brushing your teeth saves more than two full buckets of water per person every day.¹² That amounts to at least 10mn buckets of water saved every day in Oman, 70mn a week – and an astonishing 3.6bn buckets of water saved every year, just from a tiny change.”

Spotlight on groundwater

Up to 75% of water use in Oman is from groundwater; water that is stored in and moves slowly through geologic formations of soil, sand, and rocks called aquifers.⁷ With Oman’s water shortage, attention is fast focusing on how best to understand and manage groundwater. This is easier said than done, for groundwater is largely “invisible”; tracking it is far harder than other water sources. One solution is working more closely with the oil and mining industry in Oman. Years of geological study and exploration means Oman’s oil industry – which underpins the largest non-OPEC producer in the Middle East – has a strong understanding of the Sultanate’s hydrogeology. Using this intel alongside other agencies, academia, and government can enable the right technologies to be used at the right points in the value chain. In turn, this will proactively reduce misalignment and cut waste.

Focus on growing sectors

Rethinking normal water use practices in all sectors is crucial, but especially those experiencing significant growth. For example, Oman reported 9.85% growth in its agricultural industry in 2020.⁸ While positive news, it equally requires careful examination of water resources and waste. Agriculture is the largest consumer of the world’s freshwater resources.⁹ Consider that it typically takes between 3,000 and 5,000 liters of water to produce 1kg of rice and 2,000 liters for 1kg of soya, plus 500 liters for 1kg of potatoes.¹⁰ Over the long-term, Oman’s efforts to readdress this water-food balance “at home” can



support its goal to become a knowledge-exporter internationally. For one, irrigated areas in sub-Saharan Africa are expected to more than double by 2050. This will benefit millions of small-scale farmers, but 41% of current global irrigation water use occurs at the expense of environmental flow requirements.¹² Oman can help these nations and others find the right balance, which would also reaffirm its environmental know-how on the global map.

Start small, achieve big

Each member of Omani society must play a proactive role – from households, to farmers, to businesses, academia, government, and everyone in between. Even just turning the tap off when brushing your teeth saves more than two full buckets of water per person every day.¹² That amounts to at least 10mn buckets of water saved every day in Oman, 70mn a week, and an astonishing 3.6bn buckets of water saved every year – just from a tiny change. Having every aspect of society involved in the conversation will help the government pin down the areas of greatest need, be it in rural areas not wholly supported by desalination or in more urban areas that are reporting the greatest population growth.

Areas to watch

Harvesting water directly from the air is an area roundtable participants described as “promising”, as are more nature-based water management techniques. For example, the green technology of Constructed Wetlands often means few mechanical parts, limited maintenance, limited need for specialized staff, reduced GHG emissions, minimum energy consumption, and no harmful by-products, for example.¹³ Oman must also further explore how technologies can help with the green principles of ecological engineering, technologies for urban and rural water management, sustainable urban drainage systems, and natural flood management. The same applies to investigating better ways to manage ecosystem restoration and environmental connectivity and wildlife corridors.¹⁴ This all also encompasses the importance of broader environmental protection – as per the 21st century mantra of people, planet, and profit.

¹ World Bank; ² Solar Water; ³ Canvas; ⁴ Utilities Middle East; ⁵ Zawya, Oman Observer; ⁶ United Nations; ⁷ Groundwater Foundation; ⁸ Oman Observer; ⁹ United Nations; ¹⁰ WWF; ¹¹ Food and Agriculture Organization of the United Nations (FAO); ¹² Anglian; ¹³ Research Gate, Closed Cycles and the Circular Society’ Symposium 2020, Technical University of Crete; ¹⁴ Cranfield University

INSIGHTS

Circular Economy

Best approach for Oman to create a sustainable nexus?

“We are still in Chapter One of this story,” described one roundtable participant. **Achieving this nexus is a complex, nuanced, and ambitious road – but it is also a non-negotiable one.** Oman currently faces significant challenges in its adaptation to and mitigation of climate change. It lies in a region that is among the most vulnerable to climate change and it faces water scarcity, rising food and energy demand – all important inputs into society that need careful and progressive management. For now, this mix is exerting increasing pressure on Oman’s resources, ecosystems, and talent pool. Identifying approaches to reduce cross-sectoral strain of this water-food-energy nexus is a decades-long overhaul: Oman must pick up the pace now.

“We must rethink the way we have done things over the last hundred years. It’s a big ask – but there’s no choice.”



1992

saw the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal come into play, with the support of Oman from 1995.

9mn+

per year deaths occur worldwide due to air, water, and soil pollution – equivalent to nearly double the size of Oman’s population.

100bn+

tons of resources enter the economy every year – everything from metals, minerals, and fossil fuels to organic materials, like plants and animals. Yet just 8.6% is recycled and used again.

54mn

tons of electronic waste (e-waste) are generated worldwide every year, with just 17.4% collected and recycled. Oman’s high digital penetration rate (95%) means the Sultanate has the expertise to help be part of the solution.

1.5

Earths are needed in terms of resources by 2050 if we do not change how we live.

300mn

tons of plastic waste are generated worldwide every year, equivalent to the weight of the entire human population of 7.8bn people. Even taking a very relatively small step – such as reusing the thousands of plastic water bottles discarded in Oman every day – will improve the Sultanate’s contribution to this figure.

45%

of global GHG emissions come from product use and manufacturing, as well as food production. Circular economy strategies can cut these by 39%, helping avert the dangerous impacts of climate change.

Sources: UN Basel Convention; World Resources Institute (WRI); Datareportal

TOP TAKEAWAYS

Localization works

“It doesn’t make sense to move raw materials halfway around the world and then ship the finished product halfway around the world again,” one roundtable participant stressed. Accordingly, Oman must focus more on localized solutions: local production, local talent, local off-takers. In part, this means moving away from the dominant centralized system, where there is one supplier of power, one supplier of fuel, one supplier of water, and so on. Deregulation of these key components will foster a more competitive environment – critical to instilling circularity principles. This model also empowers communities to take a proactive stance, as is seen in Singapore, roundtable participants pointed out. The state rezoned its urban areas to create a community-centric management system, with circularity at its core.

Boost visibility

We can only track and mitigate what we know. Therefore, Oman must invest more resources – time, money, talent – into identifying the prime areas of circular potential across its society and businesses. Effectively pinning down and then tracking these points enables the Sultanate to craft roadmaps to instil tangible change in the next few years. Such efforts are paying off in Abu Dhabi, roundtable

“We tend to look at the energy sector, the food sector, and the water sector as individual areas. This traditional approach will no longer work. Why? Because we must think holistically to achieve a circular economy.”

participants shared. Any restaurant and hotel in the Emirate that does not participate in efforts to recycle their cooking oil into biofuels is subject to fines or a suspension of their trade license. This system is driving positive change, but it has only been possible because Abu Dhabi invested in technological resources to track the waste.

“Waste” doesn’t exist

What is commonly referred to as “waste” should be recategorized as “raw material” and it should certainly stop being exported overseas, as this means the Sultanate loses the in-country value (ICV) of redeveloping this product and creating much-needed jobs. Turning these waste items into resources requires an enabling regulatory framework. Some efforts are already underway, such as higher taxes on the export of cooking oil waste. The pressure to change is truly on, as described by Waste Dive:



“When trash is packed into a pile, the oxygen-free environment supports bacteria that thrive in those conditions. As the microbes degrade the waste, they release CO₂ and methane. The latter is 84 times more potent of a global warming agent than carbon dioxide in the first 20 years of its release.”¹

The right push-pull

Pinning down a balance of incentives and disincentives is key. For the former, this includes making it easy for investors to support recycling and reuse policies. For the latter, there should be costs associated to the disposal of non-necessary waste. For example, textile production (including cotton farming) uses almost 100bn cubic meters of water per year – approximately 4% of global freshwater withdrawal. At the same time, people worldwide throw away still-wearable clothes worth an estimated \$460bn each year.² Being charged every time a textile item is unnecessarily discarded is one route to encourage society to rethink their

consumption choices. The same mentality applies to kitchen cupboards and fridges. Nearly one-third of all food produced is wasted and that food waste continues to be the top product found in landfills.³ Circularity principles offer a here-and-now solution to address this inefficiency, but implementing it requires a fair yet effective blend of incentives and disincentives.

Embrace hearts and minds

Inspiring Oman’s large population of youth to learn, act, and innovate to support the water-food-energy nexus is an invaluable step in the 2020s. Crafting stronger ecosystems for training and job opportunities to help unleash more entrepreneurship is very important. It also helps youngsters in classrooms and the workplace to “see” a career in this field, which feeds ICV back into the Omani community. Already more than 78,000 youth in the 18-29 age group work in private sector companies, constituting 49.4% of the work force in Oman.⁴

¹World Economic Forum (WEF), Waste Dive; ²World Resources Institute (WRI); ³United Nations (UN); ⁴National Centre for Statistics and Information (NCSI), Muscat Daily



What is a circular economy?

We must transform every element of our take-make-waste system: how we manage resources, how we make and use products, and what we do with the materials afterwards. This is what will create a thriving circular economy, which can benefit everyone in Oman and beyond. A circular economy provides tools to tackle climate change and biodiversity loss together, while addressing important social needs. It also generates prosperity, jobs, and resilience while cutting GHG emissions, waste, and pollution. Other definitions incorporate carbon. For example, Saudi Aramco describes a circular carbon economy as a closed loop system for managing and reducing emissions, involving 4Rs: reduce, reuse, recycle, and remove.

Sources: Ellen MacArthur Foundation, Saudi Aramco

INSIGHTS

Collaboration

How to foster deeper collaboration between Oman’s food-water-energy sectors to streamline nexus targets and spur innovation?

Two heads are better than one, as the adage goes. This point is amplified when merging companies’ intellectual resources to strengthen this critical water-food-energy nexus. The multifaceted and nuanced nature of this challenge means “all hands are needed at the pump,” as one roundtable participant described. But the effort will reap countless rewards for society, the planet, and businesses. While Oman’s journey is still in its infancy, significant progress is being recorded.

Innovation Park Muscat, Oman’s newest and most ambitious science and technology development, is one such example, with a focus on energy, water and environment, food and biotechnology, plus health.¹ Collecting cross-sector intel “under one roof” is invaluable to fluidly sharing knowledge and identifying solutions that support all sectors – i.e.,

holistic problem-solving. Ejaad is another valuable example of collaborative efforts that have made tangible progress in Oman. This membership-based virtual platform enables industry, academia, and government to interact and engage in energy-related research and innovation activities.² It works as an enabling marketplace to connect academic research and know-how to industry needs, and vice versa on focus areas: Energy, Oil & Gas, Renewable Energy, and Water. The Ministry of Higher Education, Research, and Innovation is also getting ready to set up a unified digital platform.³ These are just some of the actions underway. Many others are being rolled out across the Sultanate, including research into using nanotechnology for desalination and building state-of-the-art housing to test renewable water methods and energy efficiency.⁴

“One of the great challenges in Oman is balancing government intervention against effective market operations.”



\$1.2bn

will be invested by the OFIC in strategically significant food-related projects up to 2027.¹

33%

of the food for global human consumption every year – approximately 1.3bn tons – is lost or wasted.⁴ Far greater efforts are needed in Oman and beyond to dramatically reduce this percentage.

164.3

points out of a maximum 300 on the Water-Energy-Food (WEF) Nexus Index in Oman are divided by: 42.7 points for Water, 63.2 points for Energy, and 58.4 points for Food.²

\$12trn

bill every year in global health, economic, and environmental costs from the global food system. This equates to 20% more than the market value of the world’s actual food systems.⁵ Especially amid the economic strain caused by Covid-19, Oman must reduce its share of losses within this equation.

\$700,000

cash reward was offered to the winner of the Oman Humanitarian Desalination Challenge, a global water prize seeking the delivery of a low-cost, stand-alone, hand-held desalination device. The device must be suitable for short-term use and rapid deployment during humanitarian crises.³ Such calls for collaborative innovation will increase as the Sultanate works to inspire its population to “think out of the box” to support this critical nexus.

50%

of all carbon emissions released by human activity by 2050 will be generated by our food industry, unless more steps are taken to reduce its environmental impact.⁶ As more companies set climate mitigation targets, uniting efforts to address this nexus will feed directly into CO₂ management as well.

¹ Oman Observer; ² WEF Nexus Index; ³ Oman Humanitarian Desalination Challenge; ⁴ UNEP; ⁵ World Economic Forum (WEF); ⁶ Eat Forum

TOP TAKEAWAYS

Commit to deploy

A win-win factor must lie at the core of every collaborative effort, especially as companies face increasing environmental, economic, and social pressure. Robust commercial viability must be evident from the outset. Part of this is ensuring a commitment to deploy, for poor tangibility means a collaboration risks “being a nice project that doesn’t make a difference,” a roundtable participant warned. The same importance applies to scalability, as collaborative efforts cannot be limited to small or medium-sized scales. The gravity of the climate challenge means the vast majority of solutions must inevitably be ramped up without weakening the economic equation.

Clearer government goals

All three sectors – water, food, and energy – tend to have large external costs and influences and it is the “function of government to internalize those,” a roundtable participant said. European governments’ ability to do this is a large reason the continent has one of the world’s fastest transitions towards a strong water-food-energy nexus and low carbon growth. Accordingly, the government in Oman needs clearer objectives. Equally, the complexity of this balancing act means such clarity cannot be achieved overnight. Some stakeholders in the

“Companies with huge operations – like Amazon – have nailed the efficiency factor. We must look at how other sectors operate and pin down commonalities. Then we can apply it to our nexus in Oman.”

food sector may want cheaper water so they can affordably grow more produce, yet getting more water at an affordable price also carries longer-term environment risk, i.e., the risk of contaminated water, unsustainable subsidies, and excessive use. By supporting one sector (food), another is jeopardized (water), which is why great care is needed. One route is to create a performance-based system that encourages sustainable methods, while providing an economic safety net – not necessarily subsidies, but competitively priced loans and grants – for those more vulnerable.

Learn from others

The US has adopted a “use it or lose it” water policy in parts of its agricultural sector, with any unused water removed from farmer’s allocation the following year. Another water management tactic is using land size to determine the volume of water allocation,



“It’s not just about solving problems – it’s also about being a problem-solver. Technology is moving at warp speed and it’s an excellent enabler that we must use far better.”

roundtable participants said. Both strategies have improved water management processes so far, as did an endeavor in San Joaquin County in California, an established farmland community. Local operators there identified dead zones due to contaminated water and decided to tax those using certain fertilizers and pesticides, or excessively using them, another roundtable participant detailed. Again, the tax worked as the farming community became better stewards of fertilizers and pesticides, leading to cleaner water supplies.

Explore vertical farming

The value of the global vertical farming market is expected to reach \$17.59bn by 2028 – a vast increase on the \$3bn this year.⁵ The anticipated growth is easily explained by the potential benefits. Every square meter of floor space of vertical farming produces

approximately the same amount of vegetable crops as 50 square meters of conventionally worked farmland, which in some places also reduces deforestation and supports soil restoration. A vertical farm is able to use 95% less water (because it is recycled) and the indoor production means virtually no herbicides and pesticides are used. It also supports the continuity of food security because vertical farming enables year-round cultivation.⁶ Oman’s first foray into vertical farming is being considered by the OFIC, the government’s food sector investment and development arm. A portfolio of new projects up to 2026 are expected to include the first ever commercial-scale project. In its pre-feasibility phase, the initial project cost is estimated at OMR10mn (\$26mn).⁷ This is a good start, but the multitude of benefits of vertical farming means Oman must significantly scale up its efforts.

¹ Innovation Park Muscat; ² Ejaad; ³ Muscat Daily; ⁴ Roundtable participant; ⁵ Fortune Business Insights; ⁶ Vertical Farming Institute; ⁷ Oman Observer

ACTION PLAN

How to find Sustainable & Holistic Solutions for Oman to Achieve Water-Food-Energy Security?

Top 10 Recommendations to Execute

These top recommendations have been extracted from the open discussions and opinions shared by all the high-level stakeholders involved in the event. They aim to give a holistic and cross-complementary overview of the next best steps to strengthen the water-food-energy nexus in Oman in 2022 and beyond.

	Champion	Support		Champion	Support
<p>1. Establish a unifying body Efforts to improve the water-food-energy nexus are mostly siloed. An overarching framework that is created, monitored, and updated by the collaborative spirit of representatives of all three sectors would bolster knowledge-sharing, strengthen risk mitigation, and boost innovation. As the adage goes: “Many heads are better than one.” A unifying body would also make Oman’s international offering more competitive and it would help the Sultanate attract more international business. Governmental participation is paramount.</p>			<p>6. Track and map groundwater A greater understanding about the nation’s groundwater reserves will help Oman accurately track, map, and plan its water management processes. With 90% of the Sultanate’s water generated by desalination technologies, more resources must be allocated to preserving natural supplies.</p>		
<p>2. Identify clear objectives The complexity of the nexus’ balancing act cannot be underestimated. For example, some stakeholders in the food sector want cheaper water to grow more produce at a more competitive rate. But greater, cheaper volumes of water can incur longer-term environmental risk, i.e., the risk of contaminated water, poor pipeline maintenance, unsustainable subsidies, and excessive use. In this scenario, supporting one sector (food) jeopardizes another (water). Clear objectives that do not clash between the sectors is essential – all must thrive in parallel.</p>			<p>7. “Waste” is no more What is commonly referred to as waste should be recategorized as raw materials, as per circularity principles. It should not be exported and instead redeveloped within Oman to enhance the Sultanate’s in-country value (ICV). This creates much-needed jobs, spurs innovation, and dramatically improves the country’s environmental and social credentials.</p>		
<p>3. Establish joint strategies The Oman Investment Authority oversees most of the nation’s agriculture and fishery products and the Ministry of Energy and Minerals oversees the oil and gas sector. Going forward, these bodies can work more closely together, perhaps under a unifying body (see Recommendation One) to develop joint policies that create a circular value chain.</p>			<p>8. Build public buy-in Greater public awareness is key to gaining Omanis’ support for strategies that will strengthen the nexus, such as removing subsidies. This is especially crucial for Oman’s large youth population. Crafting stronger ecosystems for training and job opportunities will help unleash more entrepreneurship and enable youngsters in classrooms and the workplace to “see” a career in supporting the nexus, which also feeds ICV back into the community.</p>		
<p>4. Invest in local circularity Water, food, and energy systems must be redesigned towards a circular system. This must also promote local solutions: local production, local talent, and local off-takers. In part, this means gradually transitioning away from the dominant centralized system, where there is one supplier of power, one supplier of fuel, one supplier of water, and so on. Deregulation will foster more competitive environments that can drive innovation and circularity – ultimately creating a healthier nexus.</p>			<p>9. Increase alliances’ accountability Commercial viability must be evident from the outset of every collaborative effort – the win-win matters. Part of this means ensuring a commitment to deploy, for poor tangibility means a collaboration risks “being a nice project that doesn’t make a difference to the nexus,” as encapsulated by one energy stakeholder. The same importance applies to scalability, as collaborative efforts cannot be limited to small or medium-sized scales. The urgency of improving Oman’s nexus means the vast majority of solutions will inevitably be ramped up – and must do so without weakening the people-planet-profit equation.</p>		
<p>5. Elevate industries’ role The combined experience of industry in Oman equates to thousands of years’ worth of knowledge that can be pivotal in helping the Sultanate create a robust nexus. Among the many benefits, the energy industry can significantly aid hydrogeologists as they try to map groundwater. Plus, industries have digital expertise, as per the 4th Industrial Revolution, which can save each sector time and money over the long-term – both individually and collectively.</p>			<p>10. Leverage sector crossovers Oman can explore more accessible yet highly effective methods to reinforce the nexus in the short-term. For example, lessons can be learned from the Sultanate’s dairy business, which converts slurry into biogas to create energy. Stakeholders can also support the use of carbon capture and storage (CCS) in greenhouses to accelerate food growth or invest in vertical farming to dramatically increase food production while cutting water use by up to 90%.</p>		

Special Report: ACTION PLAN



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OMAN ENERGY MASTER PLAN 2040 *Turning Climate Change Challenges Into Opportunities*



Report – Executive Summary

FORUM WORKSHOP – 12 INTERNATIONAL FACILITATORS

More than 300 stakeholders from the Omani energy sector came together for a one-day brainstorming session at the 7th Gulf Intelligence Oman Energy Forum on Nov. 25th, 2019. The focus was to craft an Action Plan on how the energy industry could support the sultanate as it works to achieve its commitments under the Paris Climate Agreement. The 20-session Forum was facilitated by a team of a dozen international experts:

- Myriem Touhami, MENA Program Manager, Finance Unit, Energy and Climate Branch, UN Environment Program
- Andrei Marcu, Managing Director, Roundtable on Climate Change & Sustainable Transition
- Dr. Aisha Al-Sarihi, Research Associate – Climate and Environment Program, KAPSARC
- Dr. Rasmi Hamzeh, Jordan Renewable Energy & Energy Efficiency Fund, Ministry of Energy & Mineral Resources, Jordan
- Abdullah Maghrabi, Senior Engineer – Corporate Sustainability, SABIC
- Othman Benamar, General Manager – Engineering, GE Power
- Shelly Trench, Managing Director & Partner, Boston Consulting Group
- Dr. Dominic Emery, Vice President – Group Strategic Planning, BP
- Dr. Aisha Al-Sarihi, Research Associate, Climate and Environment Program, KAPSARC
- David Galea, Partner, Ince & Co.
- Katie McQue, Energy Correspondent, Energy Intelligence
- Sean Evers, Managing Partner, Gulf Intelligence

\$6trn.

This is the global economic value that can be unlocked by successfully adopting

the energy transition up to 2050, according to Abu Dhabi-based International Renewable Energy Agency (IRENA). This is thanks to the very recent reversal of the world's environment-economic narrative; a paradigm shift that will have ramifications throughout the 21st century (see: Low Carbon – A New Conversation). Within that \$6trn, opportunities to achieve *Oman's Energy Master Plan 2040* abound.

Oman's Next Move?

A coordinated, multisectoral, innovative and scalable effort. This is what Oman must rapidly embrace if it wants to unlock the economic and environmental opportunities of climate change up to 2040, as per the *Oman Energy Master Plan 2040* and the National Vision 2040. But an urgent education process is also needed. A staggering 74% of *GIQ* Industry Survey respondents said Oman's energy stakeholders are not aware of the low carbon targets included in Oman's Intended Nationally Determined Contribution (INDC), which was submitted to the United Nations as per the Paris Agreement. Of equal concern is that 86% said they do not see the action required to be confident that the INDC can be achieved.

The oil and gas market has been the wind in the sails of Oman's economic growth since the mid-1900s. But now a multifaceted energy basket offers a stronger, more sustainable future by utilizing



both fossil fuels and renewables. Meeting the sultanate's rising energy demand and environmental targets – all at an affordable cost – will not happen automatically. Mammoth efforts are required to sustain momentum, especially supporting more public-private partnerships (PPPs), strengthening In-Country Value (ICV), nurturing more foreign partnerships and leveraging digitalization, as per the 4th Industrial Revolution.

The sultanate's appetite for change is clear. It has made a good start leveraging its extremely fortunate geography and its progressive leadership is eager to ensure the words of the *Oman Energy Master Plan 2040* translates quickly into on-the-ground

#1

Energy Supply is one of the five themes in the *Oman Energy Master Plan 2040*. The top recommendation within this theme is: *Create, Adopt and Implement a Comprehensive Energy Action Plan that can Facilitate the Immediate Implementation of Renewables.*

Low Carbon: A New Conversation

Financial hurdles that long derailed global efforts for a lower carbon future are now emerging as financial opportunities; the foe has transformed into an ally. Today, embracing green growth (i.e. renewables, energy efficiency, circular economies) does not conjure fears of dwindling coffers and risk-hungry niche investors. The opposite is increasingly true. Global investment in new renewable energy capacity over this decade – 2010-2019 – neared \$2.6trn, detailed the *Global Trends in Renewable Energy Investment 2019* report. And up to 2050, solar power, wind power and batteries alone will attract \$10trn in investments worldwide, according to *Bloomberg's New Energy Finance*.

Efforts Must Accelerate – Now.

Nearly half (46%) of respondents to a *GIQ* Industry Survey agreed that failing to act on climate change over the next five years would be a major threat to Oman's energy and economic security by 2030. And global efforts so far are not enough – worryingly so. Even with the pledges made, the world is on track for between 3°C and 4°C of warming by the end of the century, according to the United Nations (UN). That is far above the 1.5°C of warming that a recent UN report warned would be devastating for the planet, triggering mass-scale food shortages, migration crises and fatalities. Imagine this global climate challenge is like the weather system; knowing no borders, all interconnected. By studying the weather, we can start to predict the next steps and use that information to apply solutions. That is the state of climate change: the more we learn, the more we can mitigate, the more we can prevent.



progress. This acceleration will be helped by the sultanate's vast potential for solar and wind power generation, as well as land availability for large-scale projects and supportive government policies and frameworks (i.e. the *Oman Master Energy Plan 2040*, the National Vision 2040 and commitments to the Paris Agreement and Kyoto Protocol). While Oman's goal to have 30% of its electricity demand generated by renewables by 2030 is ambitious, momentum for positive disruption makes it credible. For example, 41% of *GIQ* Industry Survey respondents agree that revising subsidies is critical to improve energy efficiency and generate funds for low carbon growth. They would be in favor of a monthly electricity bill to help combat climate change. The Structured Removal of Subsidies is the top recommendation of the theme on Energy Demand in the *Oman Energy Master Plan 2040*, illustrating the continuity of the sultanate's efforts.

You Must Spur Change

Energy stakeholders cannot make the mistake of thinking someone else in Oman is addressing the challenge. The efforts of every individual counts. Making the *Oman Energy Master Plan 2040* a reality – including low carbon growth – means identifying and committing to the recommendations that emerge from key industry gatherings, such as the 7th Gulf Intelligence Oman Energy Forum. Only with this robust and clear roadmap, will the goals of industry, government, academia and the public be aligned by 2040. Accruing knowledge and applying lessons learned in quick time is the foundation of the *Oman Energy Master Plan 2040* and thus, a low carbon future. Ensuring all the boxes are ticked is extremely challenging – but non-negotiable.

2040
Environmental and Natural Resources combine to make one of the four themes in Oman's National Vision 2040.

2
The theme of Environmental and Natural Resources has been broken down into two pillars. Broadly, one is ensuring ecological systems effectively protect the environment. The second is ensuring Oman has an efficient and responsible ecosystem i.e. effective oversight with a swift judiciary performance.

2005
Oman signed the Kyoto Protocol (broadly seen as the Paris Agreement's predecessor) on 9 January, 2005.

74%
of Oman's government revenues come from oil and gas, according to the national budget.

2016
The sultanate ratified the Paris Agreement on 22 May, 2019. The agreement is seen by many as the last hope for humanity to preserve the foundations for a healthy planet.

2%
In Oman's Intended Nationally Determined Contribution (INDC) as per the country's commitment to the Paris Agreement, the sultanate aims to achieve a 2% cut in greenhouse gas (GHG) emissions by 2030.

#1
Oman has the largest oil reserves of any non-OPEC country in the Middle East, according to the Gas Exporting Countries Forum (GECF).

74%
of Oman's government revenues come from oil and gas, according to the national budget.

50%
Oman seeks to escalate gas production, shifting its oil-gas production mix from 35% gas in 2015 to more than 50% in 2025.

0.3%
Following a recovery of 2.2% in 2018, Oman's real GDP growth is estimated to decelerate to 0.3% in 2019, according to the World Bank.

9mn
Oman's population is set to climb by 45% to 9mn people by 2050, forecast the UN.

5th
Global clean energy investments exceeded the \$300bn benchmark for the fifth consecutive year in 2018, reaching \$332bn, detailed Bloomberg New Energy Finance.



INDUSTRY SURVEY

Pursuing a Low-Carbon Economy?

Source: 350 Omani energy stakeholders participated in this exclusive survey in Q4, 2019, to help Oman build a roadmap towards a low carbon economy.

Omani energy stakeholders are sufficiently aware of the low carbon targets included in Oman's Intended Nationally Determined Contribution (INDC), which was submitted to the United Nations.

- A. Agree
- B. Disagree



The green economy could create more jobs in the Middle East than it destroys over the next 20 years.

- A. Agree
- B. Disagree



The President of Emirates Airlines, the biggest long-haul carrier, recently said that the airline industry was not doing enough to tackle climate change. Are we, in the Middle East energy industry, doing enough?

- A. Yes
- B. No



The energy transition and the Paris Agreement have the capacity to create more jobs than they destroy over the next decade to 2030.

- A. Agree
- B. Disagree



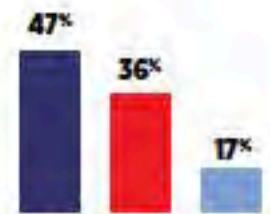
Nationally Determined Contributions (NDCs) represent the efforts of countries party to the Paris Agreement to reach the long-term goal of limiting global warming. Are you seeing enough action to be confident that this goal can still be achieved?

- A. Yes
- B. No



Which of the following stakeholders must lead in turning climate change challenges into economic opportunities?

- A. Government
- B. Industry
- C. Public/consumers



Oman will achieve its goal to meet 30% of electricity demand with renewable energy projects by 2030.

- A. Agree
- B. Disagree



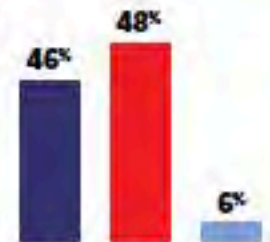
Putting a price on carbon is critical to achieving low carbon goals and spurring the green economy.

- A. Agree
- B. Disagree



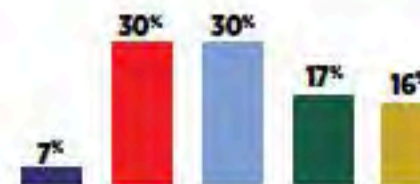
Failure to act on climate change over the next five years would be a _____ to Oman's energy and economic security by 2030.

- A. Major threat
- B. Minor threat
- C. Not a threat



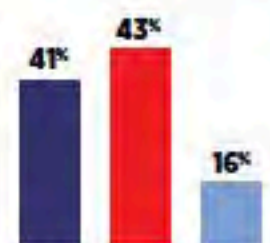
In its INDC, Oman committed to a 2% cut in GHG emissions by 2030. Which of the following could make the biggest contribution to meeting this target?

- A. Reduce gas flaring from oil industries
- B. Increase renewables in energy mix
- C. Increase industry's energy efficiency
- D. Legislation imposing low carbon limits
- E. Remove all subsidies



Subsidy revisions are critical to improve energy efficiency and generate funds for low carbon growth. How would you feel if your monthly electricity bill was higher in order to help combat climate change?

- A. In favor
- B. Not in favor
- C. No opinion



Turning Climate Change Challenges into Opportunities?

TOP 10 – STRATEGIC GOVERNMENT POLICY RECOMMENDATIONS

<p>1. ACCELERATE SUBSIDY REMOVAL: Energy efficiency – pivotal to low carbon growth – will fail without cost incentives. This includes hastening subsidy cuts in a rationalized manner, which supports various socio-economic demographics. Subsidies cost Oman \$2bn a year.</p>
<p>2. CLARIFY REGULATIONS: This is especially pertinent for clearer licensing and development parameters. Clarity will spur investors' confidence in capital growth – critical to supporting growth.</p>
<p>3. INITIATE POSITIVE CULTURAL DISRUPTION: Government must spearhead a cultural change within industry to encourage innovation, especially in state-owned companies. At the top of the pyramid for these companies, government can be especially influential.</p>
<p>4. ALIGN TECHNOLOGY DEVELOPMENT WITH AVAILABLE HUMAN CAPITAL: Focus on where the current Omani talent pool can add value in the field of technology and digitalization, thus supporting local business and nationalization. Strengthening Oman's intellectual property (IP) and transfers of technology supports the National Vision 2040 to become a knowledge exporter.</p>
<p>5. PROMOTE POSITIVE LINK BETWEEN LOW CARBON AND EMPLOYMENT: Low carbon will create, not eliminate, jobs. Sharing this message will counter fears that low carbon growth will weaken one of the sultanate's key employment sectors (energy), especially at a time of high unemployment. A Tunisian solar program, called PROSOL, has created 3,000 jobs in the last 12 years – such examples need a spotlight.</p>
<p>6. HELP LOCAL COMMUNITIES ADDRESS ENERGY DEMAND HABITS: Show how renewables can make households/transport more affordable and sustainable, thus reducing the fear factor of a low carbon future. Government-private sector-public partnerships are crucial.</p>
<p>7. CONSIDER SUBSIDIES FOR LOW CARBON/ENERGY EFFICIENCY PROJECTS: While reducing existing energy subsidies is vital, subsidies to specifically incentivize renewable projects/energy efficiency can accelerate initial adoption. As the low carbon market becomes more established, the subsidies can be revised.</p>
<p>8. INCREASE THE SUSTAINABILITY AND RELIABILITY OF POLICY-MAKING: Clear and stable policies that are not regularly revised (i.e. every 2-3 years) are in demand by a private sector seeking stability. This especially applies to big-ticket low carbon projects.</p>
<p>9. BUILD NATIONAL CONFIDENCE IN RELIABILITY OF RENEWABLES: Omanis' confidence that a low carbon future will be affordable, sustainable and not overhaul the sultanate's way of life is instrumental to building positive momentum. Strengthen awareness of how a greener Oman is a better Oman in the 2020s.</p>
<p>10. INCREASE INVESTMENTS IN RENEWABLES: Not only is this needed in order to hit national low carbon targets, but it also acts as a show of faith for local and international investors.</p>

*Not in order of priority

TOP 10 – INDUSTRY & ACADEMIA RECOMMENDATIONS

TOP 10 RECOMMENDATIONS	CHAMPION	SUPPORT	RECEIVED SUPPORT LETTER FROM MOG	IMPLEMENTATION UNDERWAY
<p>1. FOCUS ON DECARBONIZING THE POWER MARKET: This is one of the easiest parts of the energy ecosystem to decarbonize, especially thanks to Oman's abundant solar and wind power generation potential. Making significant headway will accelerate progress in parts of the energy ecosystem that are more reluctant to change.</p>		PDO		
<p>2. ACCELERATE DEVELOPMENT OF HYDROGEN: Hydrogen will be an important part of the low carbon fuel mix and has multiple uses in industry, heating and transportation. Oman can seize a regional leadership role in the hydrogen markets – if it acts quickly.</p>	EJAAD	Shell GUTech		
<p>3. SIGNIFICANTLY IMPROVE ENERGY EFFICIENCY IMMEDIATELY: The value of optimizing systems and operations is not a new idea, but the sense of urgency is. Despite multiple benefits, much potential remains unlocked. Low hanging fruits range from small investments in smart thermostats to reduce power consumption for air conditioning (AC), to predictive analytics to identify areas of operational inefficiency.</p>	OPAL	PDO		
<p>4. QUICKLY GROW OMANI LOW CARBON BUSINESS CHAINS: Creating local supply chains and businesses by Omanis within country is critical to building sustainable momentum for low carbon growth. Success feeds into improving the low carbon ICV.</p>	PDO			
<p>5. STREAMLINE LOW CARBON SMEs' FOCUS AREAS: Some investments, i.e. in CCS and hydrogen, can be too large and complex for SMEs. To avoid failed starts and frustrated sentiment, SMEs should focus on energy efficiency instead, i.e. technologies and carbon trading.</p>				
<p>6. BUILD INVESTORS' CONFIDENCE IN LARGE LOW CARBON PROJECTS: Such projects are critical to building the scale of energy generation that is needed to accelerate the energy transition. Tangible successes (i.e. Oman's Miraah solar project) must be promoted as examples of robust risk-reward investments to incentivize financiers.</p>		PDO		
<p>7. SPUR INNOVATION-CENTERED LOW CARBON EMPLOYMENT: Talent development within industry must focus more on R&D employment, as well as more creative and vertical collaborations across all energy markets (with low carbon growth as a common thread).</p>		PDO		
<p>8. ENSURE ALL ENERGY INFRASTRUCTURE IS SECURE BY 2025: The fundamentals of energy security cannot be jeopardized amid times of significant change. Industry must ensure its energy infrastructure – renewables and fossil fuels – remains reliable and scalable for the next five years. Inaction carries consequences.</p>				
<p>9. LEVERAGE IOCs' STRATEGY SKILLS: International oil companies (IOCs) in Oman, as well as Omani companies, must more proactively develop structured and quantifiable low carbon plans that the entire value chain can engage with. Industry must be more ambitious in its strategic support of national goals.</p>				
<p>10. BUILD AWARENESS OF DIGITAL BENEFITS: Industry must first improve its knowledge of digitalization and then consider how to specifically apply it to their business. Only then is adoption advised. Poor understanding of how technologies and digitalization can merge to spur low carbon growth is wasting significant resources (time, funds, talent).</p>	Muscat University	CCED		

*Not in order of priority

CASE STUDY: RECOMMENDATION No. 2 - PROJECT IMPLEMENTATION

ACCELERATE DEVELOPMENT OF HYDROGEN: Hydrogen will be an important part of the low carbon fuel mix and has multiple uses in industry, heating and transportation. Oman can seize a regional leadership role in the hydrogen markets - If it acts quickly.



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Whitepaper



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Oman Energy Master Plan 2040 **How to Accelerate Oman's Energy Transition?**

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INDUSTRY SURVEY

OMAN ENERGY MASTER PLAN 2040 How to Accelerate Oman's Energy Transition?

Saudi Arabia has promised to invest over \$100 billion to develop 41 gigawatts of solar electricity by 2032, while most other Gulf states have announced similar ambitious transition projects of their own. When it comes to implementation, which GCC country do you think is currently leading the energy transition?

- A. Oman
- B. UAE
- C. Qatar
- D. Saudi
- E. Bahrain
- F. Kuwait



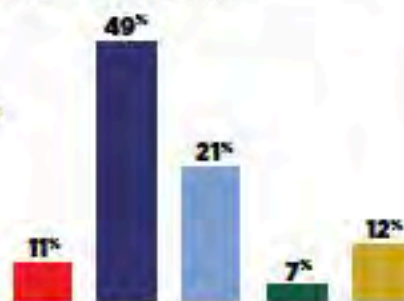
Oman's total domestic use of natural gas tripled in the 10 years since 2008 to 1.5 billion standard cubic feet in 2017. Will it be possible to meet this soaring demand growth without a centralized single authority overseeing all elements of the value chain i.e. Ministry of Energy?

- A. Yes
- B. No



Contributions that each individual country should make to achieve the worldwide goal of the Paris Agreement on climate change are determined by all countries' nationally determined contributions (NDCs). Which of the following is the most appropriate indicator to measure a Gulf country's progress in implementing an energy transition strategy?

- A. Removing subsidies on fossil fuels
- B. Amount invested in renewable energy projects
- C. Competence of local supply chain to deliver
- D. Public buy in
- E. Industry buy in



Oman and the GCC states need to go beyond their current focus on the power sector in embracing renewable energy and energy efficiency initiatives. Consideration should also be given to the replication of these initiatives in water desalination, industrial and transportation sectors.

- A. Agree
- B. Disagree



The existence of a competent and integrated localized supply chain in Oman is critical for the country to be able to accelerate its energy transition!

- A. Agree
- B. Disagree



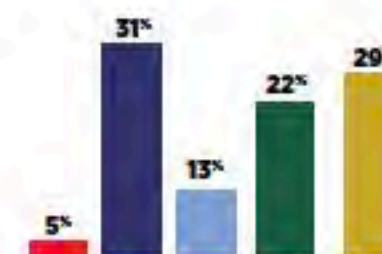
The diverse range of new energy sources within the energy transition will need complete infrastructure right through the value chain - from production and capture to processing, storage and transportation. Is Oman's legacy energy value chain an opportunity or a barrier to the energy transition?

- A. Opportunity
- B. Barrier



The energy transition must move towards secure, efficient, and low-carbon energy systems that all encompass components related to production, conversion, delivery, and end use of energy. Which of the following should be the most important next step for Gulf countries?

- A. Define the need for alternative energy sources
- B. Identify alternative (sustainable) energy options
- C. Define energy consumption per sector
- D. Define sectoral and intersectoral transition strategies
- E. All of the above



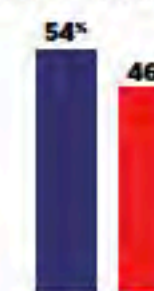
Peak power demand in Oman is expected to grow at around 9% per year, from 5,122 MW in 2014 to 9,530 MW in 2021. The sultanate will be able to meet this demand through its Vision 2040 blueprint!

- A. Agree
- B. Disagree



The Mirraah solar thermal facility in Oman is expected to deliver 6,000 tons of steam a day for EOR operations at the Amal oil field, while six new solar and wind powered projects in the sultanate aim to deliver around 2,650 MW of renewable power by 2024. Oman will achieve its goal to generate 10% of its power from renewables by 2025!

- A. Agree
- B. Disagree



Policies that provide secure payments to refinance renewable energy investments and help liberalize the power sector would be significantly beneficial in attracting more investments in energy transition projects. Does Oman have the right financial vehicles in place to encourage the investments required to achieve more sustainable forms of energy?

- A. Yes
- B. No



The World Economic Forum's (WEF) Global Future Council on Energy declared earlier this year that the global energy transition is still not moving fast enough. Therefore, the WEF said the ball is back in policymakers' court to accelerate the shift towards the clean energy solutions of the future.

- A. Agree
- B. Disagree



In June, the EU agreed a 32% EU renewable energy target for 2030, and Spain became the first EU state to create a Ministry for Ecological Transition from merging the former Ministries for Environment and for Energy. Is it possible to get left behind in the great energy transition and miss out on its economic rewards, now estimated at \$1 trillion per year?

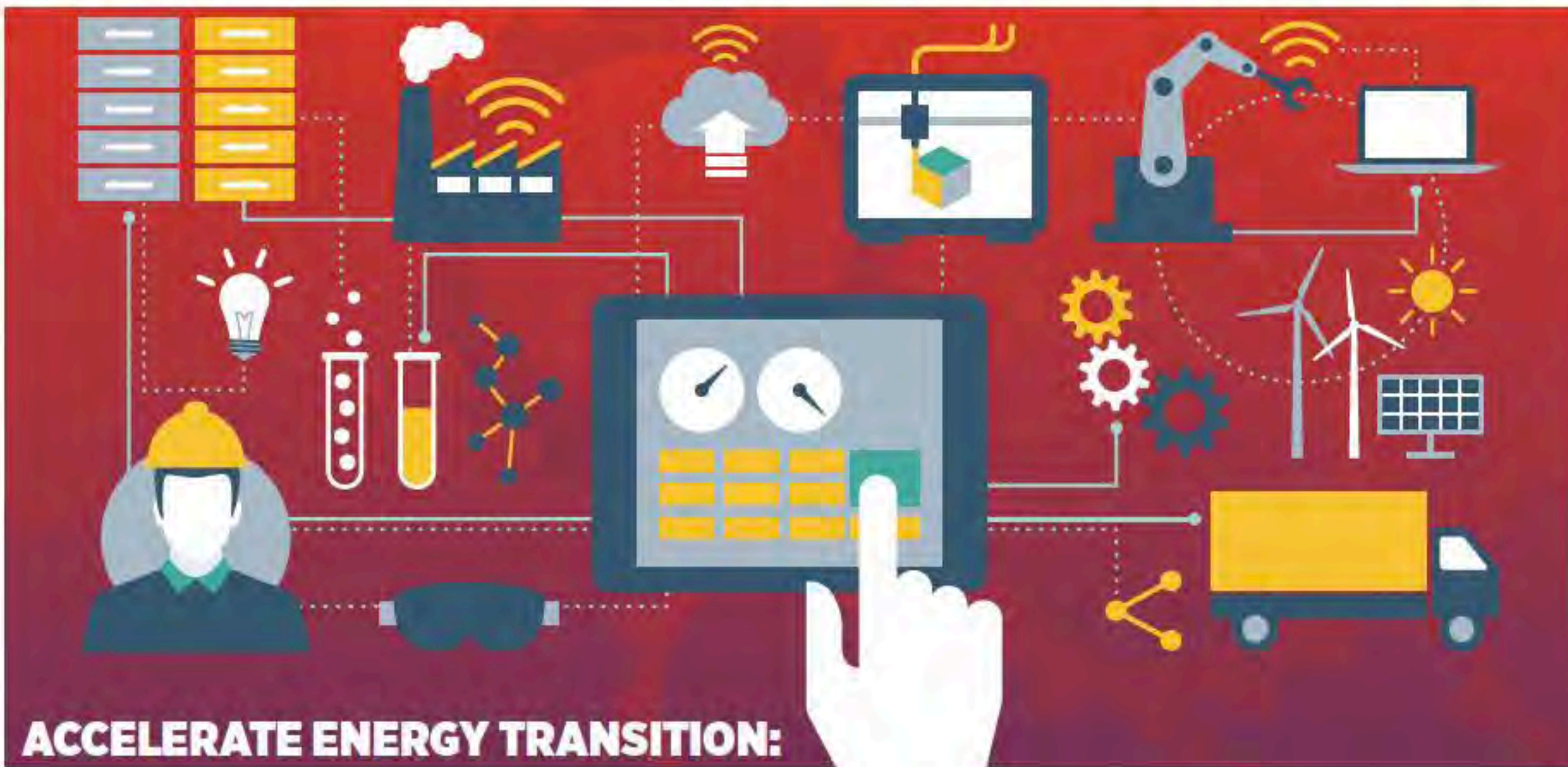
- A. Yes
- B. No



There is a two-part solution to this energy transition challenge. First, reducing emissions stemming from energy supply by increasing the share of zero-carbon energy in the supply mix. And secondly, moderating growth in demand for energy by radically increasing energy productivity (the economic output generated from each unit of energy used). Oman and Gulf countries should prioritize:

- A. Reduce supply
- B. Reduce demand





ACCELERATE ENERGY TRANSITION: Getting it Right?

THE FIRST RULE OF THRIVING IN THE GREAT ENERGY transition? Believe that positive disruption is only as brilliant as the minds that drive it. The thought leaders of tomorrow in Oman and beyond will be guardians of a new energy order, where fossil fuels and renewables are equally valuable sides of the same coin.

Water quality technicians working on oilfields, renewable-powered enhanced oil recovery (EOR), low-carbon engineers, green builders and wave and wind energy producers are the tip of a very long list of new careers that will be pivotal in academia, industry, government and society over the next decade. The trick is staying ahead of the curve so that these four pillars of Omani governance can actively pen a narrative of innovation and sustainability, rather than playing catch up.

Luckily, potential abounds. The International Labour Organization (ILO) estimates that Oman's unemployment rate was 17% in 2017. Every undeveloped talent equates into millions of undiscovered Omani Rial of potential; be they critical thinkers, innovative communicators, budding minds in science, technology, engineering and mathematics (STEM) and many more areas.

Momentum for significant change has finally gained speed after

nearly half a century of back-and-forth conversations worldwide between environmentalists, governments and financiers. People want - and need - change. Nearly all (82%) of respondents to the Green Energy Barometer Survey last year said it is important to create a world fully powered by renewable energy, regardless of age, education level or political ideology. And 73% of respondents to the survey, which encompassed 26,000 people across 13 countries, said building and producing more green energy will boost economic growth. In clean energy alone - just half of the new energy coin - investments reached \$333.5 billion in 2017, up 3% from a revised \$324.6 billion in 2016, according to Bloomberg New Energy Finance (BNEF).

Those doubting the environmental and economic motivators of the great energy transition can consider the third 'e' - the emotional driver. Sentiment is changing from a technical debate into an emotional one amid unnerving headlines reporting on pollution in Mumbai, raging wildfires in the US and the unexpected searing temperatures in the Middle East. There is an undoubted escalation in societies' emotional momentum, which could lead to a negative public reaction (panic, concern over resource allocation) if the cornerstones of national governance are not proactive.

WALK THE WALK

Oman has clear, innovative plans that now need to be delivered. We often all talk about new regulatory initiatives and policies, which have certainly paid dividends. But we must all do more to drive enforcement and make policies increasingly sophisticated. Building standards for schools have been enhanced, yet new schools are being built in accordance with old standards, for example. Poor alignment means innovative plans detailed on paper do not always translate into on-the-ground progress.

Subsidizing water and electricity next year for Oman could cost the government OMR700 million, close to \$2 billion. Oman could funnel a relatively small part of that subsidy funding in order to have a significant benefit on its social services, such as talent

Black gold still shines

The energy transition does not mean discounting the value of fossil fuels; this side of the coin is just as necessary as renewables. We are aiming to sustainably increase crude output capacity by 13% to 680,000 b/d over the next three to four years as part of a \$20 billion spend.

enhancement and energy security. Reform comes with a temporary cost. Owing to the hike in electricity tariffs and VAT, the World Bank expects inflation to inch up to 3% in 2019 before moderating in 2020 as cost-push pressures from subsidy reform dissipate. Still, this is in the context of the Sultanate's steady growth up to 2020. GDP will likely increase by 2.3% in 2018, 2.5% in 2019 and by 2.9% by 2020, reassuring amid sub-\$60/bbl oil prices.

How PDO and other energy stakeholders in Oman - industry, government and academia - position ourselves is pivotal to ensuring buy-in from the entire community. This extends to our responsibility to improve energy efficiency and renewables to supporting education and more sustainable consumption habits. Some stakeholders will be more focused on meeting Oman's obligations to the Paris Agreement, others will zoom in on the cost implications, others on the socio-economic impact and some will take more of a holistic view. Whatever your approach, united efforts are critical to make sure we make sustainable progress. After all, the red flags for the pressure points for us all in the Middle East are clear. BP Outlook expects the Middle East's energy consumption to rise by 54% by 2040, while Germany's Max Planck Institute for Chemistry and the Cyprus Institute in Nicosia warned that high temperatures could make some areas uninhabitable from mid-century onwards in the Middle East and North Africa (MENA). Plus, the United Nations expects Oman's population will rise by 26% to 5 million people, the UAE's by 39% to 13.1 million, Saudi Arabia's by 37% to 45 million by 2050.

DEEPER POCKETS PAY

The economics currently work - but they must work harder, they must sweat. Policies that encourage more funding for novel research and development (R&D), re-financing fossil fuel and renewable energy projects, more independent power producers (IPP), unbundling the current centralized framework of power generation and improving the pool of talent are pertinent to accelerating Oman's progress. Muscat must also keep pace with other countries in order to evolve into a knowledge-based economy in what is a fast-moving world of increasingly ambitious low-carbon energy policies. For example, the European Union (EU) recently agreed a 32% renewable energy target for 2030 and Spain became the first EU country to create a ministry for ecological transition (merging the former ministries of environment and energy).

Meaningful change takes time. Take our project with GlassPoint as an example. Miraah, meaning 'mirror' in Arabic, will use concentrated sunlight to generate 6,000 tonnes of solar steam each day. The steam will feed directly to PDO's existing thermal EOR operations, providing a substantial portion of the steam required at the Amal oilfield in southern Oman. Miraah will reduce carbon dioxide (CO₂) emissions by more than 300,000 tonnes each year, which is the equivalent of taking 63,000 cars off the road. This is a ground-breaking innovation, where phase one costs were more than the natural opportunity we could have had with gas, but where Phase two is in money i.e. the economics are more favourable, setting the enabling platform for phase three. Literally, patience pays. Ultimately though, the value of the project far exceeds the numbers. The project illustrates what can be achieved and how much further we can all push our expectations to guarantee an affordable, sustainable and efficient energy ecosystem. It is a marathon rather than a sprint. So pace yourselves, but don't lose your stride. ■



Local Supply Chain: Make it Count?

MANY HANDS MAKE LIGHT WORK. A VITAL ETHOS TO thrive in the great energy transition, as fossil fuels and renewables emerge as two sides of the same coin. Worldwide, local supply chains are often the unsung champions of affordable and sustainable growth. Muscat must keep turning up the volume.

Local expertise is an engine for growth; one that can tick over or one that can roar. The latter requires the celebration and increase of local entrepreneurs and small and medium-sized enterprises (SMEs). Team work lies at the heart of success, as best said by His Majesty Sultan Qaboos bin Said on the day of his accession on 23 July 1970: "My People, I will proceed as quickly as possible to transform your life into a prosperous one with a bright future. Every one of you must play your part towards this goal." This still rings true, nearly half a century later.

Oman also needs to keep pace with international progress. In the wider GCC region, SMEs are forecast to grow by 156% in the next five years, with the sector set to be worth \$920 billion, according to MENA Research Partners (MRP) last year. The SME sector in the Gulf will employ 22 million people by the early 2020s – gold dust for a region with high unemployment rates and endless potential for ground breaking ideas.

Accordingly, Shell Oman has been a key participant of in-country value (ICV) for nearly six decades through its joint ventures. The stronger the Sultanate's talent pool, the more ground breaking the results. Omanis account for more than 85%

of the in-country workforce in Shell companies in Oman and in 2018 Shell provided more than 66 training, further education and on-the-job development opportunities for our employees and the next generation of Omani professionals. We are far from alone; many in industry make a meaningful effort. In 2018, Petroleum Development Oman (PDO) has fully Omanised its hoist fleet for the first time after agreeing contracts with five local companies worth more than US\$800 million. Another ICV highlight from PDO is its National Objectives programme, which seeks to create more than 50,000 employment opportunities for Omanis since its launch in 2011. Shell Oman Marketing Company has provided more than 120 opportunities for local companies to be retailers and operators across its strategically located service station network in Oman.

PRIDE MATTERS

Building national pride in the local value chain is the first step. A more holistic celebratory approach can unlock novel ideas across the socio-economic profile. For example, energy companies in Singapore champion the CEO as much as the individuals at the bottom of the hierarchy so that all the 'slices in the corporate pie' are equally valued. In a chicken-and-egg scenario, this encourages government, larger corporations and financial institutions to help the local value chain overcome the oft-discussed hurdles. Supportive policies that accelerate progress, sharing of research and development, technologies and the accessibility of funds are at the top of challenges that more established parts of the energy

ecosystem can help the local value chain scale. This collaborative dynamic in Oman's oil and gas industry is constantly improving; these lessons must also migrate to the greener market. The two sides of the coin must be equally robust.

MORE CHOICE?

The Oman Power and Water Procurement Company (OPWP) has been very successful at tendering central generation and providing the bulk of supply for the sultanate. Historically, the Government's greater control has worked well for two reasons. Firstly, to ensure an affordable balance between demand and consumption, with a 6.5% surplus acting as a buffer for forecasted peak demand. In the last fifteen years, generation has only dipped below consumption once. Subsidies are the second reason; the government has had to keep a firm eye on spending to sustain this privilege.

But there's a catch. The current regulatory framework in Oman means one can only sell electricity to OPWP, and only if it is generated by a project that has been tendered by OPWP. Consequently, all immediate solar generation, especially larger projects, will likely be awarded to the lowest tariff for the tender. This risks diluting the sustainable ICV impact of a project, including the inclusion of the local supply chain. What can be done to broaden the profile of participants in this tender process?

As energy demand grows and the country's subsidy program is reshaped, an architecture with the option for distributed generation will help ease the pressure on government and sustain efficiency. Plus, surely stimulating entrepreneurialism, innovation and competition among SMEs won't hurt?

Occasionally, the make-up of an energy project will be too complex to 'unbundle' to give more opportunities to the local supply chain. In this case, an SME could 'shadow' the lead company or companies as part of a training program. This would strengthen the ICV of the local supply chain, reinforce SMEs' ability to bid on the next project, support the corporate and social responsibility (CSR) goals for the lead company and generally improve knowledge-sharing in Oman's energy ecosystem. In short, it's a win-win.

Inevitably, stumbling blocks will emerge. Some engineering, procurement and construction (EPC) contracts for SMEs act as

a cover to open a floodgate for expatriate workers, which dilutes the true measure of ICV and Omanization, for example. But this challenge is hardly insurmountable. Eagle-eyed stakeholders across the ecosystem – industry, Government, academia, financial institutions – with the common goal of supporting the local value chain can halt this activity.

GET ORGANIZED

How the local value chain is categorized matters; in terms of skill, size, capabilities, geographies and so on. Proper data management will ensure that the right local expertise can bid for the right projects. Steps in this direction are already being made, as illustrated by the Omani Authority for Partnership for Development, to manage the Partnership for Development program. The objective is economic diversification and support of strategic sectors through technology, leading to a knowledge-based economy ideally through joint ventures. Note the last two words: joint ventures. But this is just one step; many more are needed.

Aspiring for a knowledge-based economy as per the National Vision is no small feat. The more we know about the skills we have in Oman now, the more accurately we can nurture the skills needed for the 2020s and beyond. The sands are forever shifting. For example, a quarter of a century ago, chemical engineering was largely focused on raw materials and commodities. Today, it is primarily focused on specialty chemicals. Within this same time period, renewable energy has transformed from a bespoke utilization by a few into a mainstream method adopted by governments and multinationals.

More informational advertising campaigns that highlight the value of the local supply chain in this energy transition are essential to attract the brightest minds; today's best students are tomorrow's energy pioneers who will make the engines of growth roar. All hands are needed at the pumps. ■

ENERGY TRANSITION

Keeping Pace with Change?

WHAT HAPPENS IN THE YEAR 2169? THE GLOBAL oil supply will run out: 150 years to go at today's demand according to IEA. So, why should the energy transition be on our agendas now? In short, because meeting rising energy demand as well as the targets of the Paris Agreement are not possible with the world's current reliance on fossil fuels. A new and diversified energy strategy to meet the demands of a swelling population, nearing 10 billion by 2050, is the only smart solution.

PDO started its transformation from an oil and gas player into a fully-fledged energy company with a greater focus on improved efficiencies and decarbonization. The primary new 'tools' available in the energy transition in Oman and beyond include renewables, carbon capture and storage (CCS) technology and possibly nuclear power. Plus, the traditional fossil fuel market is getting a lower-carbon makeover.

UNTAPPED GOLD DUST

Worldwide, the cost of renewables has fallen by 40% in the past three years there is approximately 1,000GW of solar and wind capacity, with this rising by 5% every year. And global investments in renewables totaled \$250 billion in 2016. What does this mean for Oman? In short: boundless opportunities.

Oman's solar radiation per square meter is similar to that in India, Spain and the US, i.e. very promising, as well as optimum wind conditions at night. One area of great potential is the ability to use solar to create steam, heat and hydrogen. This is best demonstrated by Oman's Miraah project, which will generate 6,000 tons of steam per day for enhanced oil recovery (EOR) work at the Amal field. Such technology is gaining momentum worldwide; Shell has invested in a large facility in Germany to produce hydrogen, for example. Next on the agenda is innovative storage strategies for renewables, as is developing the local supply chain, streamlining governance and more investment incentives to help de-risk the local business environment. Setting clear and ambitious targets, guided by realistic scientific and financial realities, is also high on the agenda. Oman can look to success stories in Morocco and South Africa, for example, with both countries setting clear targets, leveraging local supply chains and establishing dedicated entities.

RETHINKING OLD HABITS

Managing consumption is critical in energy efficiency, including subsidies. We have seen successful reduction models implemented in Indonesia and Mexico, where subsidies have gone towards supporting the most vulnerable in society. Good timing of such measures is essential. It is cheaper to lower or remove subsidies amid lower oil prices, but this means hammering public sector finances as social discontent is potentially at its highest.

Continued subsidized fossil fuels and electricity will weaken incentives to invest in and deploy renewable technologies and projects in Oman. Yes, the sultanate has enough gas to cover the duration of current contracts with power generators. But we won't have that luxury as energy demand rises in the medium to long-term. Breaking the economic cycle associated with subsidized energy is one of the most important goals we need to achieve in Oman and the wider Gulf.

Accordingly, PDO launched a campaign on energy conservation to both establish a baseline for consumption in internal operations and to promote efficiency externally. We've collaborated with the Ministry of Education to start infusing a lower-carbon culture in Oman. On the international stage, we have collaborated with the European Commission at an event that focused on energy efficiency. Creating more strategic partnerships and sharing our expertise is crucial.

BRIGHT MINDS

The importance of enhancing talent cannot be over emphasized; our minds are the roots of positive disruption. PDO has a national objectives program to offer school leavers and graduates apprenticeships and short training courses to reinforce the sultanate's talent pool. Oman currently has

enough basic expertise for installing solar panels, but talent for emerging areas of expertise – energy storage, the breakdown of heat, steam and hydrogen into energy and so on – is wanting. We also recently launched the EJAD platform, which is a digital marketplace where academia and industry can collaborate on pressing R&D issues. These range from the impact of dust and moisture on solar panels to storage solutions for solar and wind power.

Shifting sands raise a lot of questions, fuel a lot of furrowed brows. The unknown is often unnerving, but exploring new territory lies at the core of sustaining energy security. The world is changing and we must change with it, if not spearheading it. The transition is an opportunity not a threat – one Oman cannot afford to miss. ■



RECOMMENDATIONS

IMPLEMENTING TANFEEDH ENERGY LAB OUTCOMES:

Tanfeedh Energy Labs have identified three pillars to pursue efficiency and transition:

- A. Electricity** – work towards achieving the country's target to meet 11% of power generation from renewables by 2023.
- B. Gas** – diversify energy sources to reduce 97% reliance on gas and allow for its allocation to other industrial sectors.
- C. Government Policy** – streamline energy strategy across the oil, gas and electricity sectors.

WHAT'S NEXT?

1. INTRODUCE SPEEDIER INTERIM APPROVALS

Quicker regulatory decision making needed to avoid abandonment of initiatives. There are currently over 200 companies in Oman in the electricity business with products and technology ready to go, but are often stalled waiting for approval. One cited example is delays in allocating land for solar projects. Tanfeedh has identified a number of 'quick wins' - projects that can be implemented today. Waiting for frameworks to be in place to be able to feed electricity back into the grid will take time so need to set up interim standards along the lines of the 'building code' model, to achieve quick progress.

2. DRIVE PUBLIC AWARENESS ON TRANSITION

Mindset on energy transition still needs to shift. The government should focus more on building general awareness of energy efficiency so that this is instinctively translated into measures taken within households and industry. Examples can vary from basic demonstration of how automating AC temperatures can save energy, to reaching into the education sector as early as primary and introducing the United Nation's 17 Sustainable Development Goals.

3. ADDRESS ELECTRICITY SUBSIDIES

Otherwise, consumption won't drop and a fully-fledged renewable energy sector can't develop. However, care must be taken to prepare the public on tariff changes for at least a few months ahead of actual implementation. Malaysia example cited – executed a two-year public campaign ahead of introducing VAT.

4. LOOSEN RESTRICTIVE CLAUSES ON TENDERS

Install less restrictive terms and conditions in tender processes – currently for example, companies have to have completed a minimum of two previous projects within the region to qualify – this drives valuable international investors away.

5. ADJUST PPA CONTRACT COMMITMENT

Shorten length of PPA contract – current 15-year structure restrictive – can lead to risk exposure of technology becoming obsolete during the contract period, with related costs.

6. BUILD IN-COUNTRY R&D

Grab the opportunity of inherent demand in Oman and build the economic supply chain. Lessen the reliance of importing technology from countries like China or from Europe and set incentives to attract R&D companies to come to Oman and take advantage of its unique environment of wind and solar resources.

7. STRIVE TO EXPORT TECHNOLOGY KNOWHOW

Become a regional leader in renewable energy technology and export it - existing example is the proven technology of conversion of heat to produce hydrogen.

8. LEARN FROM BEST PRACTICE

Renewables is a relatively new field to Oman. Seek to learn from other countries and garner advice on how to accelerate the process of implementation.

9. MAXIMISE OPPORTUNITY IN ROOFTOP SOLAR

Install Rooftop Solar for both individual energy usage and for households to sell on any surplus to distribution companies. This in turn encourages investment into SMEs for installation and servicing and boosts employment. For this to succeed, government needs to set very clear frameworks around the country's distribution network and occupational standards for the manpower required.

GULF BEST PRACTICE LEARNING FROM THE NEIGHBORS?

TOP 5 RECOMMENDATIONS

- 1. COORDINATE POLICY ACROSS SECTORS**
GCC governments need comprehensive frameworks built on intersectoral strategies, to allow economic opportunities for deployment of renewables.
- 2. INCLUDE ALL INDUSTRIES IN EFFICIENCY DRIVES**
GCC energy efficiency initiatives need to focus beyond electricity and towards water desalination, other industry and transportation sectors. Opportunity for decarbonization outside the power sector globally is 80%.
- 3. DECOUPLE POWER AND WATER GENERATION**
Integration of power and water generation too tightly coupled in the GCC – governments should work towards segregating power for desalination and thermal generation.
- 4. CONSUMPTION CONTROL**
MENA countries need to progress faster in implementing renewables solutions (e.g. Saudi Arabia's critical need to meet the 800,000 b/d peak in oil demand during summer months). Demand side dynamics require more focus on efficiencies in households and district cooling.
- 5. ACCELERATE POWER DEREGULATION ACROSS THE GCC**
The GCC has made great strides in clean energy technologies – more progress needed now towards privatization and segregating generation and distribution.

ENERGY ECOSYSTEM

Strategies for a Successful Transition?

TOP 5 RECOMMENDATIONS

- 1. LEVERAGE DIGITAL TOOLS**
Digitalization and technologies can be leveraged more coherently to have a greater enabling role. Such tools are key in achieving scalability in the transition, such as when renewables will inevitably account for more than 15% of the overall grid. The same applies to creating a digital cloud to incentivize more FDI, therefore enabling a greater flow of ideas and funds to drive the energy transition.
- 2. ESTABLISH LONGER-TERM TARGETS**
Clear targets are one step; there are two other steps in this nexus. The first is to ensure there is enough ambition and longevity in the target i.e. visions and associated policies for change can stretch to 2040, not just the 2020s. Secondly, clear and practical policies must be devised to make the targets a reality. Establishing a central institution i.e. a Ministry of Energy, could help identify the right policies with assigned responsibilities.
- 3. IMPROVE DEMAND MANAGEMENT**
Supply and demand are two sides of the same coin; one cannot succeed without progress on the other. The policy and implementation of efficiency standards – be it for vehicles,

TRANSITION ENABLERS

Identifying all enablers for capturing renewables in Oman, including de-risking of projects, governance, infrastructure and concrete next steps for implementation?

TOP 5 RECOMMENDATIONS

- 1. PUBLIC-PRIVATE COORDINATION**
Key to energy efficiency success is that government policy and the private sector work hand in hand. GCC governments should focus on setting regulatory frameworks for energy efficiency (subsidies, competition policy) while industry gets on with innovating and providing smart solutions to the customer.
- 2. SUBSIDIES STYMIE EFFICIENCIES**
Removing/lowering subsidies on water and electricity is essential to trigger end users to make rational choices and adopt energy efficient solutions (such as home smart meters) that private businesses are offering. Simultaneously also encourages SME and jobs growth in Oman.
- 3. RESOLVE OMAN GAS SHORTAGE**
Oman needs to adopt renewables and other energy efficiency and carbon emission solutions, such as CCUS & EOR, more urgently, to prevent gas shortage and free up gas for export.
- 4. HYDROCARBON INVESTMENT REMAINS CRITICAL**
Continued investment in hydrocarbons is critical in parallel with renewables growth to meet global demand for oil in 2040 (70 million b/d according to IEA) – driven by oil-fueled petrochemicals, aviation and heavy transport.
- 5. DEREGULATE & INTRODUCE SPOT MARKET**
As Europe has done in the past 10-20 years to its monopoly-style utility sectors, Oman should move to deregulate and privatise parts of its power infrastructure and introduce a spot market to allow for competition along all elements of the value chain. This would open up end user choice which is critical for enabling energy transition, particularly when it comes to driving consumer behavior and introducing new technology.

in homes or appliances – are hugely important enablers. The same applies to public buy-in. This requires comprehensive communication strategies, especially when it comes to price i.e. adjusting subsidies.

- 4. HARNESS LOCAL TALENT**
People matter; investing in local capabilities will pay off. This broad spectrum encompasses better alignment between industry and academia, such as ensuring longer-term internships in the winter and not summer months. The same applies to increasing the volume of vocational education in academia and investing in talent on Omani soil to create a more sustainable talent pool.
- 5. GREAT COLLABORATION AMONG INDUSTRY STAKEHOLDERS**
Accurately monitoring and responding to supply-demand balances requires cohesion among industry stakeholders; even more so amid the shifting sands of the energy transition. Achieving greater clarity means leveraging digitalization, addressing the supply and demand side both separately and as one, harnessing more FDI and enhancing the talent pool, among other points. The thread that ties these all together? Collaboration between industry stakeholders. How can all the

LOCAL SUPPLY CHAIN

Oman's local supply chain is an engine for economic growth and innovation – a key cog in the National Vision to become a knowledge-based economy with deep-rooted energy security. As the sultanate embraces the global energy transition – a mix of fossil and renewable fuels – how can it leverage and create its local supply chain of small and medium-sized enterprises?

TOP 5 RECOMMENDATIONS

- 1. BROADEN THE TENDER PROCESS**
Changing the current regulatory environment will make it easier for local SMEs and the wider local supply chain to bid – and win – roles in larger projects. Clarifying economies of scale first is crucial to accurately localize services and responsibilities.
- 2. NURTURE LOCAL CHAMPIONS**
Bolster the respect and prestige associated with SMEs and the wider local supply chain to encourage sustainable growth, including enhanced training, reducing the brain drain and boost commercial confidence.
- 3. REPLICATE LESSONS LEARNED IN OIL AND GAS**
Many successful techniques to engage and grow the local supply chain have trialed and tested in the fossil fuels market. Do not reinvent the wheel; apply success stories to lower-carbon growth.
- 4. CATEGORIZE AND SUPPORT SMES**
SMEs are an integral part of affordably and efficiently achieving success in Oman's energy transition; they must be supported. Such support can be provided via on-job training (i.e. 'shadow SMEs' for a large company completing a tender) and in the categorization of SMEs' capabilities. This ensures the correct skills are allocated to the correct roles, as well as enable SMEs to broaden their horizons by working cross-sector with other SMEs.
- 5. INCREASE VOCATIONAL TRAINING**
Pairing a strong academic knowledge base with vocational training means university leavers can apply classroom knowledge directly to a project more effectively. Such efficiency will prove vital in SMEs' ability to not only successfully compete for bigger tenders, but also support the sultanate's energy security. The intellectual gap between theoretical and practical skills must narrow.

SUSTAINABLE FINANCE

How can transparent and climate-smart investment support the speed of energy transition within Oman?

TOP 5 RECOMMENDATIONS

- 1. INCREASE GLOBAL INVESTMENT IN RENEWABLE ENERGY**
Global investment in renewable energy needs to increase annually by 150% year on year to meet Paris climate agreement objectives - about \$16 trillion through to 2050 so government policy should be designed to help finance meet these climate mitigation objectives, such as directing local credit to local initiatives and putting guarantees in place to make projects bankable.
- 2. INTERNATIONAL PARTNERSHIPS**
GCC governments should partner with international development agencies such as the World Bank to ensure projects follow best practice standards and so more easily attract other commercial funding.
- 3. INVESTMENT INCENTIVES**
IRR for renewables projects in region in single digits compared to hydrocarbons at around 15-20% and utilities at 10-15% so countries need to create other types of incentives for renewables investment such as rent-free land or removing taxes on imports of solar PV equipment.
- 4. ALIGN TAX RATES**
Oman needs to better align the current disparity in withholding tax rates on renewable projects between different countries. e.g. currently 5% on China and 10% on the GCC.
- 5. ALTERNATIVE FINANCING FOR RENEWABLES**
Countries with smaller sized renewables projects need to develop an ecosystem for alternative non-conventional financing.



How to Accelerate Oman's Energy Transition?

TOP 10 – STRATEGIC GOVERNMENT POLICY RECOMMENDATIONS

	CHAMPION	SUPPORT
1. GOVERNMENT REGULATION TO IMPROVE DEMAND MANAGEMENT: Gov't policy and implementation of efficiency standards - be it for vehicles or domestic appliances – are hugely important enablers. The same applies to public buy-in, which requires comprehensive communication strategies to drive awareness on transition, especially when adjusting subsidies.		
2. ACCELERATE POWER DEREGULATION & INTRODUCE SPOT MARKET: Oman should move to deregulate and privatize parts of its power infrastructure and introduce a spot market to allow for competition along all elements of the value chain.		
3. ESTABLISH CLEAR LONGTERM TARGETS FOR RENEWABLES & ALIGN TAX RATES TO DRIVE INVESTMENT INCENTIVES: Oman should set clear targets that stretch out to 2040 and beyond, while at the same time correcting the current disparity in withholding tax rates on renewable projects between different countries. e.g. presently 5% on China & 10% on GCC.		
4. OMAN SHOULD INCLUDE ALL INDUSTRIES IN ENERGY TRANSITION: Oman Energy Efficiency initiatives need to move beyond electricity and towards water desalination, transport and other industries – opportunities for decarbonization outside the power sector globally is 80%.		PDO
5. INCREASE INVESTMENT IN RENEWABLE ENERGY: Global investment in renewable energy needs to increase annually by 150% year on year for the world to meet the Paris Climate Agreement objectives – about \$16 trillion through to 2050 – so government policies should play a central role to ensure projects are bankable.		PDO
6. INTERNATIONAL DEVELOPMENT AGENCIES/ PUBLIC-PRIVATE: Oman should partner with international development agencies, such as the IFC/World Bank, to ensure projects follow best practice standards and so more easily attract other commercial funding.		PDO
7. RESOLVE OMAN GAS SHORTAGE: Oman needs to adopt renewables and other Energy Efficient --low carbon emission-- solutions, such as CCUS and EOR, with greater urgency to prevent a gas shortage and free up gas for industrial development and export.	PDO	
8. INTRODUCE FLEXIBLE REGULATORY FRAMEWORK FOR RENEWABLES: Install less restrictive terms & conditions in tender processes – currently companies have to have completed a minimum of two previous projects within the region to qualify, which drives international investors away, and quicker regulatory decision-making is needed to avoid abandonment of initiatives.		
9. FIRST MOVER ADVANTAGE: Renewable energy is a relatively new field to the GCC which presents the opportunity to become a regional leader in technology development/ deployment and export it – existing example is the proven technology of conversion of heat to produce hydrogen.		
10. REMOVE ELECTRICITY SUBSIDIES: Remove/lower subsidies on water & electricity is essential to trigger end users to make rational choices and adopt energy efficient solutions (e.g. domestic smart meters) that private business are offering, which would simultaneously encourage SMEs and jobs growth in Oman.		

TOP 10 – INDUSTRY TO EXECUTE

	CHAMPION	SUPPORT
1. APPRENTICESHIP: Develop an apprenticeship program in partnership with industry in energy savings technologies for the Construction Industry.	GUTECH	
2. CATEGORIZE & SUPPORT SMEs: Omani companies should broaden the tender process to facilitate SMEs which are an integral part of affordably and efficiently achieving success in Oman's energy transition -- support can be provided via on-the-job training (i.e. 'shadow SMEs' for a large company completing a tender) and in the categorization of SMEs' capabilities.	PDO	
3. NURTURE LOCAL SUPPLY-CHAIN CHAMPIONS: Bolster the respect and prestige associated with the wider local supply chain to encourage sustainable growth, including enhanced training, reducing the brain drain & boost commercial confidence.	Shell	OPAL
4. COLLABORATION AMONG INDUSTRY STAKEHOLDERS: Accurately monitoring and responding to supply-demand balances requires cohesion among industry stakeholders; even more so amid the shifting sands of the energy transition.	OPAL	
5. REPLICATE LESSONS LEARNED IN OIL AND GAS: Many successful techniques to engage and grow the local supply chain have trialed and tested in the fossil fuels market. Do not reinvent the wheel; apply success stories to lower-carbon growth.	PDO	
6. ADVOCATE VOCATIONAL TRAINING: Pairing a strong academic knowledge base with vocational training means university leavers can apply classroom knowledge directly to a project more effectively. Such efficiency will prove vital in SMEs' ability to not only successfully compete for bigger tenders, but also support the sultanate's energy security. The intellectual gap between theoretical and practical skills must narrow.	Shell	PDO
7. INTERNSHIPS - HARNESS LOCAL TALENT: People matter - investing in local capabilities will pay off. This broad spectrum encompasses better alignment between industry and academia, such as ensuring longer-term internships in the winter and not summer months.	PDO	
8. BUILD IN-COUNTRY R&D: Undertaking applied research project on solar panel efficiency to maximize the opportunity for rooftop solar in Oman. Building in-country R&D capabilities for wind and solar will allow SMEs to grab the opportunity presented by the inherent demand in Oman and build the economic supply-chain.	GUTECH	
9. LEVERAGE DIGITAL TOOLS: Digitalization & technologies can be leveraged more coherently to have a greater enabling role. Such tools are key in achieving scalability in the transition, such as when renewables will inevitably account for more than 15% of the overall grid. The same applies to creating a digital cloud to incentivize more FDI, therefore enabling a greater flow of ideas and funds to drive the energy transition.		
10. DRIVE PUBLIC AWARENESS ON TRANSITION: The mindset on energy transition still needs to shift – industry should work with the government to build general awareness of energy efficiency so that this is instinctively translated into measures taken across the economy and within households.		PDO

NB. With the recent establishment of a defacto Ministry of "Energy" – Oil, Gas and Electricity – in Oman (which was a prime recommendation of the Oman Energy Master Plan 2040); a new blueprint should address how to stimulate the Energy Transition – Some points to include:

1. Establishment of a National Renewable Energy Sources (RES) Blueprint for Oman – beyond the Tanfeeth timeframe. This Blueprint shall focus on energy supply for power generation and power-to-x
2. Establishment of a National Energy Efficiency (EE) Blueprint – this will entail efficiency practices, lower consumption and thus free up more gas for export
3. Establishment of a SME Development Program and Supply Chains Blueprint

Whitepaper

The 5th Oman Energy Forum



Oman Energy Master Plan 2040

The 4th Industrial Revolution
Future of Work & Work of the Future?



Consultancy
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EXECUTIVE SUMMARY

A New Professional Dawn**WINNERS
& LOSERS?**

Data Science. Mobile supercomputing. Intelligent robots. Automation. Data Harvesting and mining. Self-driving cars and so much more. We stand on the brink of a technological revolution that will fundamentally alter the way we work and how labor markets are structured. In its scale, scope and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know how it will unfold. But one thing is clear: the response must be integrated and comprehensive, involving all stakeholders from the public and private sectors, stretching from academia and society. Opportunities abound.

Deloitte found that technology has created far more jobs than it has destroyed, describing it as a "great job-creating machine". And there's 140 years of data to prove it. Plus, 79% of respondents to a Gulf Intelligence Survey in late-2017 disagreed with the notion that technology will destroy more jobs than it creates in the Middle East's energy industry over the next decade. The main role of technology has been helping disruptors to improve and innovate established models across a host of sectors and industries. This reflects how technology has empowered generations of innovators, as they search for new and efficient ways to reshape the status quo.

Vast waves of technological advancements have also been a major contributor to increased prosperity, productivity and job creation. Inevitably, each industrial transformation triggers custom-made challenges. With the 4th Industrial Revolution, it has become imperative to ensure that the skills and attitudes of talent and the job market evolve. In many industries worldwide, the most in-demand occupations and specialties did not exist even five years ago. Popular estimates suggest that up to 60% of children entering school around the world now will have job titles that do not yet exist, with the velocity of change only accelerating. Understanding what skills will be required and employment trends will be critical for businesses, governments and individuals to provide energy and job security – both cornerstones of the sultanate's prosperity.

This Whitepaper details the key trends that emerged from the Oman Energy Forum in Muscat last November. Brain power amounting to approximately 1,000 years of higher education gathered under one roof during the event to map out the most efficient and affordable route for the Sultanate's energy future. ■

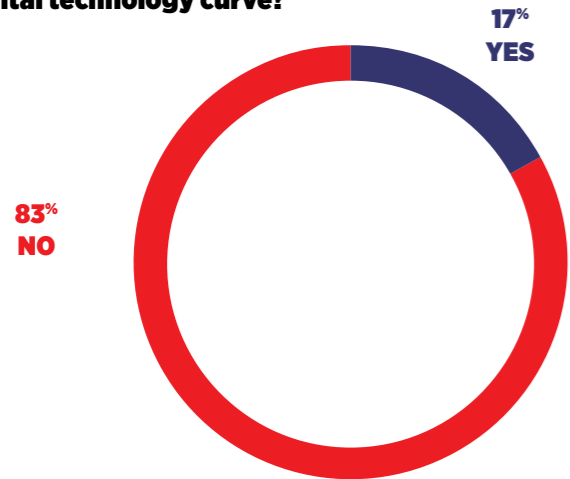


GI OMAN'S DIGITAL TRANSFORMATION The Current Outlook

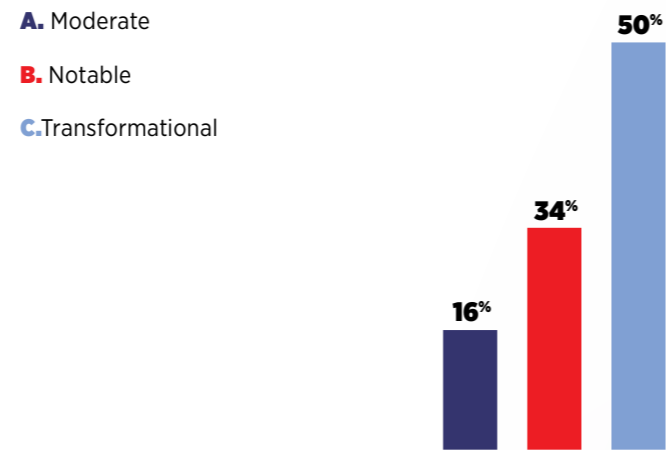
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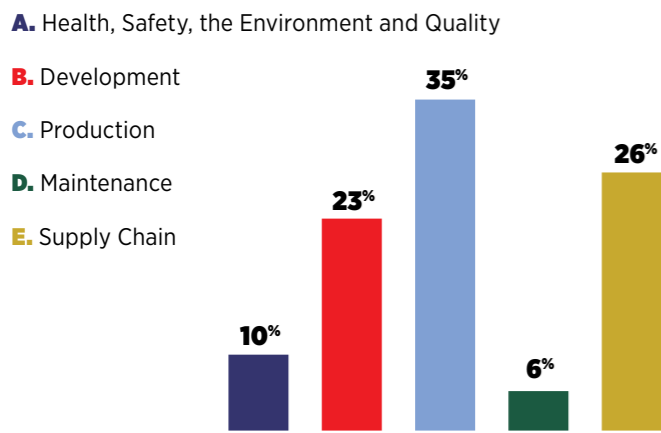
Is the Middle East energy industry doing enough to be ahead of the digital technology curve?



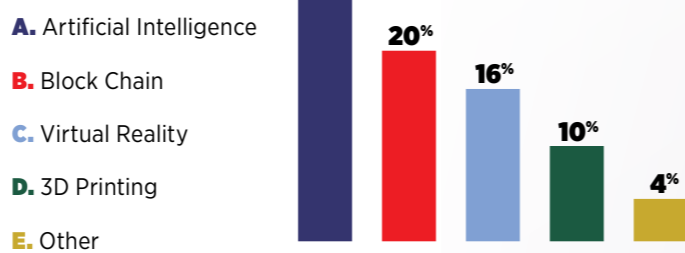
What impact will digital technologies have on the Oman Energy Industry over the next decade?



Which aspect of Oman Energy operations will digital technologies impact the most?



Which of the following digital technologies will have the biggest impact on the Oman Energy industry over the next 10 years?



Digital literacy within the Oman energy industry is:



TALENT: TACKLING UNPRECEDENTED 21ST CENTURY CHALLENGES

Oil Worker of the Future

How can Technical and Vocational Training Programs evolve to better Re-skill and Up-skill Omani workers?

Industry & Academia in Oman need to align better to enhance vocational education and meet future labor market requirements. Currently, vocational education is viewed as an alternate educational pathway whereas, in its essence, it should be viewed as complementary and just as a different style of learning, that can work hand in hand with traditional education. Rebranding the image of vocational education and enhancing the current mindset around its reputation in Oman needs improvement. Society needs to move away from

the commonly held view that vocational education is not up to par or not as prestigious as a university degree. Industry, academia, and government need to work together to encourage the younger generation through designed incentives. Improving accreditation and standards for vocational education through new legislation in Oman would be a pathway to further credibility - young professionals need to be assured that their training is transferable and fully accredited, and it is crucial that individuals are recognized both domestically in-country and internationally.



Improving accreditation and standards for vocational education through new legislation in Oman would be a pathway to further credibility. Young professionals must be assured that their training is transferable and fully accredited and it is crucial that individuals are recognized both in-country and internationally."



for a diverse skill set of knowledge and provide the required tool kit for future success. The new world of technology is a key pillar in generating entrepreneurs and self-employment and contributes to the growth of the private SME sector - a critical factor in developing economies' growth trajectories.

One of the top recommendations harvested from the 2017 Oman Energy Forum was that Industry should work with academia throughout the entire period of a student's university career to develop vocational qualifications. Having a structured framework and learning process where students go from university or college into the workplace will resolve at least some of the challenges in meeting future labor market requirements in Oman. Vocational qualifications can be established from entry university level through to PhD; an example of a vocational PhD would be a medical doctor that gains hands on experience while completing a theoretical degree in tandem.

Internships and apprenticeships are the bedrock of skills training. They encompass all three stages of learning - watching, participating and doing. The culture and environment surrounding apprenticeships or internships in Oman needs to be greatly enhanced.

Applied skills in technology and real-world learning will be particularly crucial in the new era of the 4th industrial revolution - and would allow

Given the rapidly changing environment brought on by digital disruption, energy stakeholders should strive to work with technology companies to ensure that standards and accreditation for technical education is constantly improving and up to date. By establishing this closer collaboration, they can learn better and faster how technological infrastructure is developing and introduce that into current and future vocational standards and frameworks.

The rapid rate of technological advancement renders what we learn today obsolete in a very short period of time, so learning and re-learning continuously has to become an important skill and needs to be cemented into society. It has been suggested that 65% of children entering school today will, when they graduate, work in jobs that currently do not exist. The education system will only go so far, and energy stakeholders have to understand this. Organizations need to direct their staff actively on transferring knowledge and teaching their employees how to be efficient learners. ■



Higher Education: Are we Missing the Point?

What are the key elements that will define value-added curriculums for the energy sector in the 4th Industrial Revolution? Trends in the world of technology create many new cross-functional roles for which social, analytical and technical skills will be required. However, most educational methods and institutions provide silo training and utilize dated practices that do not foster progress in talent development.

One of Oman's current challenges is how best to diversify its energy mix to ensure energy security for its rapidly growing young population. There is recognition that an effort to foster better collaboration between academia and industry could provide one pathway towards this. But not enough progress has been made. Why are academia and industry still

not engaging in a meaningful enough way to meet their mutual needs? Very few universities around the world have been successful on this front thus far, bar a handful, such as Princeton University in the US and Masdar Institute in the UAE. What needs to be done to finally bridge this gap?

Education in Oman needs to keep up with what is happening in the industry and identify how it can be more relevant and flexible. This requires a structured and defined dialogue. Some are of the view that academia must not work in isolation and need to first get their 'own house in order' before engaging with industry. This would ensure that the courses they offer are complementary; this would give them a stronger case when they approach corporates for investment or collaboration. Perhaps the educational sector is



currently overregulated, which prohibits it from being creative and achieving certain targets.

Academia should work on devising programs, courses and methods of delivery that are relevant to today's generation, be it theoretical or vocational. Sometimes for example, the training requirement is what's needed more than academics and using social media as an educational tool may be more effective than a power point presentation. Another avenue is to choreograph and align educational courses to match more precisely the needs of Omani industries. Otherwise their knowledge could be rendered mostly irrelevant when they start work.

Academia needs to deliver active and independent learning processes. There are different ways to cultivate and nurture students' development. One can often find students at universities who want to be creative and innovative, but certain curriculums or teaching methods force them into a certain way of learning that are no longer in sync with the environment.

Some progress is being made in the way that academia thinks and functions, such as using benchmarking. The University of Oman Project Office recently established a new campus that will specialize in science, technology, medicine and health sciences. It benchmarks against Nanyang Technology University, which has partnerships with industries like Rolls Royce engines. The model entails measuring performance on how such partnerships are working, research and development and even detailing what each faculty or researcher is doing and who is involved in the process.

The private sector must ensure it is making its own needs clear to academia. There needs to be a full and continuous mechanism of engagement about where that is headed. This includes interactive feedback on whether industry needs oil engineers, chemical engineers, IT engineers, or indeed renewable energy technicians. These elements must be mapped out and adopted as a national strategy that is compatible to all participating companies.

“The energy industry needs people with skills in critical thinking as well as the fundamentals like numeracy, literacy and science. Students also need to be fully represented as the third leg of the academia-business stool.”

The energy industry needs people with skills in critical thinking as well as the fundamentals like numeracy, literacy and science. Students also need to be fully represented as the third leg of the academia-business stool, but this is often not the case. Young and relatively inexperienced talent can sometimes identify opportunities that no one else can. An open mind must always be kept when thinking of ways to involve them.

The UK has a model called the Knowledge Transfer Partnership or KTP, whereby the government funds 50% of a project and the academic institution funds another portion, as does business, for example. Graduates doing a Bachelors or Masters degree are then placed in industry. A company like PDO could do this and place a student with preliminary knowledge on a 6 or 12-month project. There would be a workplace mentor, as well as an academic mentor and the company would work with academia via this individual's secondment through regular monthly meetings and measured outcomes.

Lastly, there is no need to reinvent the wheel as there are many models out there that have been proven to work. Studying best practices that have been tried and tested when it comes to integrating academia with industry is a viable route. For example, universities in Australia are quite aggressive at marketing themselves and engaging with industry on what students they may be seeking. They inform industry on what research is being done and what innovation centres they hope to open and so on. That way, they both establish a relationship and capture investment. ■



A New Breed of Talent: Millennials

Millennials are ambitious, career-driven and tech savvy. They thrive on challenge and have a strong focus on the mission and vision of companies. They research their roles thoroughly and are more structured in their approach to work in general. Creative thinking is embedded in their psyche and they enjoy and expect to have a work life balance. They look for collaborative environments, while also being capable of independent thought.

Understanding these attributes, among others, and adapting to accommodate them is crucial in enabling the energy sector to attract millennials. By

2020, they will make up 50% of the global workforce. The industry needs to instill a level of trust in them and create opportunities to do the jobs they want to do – and that requires a change of mindset.

Millennials will change jobs more often and organizations unprepared to accommodate this may lose out. A healthy turnover of staff benefits both employees and companies in the long-term as they gain exposure to new skills, new ways of thinking and doing. This brings in fresh intellectual material.

The on-off switch for millennials is undoubtedly passion; that's the bottom line for retention, particularly with the diverse industries that are



“It's part of business strategy to compete on our best assets and those are not the drill machines - it's the people. They are more relevant and important now than ever.”



springing up in technology. If millennials think an energy company is focused on the environment for example, it may be a more attractive prospect. They tend to view their work as serving the larger community and not just the company per se.

Nurturing creativity to help solve problems is important. Millennials should be empowered to act relatively freely and not be suffocated by convention or a top-down approach. Clear company structure and leadership guidance is key. At the same time, giving young leaders direct access to senior company members to pitch innovative ideas and be part of the decision-making process reinforces an ecosystem of full engagement. The alternative ideas that new recruits present may sometimes be naïve, but challenging the status quo can also be a very powerful tool. Of course, it is not just millennials who are introducing changes to the work environment in the energy sector. Technologies

and value chains are evolving, so it's about how the transition in the oil and gas industry in Oman is managed going forward.

Traditional skill sets still matter. If you are an operator running a dangerous operation, you must have experience. Some parts of the business simply need that rigor and diligence and such experts cannot be replaced with technology. Millennials can work and learn from this old school experience. Yes, we need to focus on millennials' potential, but we also need to ensure that we are not leaving the Baby Boomers behind.

The world has become more connected, opportunities are more available and skill sets are more developed. We need to stay relevant by re-training the workforce and transforming the leadership mindset. It's part of business strategy to compete on our best assets, and those are not the drill machines - it's the people. They are more relevant and important now than ever. ■



Artificial Intelligence & Robots

- What Impact will automation, robotics and artificial intelligence have on the future of work?

Automation will be a game changer for the energy industry. More digitization, machine learning and robotics, specifically in the drilling industry, will reduce non-productive time, disruption due to human error, injuries and fatalities. Until about five years ago, there was minimal talk about automation, digitization or using artificial intelligence (AI) in the upstream oil and gas business. Now, AI has the potential to automate almost the entire process of drilling wells using robotics and digitized controls of the whole system. A rig generally employs about 120 people, excluding supporting logistics staff; automation can cut that manpower requirement by about 70% and synchronize, drastically improve operational and safety performance and hence reduce operational costs.

While automation will make some jobs redundant, it will also create more targeted jobs which will require people with specialized and focused skills and emotional intelligence. Striking the right balance is important, and strategizing to make sure we automate correctly and employ the right people in the appropriate domain to minimize redundancy and safeguard against machine-made errors. Moreover, we need to ensure our future strategies continue to create the appropriate jobs along the supply chain.

Machines will be important in harvesting, collating and tabulating data but the human element will always be required for knowledge and expertise in deploying emerging AI areas. However, we also need to be mindful of human error and bias and ensure the appropriate talent and expertise is employed in data



Automation will create more targeted jobs, which will require people with specialized skills, a high IQ and emotional intelligence. Striking the right balance is important and strategizing to make sure we automate and employ people correctly to minimize redundancy and machine-made errors will be a top priority."

analysis and data science – these upgraded skill sets are very important. It is also crucial to be committed to not only harvest data but also make sense out of it - analyze it and be transparent about what has been collected. This will ensure alignment across the business cycle and help in deploying AI most efficiently.

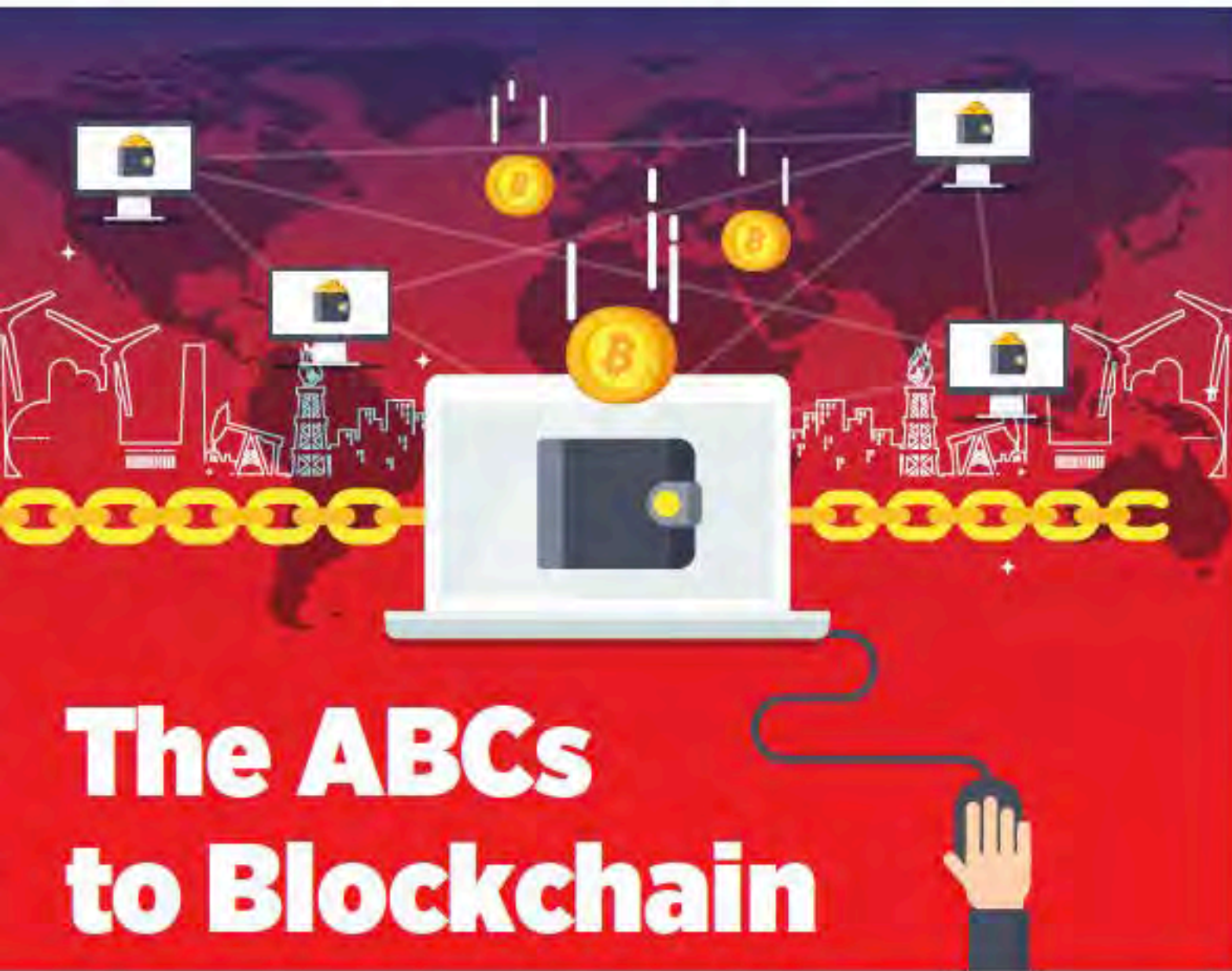
The uptake of automation has tended to vary widely within company strategies. So far, it's the service companies who have invested more than the operators have.

Companies like BP, Shell, Total are starting to move their core systems to the cloud because they realize the benefits of accelerating AI adoption but in this region and some other countries, it's not happening as fast as it could due to data security sensitivities. We need to educate and create an awareness and understanding that AI and its related applications are secure. The lack of technological literacy is still creating a fair amount of fear of cloud technology and its related advantages.

In Oman, we need to work on building digital skill sets, and fast, so that a healthy level of employment can be maintained. Traditional and basic skills will always be needed but we have to be able to complement

these with qualifications that can address particular elements related to AI and digitization – and this takes a very selective approach. New jobs need appropriate training.

The World Economic Forum Jobs Report highlights that by 2020, more than a third of the desired core skillsets of most occupations, do not currently exist in today's job market. In this region alone, digital transformation could create above 20 million jobs over the next three years but only if the right skill sets are developed. There is still much misalignment between those seeking new jobs and the skills needed in the new economy, across both companies and geographies. The soft skills of emotional intelligence are progressing, but we also need to focus on specialized and technical attributes. The adoption of personal computers globally over the past four decades has created around 300 million jobs in programming and related fields and we now witness it transitioning into areas like AI. This is proof that technology disruption can be a very positive development but the labor market and the policies directing it must keep up for this to be fully realized. ■



The ABCs to Blockchain

How can companies take advantage of this new technology?

Blockchain is everything that we know about cryptography, networks and operating systems. It is one of the key elements that enables us to bring forward a permanent digital record. Before blockchain, anything digital could be fiddled with, but that is no longer necessary. There are three key features of distributed ledger technology in blockchain that are important. Cryptography – where the underlying method of exchanging data is encrypted – and in this increasingly insecure digital age, that's an important advantage. The second is that it is a distributed technology – it doesn't sit on one server, computer or any one cloud – and it has the capacity to share

information synchronously everywhere. And thirdly, it uses various protocols that allow for data to be immutable, which means in theory it cannot be changed by any one central player.

Disruptive instruments of change like blockchain are increasingly becoming an area of focus for all businesses. Gartner Research has said that two thirds of large companies with more than 20,000 employees expect to implement blockchain technology into their systems during 2018. There has already been \$2 billion invested in corporate venture capital activity in companies targeting this technology and exploiting it to add value to new and existing industries.

The oil industry is a target rich environment for

blockchain as there is a lot of interaction. Interaction between parties associated with government, contractors, subcontractors and many more all encompass factors that are enhanced by the consensus layer element of blockchain. Remove this layer and you are left with a database. Distributed databases today are used among a few groups, but they are not the same as a distributed ledger or blockchain, which critically brings a new level of trust to any interaction. It apportions responsibility and you also get resilience in a manner that is permanent and unchallengeable. Blockchain is very effective where there is a need to decentralise activities – it cuts out the middle man.

The most well-known successful application of this, thus far is Bitcoin, the first generation of cryptocurrency. Another blockchain application is in smart contracts – such as Ethereum – that can be used in the finance or insurance industries, as well as other sectors.

The most advanced generation of blockchain application is in the Internet of Things (IoT), which would be a gateway to the technology's use in the energy industry. To find out where blockchain would be most useful, we need to figure out who the players might be – they may not necessarily trust each other and have different responsibilities. We also need to establish how that trust may fail and lastly, where this sits exactly within the scope of government and private enterprise. Most critically, we should study where this technology of digital transfer can reduce costs and enhance the speed of projects and services and make quality enhancements. What can it do, for example, for challenges in oil production, for gas distribution businesses, transport logistics, sensors in the oil field? And where can it lead to cost savings in the oil industry?

A blockchain solution would mean everyone has the same Excel sheet and ledger and no one could change it without consensus. All players can add data and applications to this process – as long as all agree on them. Thereafter, the system is automated through a sensor and then judged by a smart contract which rules on performance.

An example of blockchain in the upstream sector side of the business could be in the paperwork on moving water in shale projects. Blockchain could remove the need for manual ticketing and would instead store records digitally and remove the friction around the speed of payments and processing.

Further downstream, in trade finance or in the process of trade documents, advantages could be found in reducing back office operations and costs by 30-50% and in removing fraud and errors in trading. The focus would be on process efficiency and the crystalizing of sharing information back and forth.

On the other hand, bear in mind that blockchain is not necessarily a solution for all problems. We really must understand where the value is and how to move forward in degrees of access to the iCloud.



Automation will create more targeted jobs, which will require people with specialized skills, a high IQ and emotional intelligence. Striking the right balance is important and strategizing to make sure we automate and employ people correctly to minimize redundancy and machine-made errors will be a top priority.”

For example, on a national level, there are currently constraints because of sovereign limits, such as China's limits on Bitcoin.

The first steps to implementing blockchain in the energy industry would be to educate people on its mechanics and develop skill sets for it. For example, Oman has established an Oman Blockchains Solution Company and an Oman Blockchain Club to spread awareness and educate people on what databases do and what are basic scripting languages like JAVA.

The Oman Research Council is testing blockchain by running proof of concept and pilot case studies with partners in government, academia and industry. One example would be an application in renewable energy, whereby residents would sell energy to neighbors and get micropayment using cryptocurrency. Oman wants to trial that via PPPs and other projects in the supply chain of the energy industry.

Blockchain has different scopes. Bitcoin, which has had millions of transactions and never been hacked is an example of a public blockchain that is anonymous and decentralised. An example of a private permission blockchain is the one recently designed for Dubai's government, where 50 entities will share documents and 120 million documents will be removed through the use of blockchain by 2030. Then there is the consortium model, such as in companies like IBM and the finance sector. This is where multiple people work along the value chain on something that is controlled by that chain.

An element of control needs to be applied to private permission blockchains, be it a governance or procedure. Blockchain has turned security upside down, so we need to figure out which parts of our data will remain encrypted and private for a long time and which won't. ■

THE FUTURE OF WORK – ACTION PLAN

The Leadership Summit brought together an exclusive group of senior stakeholders in Oman to be briefed on The Future of Work Action Plan.

The senior leadership then voted on and scored in order of priority the Top 10 Recommendations from the action plan to be implemented immediately.

Recommendation	Total Score	LEAD INSTITUTION	SUPPORT INSTITUTION	IMPLEMENTATION
1. Energy industry to lead an emotional advertising campaign that places vocational education in line with being a patriot building the future of Oman.	310		PDO	
2. Create and execute an action plan to enhance digital literacy throughout Oman's energy sector.	279			
3. Create a digital platform that directly matches job seekers with industry opportunities based on their identified skill sets – an Oman LinkedIn. A job seeker can upload their CV to the platform and receive insights on the best jobs that they have skills and experience for.	275			
4. Create an Innovation Index that Measures a Company's Performance on Advancing the Employability of Omanis?	204	GI		GI hosted 3 Seminars in Q2, 2018 to establish criteria for Employability Index: attendees included OOC; OPAL; PDO; Bank Dhofar; MOFA; the IDO; Salam Air & the OAMC
5. Create a digital platform that facilitates real time engagement between industry and academia on labor market requirements. This will provide a foundation where academia can proactively evolve its curriculum.	178		PDO	
6. Align Industry & Academia to enhance vocational education and meet future labor market requirements. (ex. Leverage a protocol framework that closes the gap between industry & academia on vocational training).	173	PDO	OPAL	
7. Run proof of concepts and identify the pain points within the energy sector that can be greatly improved by implementing blockchain technology.	172			
8. Establish internship or apprenticeship programs that last for a minimum of 1 Year where students can engage in a longer period of applied learning.	169	PDO	OPAL	
9. Establish a structured framework, aligned with industry and academia, to develop vocational qualifications throughout the entire period of a student's university career.	161	PDO	OPAL	
10. Blended Degrees: Make it a compulsory part (elective courses) of university education that every student must have at least two semesters in a vocational training skill (plumbing) and/or 4th industrial revolution skill (AI).	80		PDO	

CASE STUDY: RECOMMENDATION No. 8 - PROJECT IMPLEMENTATION

Establish internship or apprenticeship programs that last for a minimum of 1 Year where students can engage in a longer period of applied learning

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OMAN / EDUCATION

Second Phase of 'Eidaad' internship program launched

PUBLISHED: 4:25 PM, AUG 19, 2021

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MUSCAT: The Ministry of Higher Education, Research and Innovation (MoHERI) today announced the launch of the second phase of the National Internship Program "Eidaad".

The program extends for a full academic year and targets students from public and private higher education institutions.

**وكالة الأنباء العمانية
Oman News Agency**

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NEWS

"Eidaad" Internship Program Launched

**شركة تنمية نفط عمان
Petroleum Development Oman**

Muscat, Nov 16 (ONA) --- Petroleum Development Oman (PDO) has joined forces with the Ministry of Higher Education, Research and Innovation (MoHERI) and a number of higher education institutions to launch a new programme which aims to enhance the working relationship between industry and academia.

"Eidaad" is a pioneering education initiative to establish a one-academic-year internship programme with leading companies in the Sultanate so students can engage in an extended period of applied learning in a discipline that is needed by industry.

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Home > About Ooredoo > Media > Press Releases > Ooredoo Supports Eidaad Internship Through Training Opportunities

Ooredoo Supports Eidaad Internship Through Training Opportunities

Muscat, 24 October 2021

Inspiring the nation's future business leaders, Ooredoo has joined hands with the Ministry of Education and Petroleum Development Oman (PDO) to train students participating in the Eidaad Internship programme. Starting in September 2021, final year students from colleges and universities across Oman have the chance to spend nine months at the Ooredoo HQ and learn key skills before they enter full-time employment. Eidaad is designed to help the interns gain real-world experience prior to graduation, teaching key skills including leadership, teamwork and creativity along with technical skills to give them an advantage in the competitive jobs market.

Amaal Al Lawati, Chief People Officer at Ooredoo said, "With more job seekers entering the market, the Eidaad program aims to bridge the gap between education and employment by giving the students a real-life experience. Lasting the length of a full academic year Ooredoo experts from various departments will offer an industrial exchange of knowledge and provide them with the skills that will last a lifetime."

STUDY / CENTRES / RESEARCH / SERVICES / BE INSPIRED / ABOUT

Introduction of "Eidaad" Program

Sohar University received a delegation from Petroleum Development Oman, as part of the efforts to enhance industrial and academic cooperation. This came on Thursday, December 31, 2020 at the Campus in the Learning Resources Centre. The aim of the visit was to introduce the "Eidaad" program, which is considered one of the important initiatives in collaboration between The Ministry of Higher Education, Research and Innovation and Petroleum Development Oman, and in cooperation with some academic institutions affiliated with the Ministry. This initiative aims to bridge the gap between industrial and academic institutions. Also, it aims to provide a combined internal training program for a full academic year. In addition, the program aims at building the students' applied abilities. The needs of the industry and the labor market. It also includes a pre-approved and recognized by academic institutions. The delegation included Maryam Al-Za'ajalya, as part of the PDO team. During this visit, some students' capacity and practical experiences to provide the necessary support to the university and related research laboratories.

NEWS CENTRES
NEWS Eidaad National Program is inaugurated

Sources:

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<https://www.youtube.com/watch?v=W-VA1XNPvZ8>

WHITEPAPER 2017

The Oman Energy Industry-Academia R&D Protocol

Narrowing the Gap between Industry and Academia to Establish Efficient Partnerships



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INDUSTRY-ACADEMIA COLLABORATION

Nurturing Oman's R&D Ecosystem: 3 KEY STEPS TO SUCCESS

Oman's historic entrepreneurial spirit has already reshaped the status quo of energy R&D. The long list of positive changes includes increasingly sophisticated enhanced oil recovery (EOR) technologies – such as Miraah, one of the world's biggest solar energy plants – to highly successful private-public partnerships that spur job creation for the sultanate's plentiful intellectual talent. Strategic R&D between Industry and Academia heralds a release valve on the growing pressure to master a delicate balancing act; sustain local production to support a swelling population while further safeguarding energy security by bolstering investors' confidence and geopolitical alliances.

Think Decades Ahead

Alongside other oil-producing centric economies, Oman stands at an unprecedented crossroads; embrace risk by shifting gears towards a diversified energy portfolio or risk becoming economically frail by sticking within traditional boundaries while competitors explore new methods. Hydrocarbons still account for 33.9% of GDP and 78.7% of Oman's state revenues, according to the Oxford Business Group, but the sultanate's non-oil sectors are playing an increasingly prominent role in the country's economic profile. One of PDO's many goals to enhance human capital includes 50,000 job and training opportunities for nationals outside oil and gas between 2017 and 2019. Oman's energy sector must also continue employing the digital toolbox of the 4th Industrial Revolution to boost operational efficiency while curbing rising costs. Artificial Intelligence (AI), predictive analytics and advanced robotics are the tip of an ever-growing digital iceberg that Oman would benefit from mastering before its competitors. The same ethos must apply to talent management: improving nationalisation, encouraging Oman's post-graduate talent to work locally and moulding a new generation of digitally-savvy and critical thinking workers who can flex to a rapidly changing job market. According to popular estimates, 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist. Flexibility will be king.

Geography Matters

Oman's energy R&D ventures must leverage the country's geographical potential; the sultanate lies at the crux of the historic Old and New Silk Road, China's 'One Road, One Belt' programme and India's 'Think West' policy. Major port developments, such as Sohar and Duqm, are beginning to take full advantage of the sultanate's potential in terms of maritime logistics. But unexplored opportunities along the country's 1,740km coastline remain. For example, Oman's energy industry could emerge as a regional, if not global, leader in the R&D of desalination and water recycling. Such growth is especially pertinent as the World Bank said more than half of current water withdrawals exceed what is naturally available and 82% of wastewater is not recycled in the Middle East and North Africa (MENA). The region faces the greatest expected economic losses from climate-related water scarcity – up to 14% of GDP by 2050.

Every Size Counts

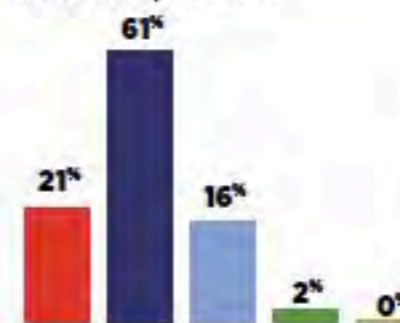
Oman must maximize the potential of its quickly growing pool of small and medium-sized enterprises (SME). The SME sector in the GCC region has the potential to employ over 22 million people in the next five years, research by Mena Research Partners (MRP) shows. For green growth alone, around 25% of the \$6.4 billion to be invested in clean technologies in the developing world over the next decade represent business opportunities for SMEs. Embarking on R&D efforts now – especially applied research – means Oman can take a good-sized slice of this emerging economic pie. Positive and quantifiable efforts are already underway, as illustrated by the business resources, services and funding solutions that are being provided to start-ups and SMEs by the new 'Meethaq Accelerate SME' portal.

STEPPING STONES TO SUCCESS

Survey responses during the Oman Energy Forum in 2016 highlighted the main gaps in the country's R&D ecosystem. The newly released Oman R&D Protocol and Ejaad platform aim to realign all stakeholders' goals to accelerate sustainable progress. Overall, the value of better communication is clear.

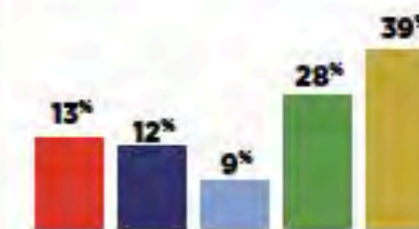
How wide is the gap between Oman's Industry and Academia that needs to be bridged to build an aligned 21st century R&D ecosystem?

- A. Very Wide as in > 5 years
- B. Wide but bridgeable in 3-5 years
- C. Not so wide as bridge already being built, completion in less than 2 years
- D. Vast and insurmountable
- E. There is no Gap – all is well



Which of the following is the greatest challenge facing efforts to bridge the gap between Industry and Academia on R&D?

- A. Available capital
- B. Available Talent
- C. Domestic market is too small
- D. Industry doesn't communicate clearly what it wants from R&D cooperation with academia
- E. Academia not structured for Applied research



A major conclusion of an OECD Growth Study was that Governments need to be more responsive to the rapid transformation of innovation processes and related business needs and strategies and that greater use of public-private partnerships can increase this responsiveness and enhance the efficiency and cost-effectiveness of technology and innovation policy.



IN FOCUS

What is R&D?

R&D refers to investigative and innovative activities aimed at improving existing products and thinking or that lead to the development of new products and methods. R&D typically aims to improve cost-efficiency, operational productivity and push the boundaries of the status quo.

Why does it matter?

Think back 100 years to families sheltering from the midday summer sun in the deserts of the Gulf, or the 2,000km trek by foot and camel to cross the Arabian Peninsula. Today, thanks to 20th century industrial innovations, Oman and its Gulf neighbours enjoy 24/7 air conditioning and the Peninsula can be crossed during a comfortable five-hour flight. Similarly, energy markets have benefitted from both

technological and intellectual growth. The scale and speed of Oman's operations in upstream oil production – sensors and automatic, predictive analytics to mention a few – are mind-boggling compared to the country's first drilling operations in the mid-1950s, for example. R&D is a cornerstone of making such dramatic and positive change possible; it inspires and nurtures humans' innate appetite to explore and push the boundaries of what we think we know. Without intellectual curiosity, progress stagnates. But ground-breaking R&D does not just happen. It needs robust foundation of financial, technological, regulatory and human capital tools to progress. Therein lies the value of the R&D Protocol; uniting efforts to make more meaningful progress at a faster pace. The only thing we know for certain is that there is much more to know.



Global Snapshot: ECONOMICS OF R&D

\$67bn

The volume spent on energy research and development worldwide in 2015, according to the International Energy Agency's World Energy Investment 2017 Report

4

Spending on energy technology generally or clean energy specifically has not risen in the past four years

28%

Europe and the US are the largest spenders, each accounting for just under a third of the total spend

1st

China is the highest spender on energy R&D as a share of GDP, after overtaking Japan in 2014

50:50

Although public and private sources each represent around half of the R&D total, most private R&D is in the oil, gas and thermal power sectors. Most public R&D is devoted to clean energy technologies

\$47bn

The future role of digital technologies has taken centre stage in energy discussions, with around \$47 billion spent in 2016 on infrastructure and software directed towards digitalization of the electricity sector alone. The oil and gas industry is also scaling up its utilisation of digital technologies to improve performance while curbing costs

Source: Compiled using the International Energy Agency's World Energy Investment 2017 Report

INTRODUCTION

Creating an



ECOSYSTEM

3
The majority of GIQ Survey respondents (88%) said in October that it is possible to bridge the gap between Industry and Academia within three years

62nd
Oman's ranking in the World Economic Forum's (WEF) Competitiveness Report 2017-2018 has moved up four levels, from 66th to 62nd in just one year. The UAE and Saudi Arabia rank 17th and 30th, respectively.

26%
The UN's growth estimate for Oman's population by 2030; from today's 4.6m to 5.8m

45%
The UN's growth estimate for Oman's population by 2050; from 4.6m today to 6.7m

INNOVATIVE OMAN: Hard Works Pays Off - But More Must Follow

77th
Oman's ranking on the Global Innovation Index for 2017, out of 127 countries

37th
Oman's impressive global ranking for Joint Venture-strategic alliance deals

29th
Oman's global ranking when it comes to the ease of starting a business - ideal for nurturing the sultanate's entrepreneurial spirit

39th
Oman's global ranking for its institutions; a combination of the sultanate's positive political, regulatory and business environment

61st
Oman's global ranking for gross domestic expenditure on R&D (GERD) financed by business

64th
The QS university ranking when considering the average score of Oman's top three institutions

73rd
Oman's global ranking in terms of gross domestic expenditure on R&D (GERD) performed by business

85th
Oman's global ranking for gross expenditure on R&D as a percentage of the sultanate's GDP

122nd
Oman's global ranking for patents by origin. Increasing the number of local patent registrations is a key goal, especially amongst the post-graduate community

Source: Global Innovation Index 2017

The success of R&D efforts in Industry, Academia and Government all feed back into accelerating Oman's economic growth and bettering its energy security. One part of the chain cannot succeed without progress in the other. A common understanding is essential.



“Incorporating financial sustainability into the R&D Protocol is vital to ensuring longevity. A clear financial methodology gives us the foundation for whatever challenges we face in the future and it avoids the creation of a philosophical protocol that lacks teeth. We now have a road map that promotes - rather than just discusses - the next steps to create tangible action. We have a protocol with a bite.”

H.E. AL RUMHY, MINISTER OF OIL AND GAS, MINISTRY OF OIL & GAS, SULTANATE OF OMAN



“We must move away from ideas and towards actionable goals - we cannot strategize forever. We have the ideas and we know who is responsible for each one of the ideas, but now they must be implemented. And we have a great deal of brainpower determined to see real change. Therein lies the value of the R&D Protocol.”

H.E. SALIM AL AFI, UNDERSECRETARY, MINISTRY OF OIL & GAS, OMAN

Academia

Academia cannot do research for research sake; efforts must be focused to deliver results that are useful to the industry and support Oman's national goals. Academia must fully understand the challenges that industry faces - legislative and economic hurdles, for example - and work with private and public companies to find solutions. Equally, industry must respect the capacity and limits of local universities and research institutions. Oman is blessed with considerable intellectual and vocational talent, but Academia needs the correct signposts from industry and government to ensure such potential is steered towards careers that support the sultanate's national goals.

Industry

Industry must clearly and frequently communicate its key objectives and expectations to Academia, especially considering the fast-changing nature of the energy market. Industry needs the best tools - both intellectual and technological - to ensure it can continually sharpen its edge in what is a deeply competitive industry. It must also appreciate the capacity and funding limits of local universities and research institutions and be ready to come to the aid of institutions to help propel their learning and research capabilities. This will help ensure that Oman's Academia has the tools and facilities required to nurture a world-class R&D energy ecosystem.

Government

Government faces a delicate balancing act. It must act as a positive link between industry and Academia and keep atop of developments to ensure it has a clear outlook of Oman's intellectual and technological value chain - both factors are integral to the country's National Vision and economy. State involvement can facilitate and not hinder progress by providing regulatory support that encourages positive and accelerated R&D progress in industry and Academia.



“We need to narrow the gap between today's knowledge creation and application - this is where Ejaad comes in. It's a partnership institution - not a government, nor an academic, nor an industry institution. It is a collective effort where concepts and ideas can be transformed into viable options - a step of huge significance.”

H.E. DR. HILAL AL HINAI, SECRETARY GENERAL, THE RESEARCH COUNCIL



“The R&D protocol is a clear win-win for all of us. Why do I say that? Because it facilitates industrial investments to better find solutions and broaden our scope of what we think is possible. It's about the evolution of information. We can apply research to create real solutions out in the field and then feed operational knowledge back to the research lab to support further innovation. It's an ecosystem that requires each component to take part.”

RAOUL RESTUCCI, MANAGING DIRECTOR, PETROLEUM DEVELOPMENT OMAN

A Work in progress → **Stepping stones** → **Let's talk**

Oman has demonstrated a sustained commitment to innovative R&D over the past decade. The sultanate's position as a world leader in enhanced oil recovery (EOR) is just one example of the fruits of such efforts. Not only have Oman's novel EOR strategies stemmed and reversed a dramatic decline in domestic oil output, but they have also acted as a global showcase of the country's appetite for innovative and positive change. Such fresh-thinking will only become more critical as Oman prepares to tap more of its heavy and complex crude oil reservoirs to sustain and advance production.

The R&D Protocol acts as a map and compass for the next chapter in the sultanate's push to create a world-class R&D ecosystem that smoothly aligns the ambition and objectives of both industry and Academia. Many of the innovative technologies currently used in Oman's energy market are still imported via international partnerships instead of being developed within the country's borders. Reversing this trend means supporting all the surrounding factors that will make the alignment of R&D a reality; leveraging financial resources and proactively supporting communication and collaboration, for example.

Communication is key to ensure that the right challenges being faced by industry in the field are the challenges being tackled by Academia in the laboratories. Unprecedented shifts in the energy industry in Oman and beyond - notably the advent of the 4th Industrial Revolution and significant population growth - mean that the rules of the traditional game are evolving. It makes sense to learn the new rule book together, with what are two sides of the same coin closely collaborating. Greater clarity on funding costs, technological requirements, experimental facilities, timelines, field and research capacity and many other key factors is crucial.

INDUSTRY-ACADEMIA COLLABORATION

Lessons learned

REVIVING AMBITION:

What has hindered appetite for collaboration?

- ✓ Facilities required for experimental research are limited
- ✓ Research proposals from Academia for Industry lack clarity
- ✓ Limited clarity on availability of academic capacity and capability
- ✓ Limited in-country expertise to achieve some high-level research goals
- ✓ Expensive delays to discussions on potential solutions and scope of work

STUMBLING BLOCKS:

Why have some collaborations fallen short of expectations?

- ✓ Competency of the research team can be limited
- ✓ Unclear targets and timelines hinder depth and speed of projects
- ✓ Gathering data points in a timely manner from Industry can be challenging
- ✓ Industry and Academia have limited understanding of the other's capacity and capabilities
- ✓ Industry prioritizes solutions over understanding Academia's fundamental research challenges

PROMISING PROGRESS:

Why have some collaborations been successful?

- ✓ Industry communicated the nature of their challenge well
- ✓ Strong level of trust between Industry-Academia at the highest level
- ✓ Industry offered clear project expectations, transparent schedule and objectives
- ✓ Industry provided Academia with funding and relevant data to support research activities
- ✓ Industry-Academia had full and common understanding of the purpose behind the research



NEXT STEPS:

What is needed to encourage more productive collaboration?

- ✓ Continue to strengthen mutual trust - integral to the vital knowledge sharing processes
- ✓ Greater transparency between teams while safeguarding sensitive intellectual property
- ✓ Enhance Academia-Industry awareness of market requirements and research processes
- ✓ A holistic outlook: both sides to better understanding of overall challenges and opportunities
- ✓ Clear and accountable objectives, deliverables, key performance indicators (KPIs) and timelines

* Source: These top 5 responses for each key question were derived from the responses of fifty participants at The 2017 Oman Energy Industry-Academia R&D Protocol Ratification Seminar on October 24, 2017 at the PDO Learning Centre. Points not in order of priority.

GOVERNMENT FOCUS:

Regulatory Burdens Affecting Industry-Academia Collaboration

- ✓ Inflexible rules and regulations
- ✓ Centralised decision-making processes
- ✓ Complex and lengthy administrative processes
- ✓ Career incentives linked with administration versus research
- ✓ Limited time for research due to administrative and teaching load
- ✓ Non-competitive, cost-focused and time-consuming purchasing policies

Source: The Research Council (TRC), 2016



FEEDBACK FROM R&D VETERANS*

Factors for Successful Industry-Academia Collaboration In Oman

- ✓ An ecosystem needs to be created to align fragmented efforts and initiatives between Industry and Academia.
- ✓ A truly successful R&D partnership requires a culture of innovation, which serves as a foundation for further progress between Industry and Academia.
- ✓ Centers of excellence must be created to offer research grants for identified projects into which PhD students can contribute. This would avoid duplication and save on costs for both Industry and Academia, as resources and facilities would be shared.
- ✓ The secondment of staff from Industry to Academia is crucial for Academia to truly understand Industry's R&D requirements. In turn, this will enhance the success of future projects between universities and Industry.
- ✓ Clearer processes need to be established to improve the methods by which Oman's innovative research and spinoff investments are funded and commercialized, both domestically and globally.
- ✓ A clearer funding structure for basic, applied and experimental research must be established.
- ✓ A clearer governance structure between Industry, Academia, and Government must be established.
- ✓ A more robust Intellectual Property (IP) policy must be developed in Oman to leverage the country's R&D offering at home and abroad.
- ✓ The Government should act as a regulator and not as a service provider. The latter should be left to the institutions themselves in conjunction with Industry when appropriate. The Government can help create an environment where R&D and innovation can thrive, but it is up to Industry and Academia to collaborate and take advantage of the resources at hand.
- ✓ Successful partnerships between Industry and Academia are established when there is complete transparency between both parties. This allows for the development of clear objectives, accountability and targeted KPIs.

* Source: Ejaad 2017 Veterans Survey, GI Consultancy, Ministry of Oil & Gas Oman, Ministry of Foreign Affairs, Oman State council

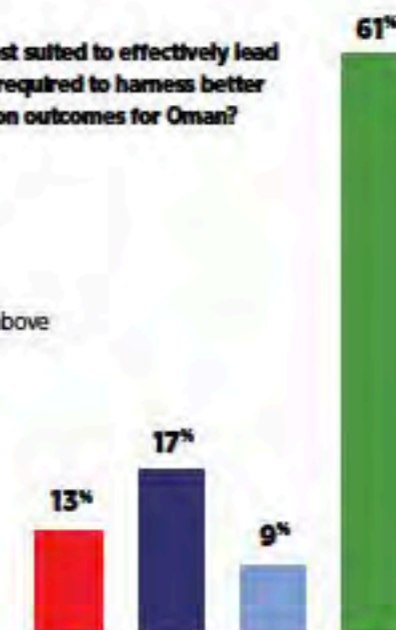
R&D Academia groups in Oman have taken on industrial ideas and challenges and produced reports and prototypes thus far. But they have failed to progress further to the commercial solution or product stage. Why?

- A. Lack of a pre-defined commercialization plan
- B. Lack of capability and resources in Academia to take the results to commercialization
- C. Lack of effective follow-up and confidence from Industry
- D. Lack of interest from industry due to costs of reaching commercialization
- E. Inadequate interaction between Academia and Industry dilutes value realization
- F. All of above



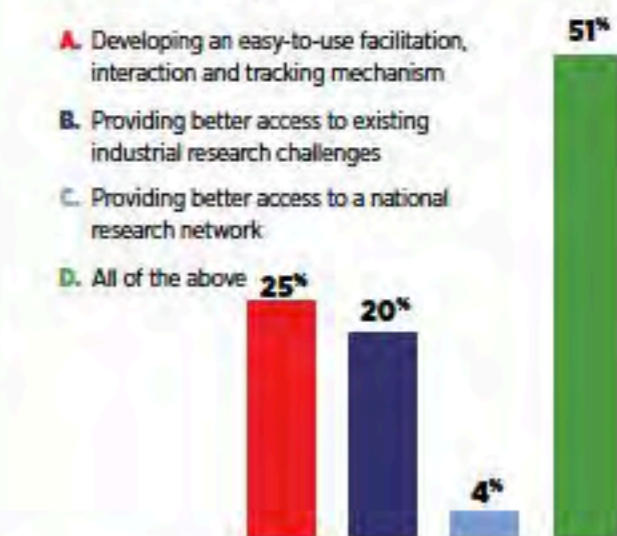
Which body is most suited to effectively lead the collaboration required to harness better R&D and innovation outcomes for Oman?

- A. Government
- B. Industry
- C. Academia
- D. A mix of all of above



The best way to bridge the gap between Industry and Academia is through:

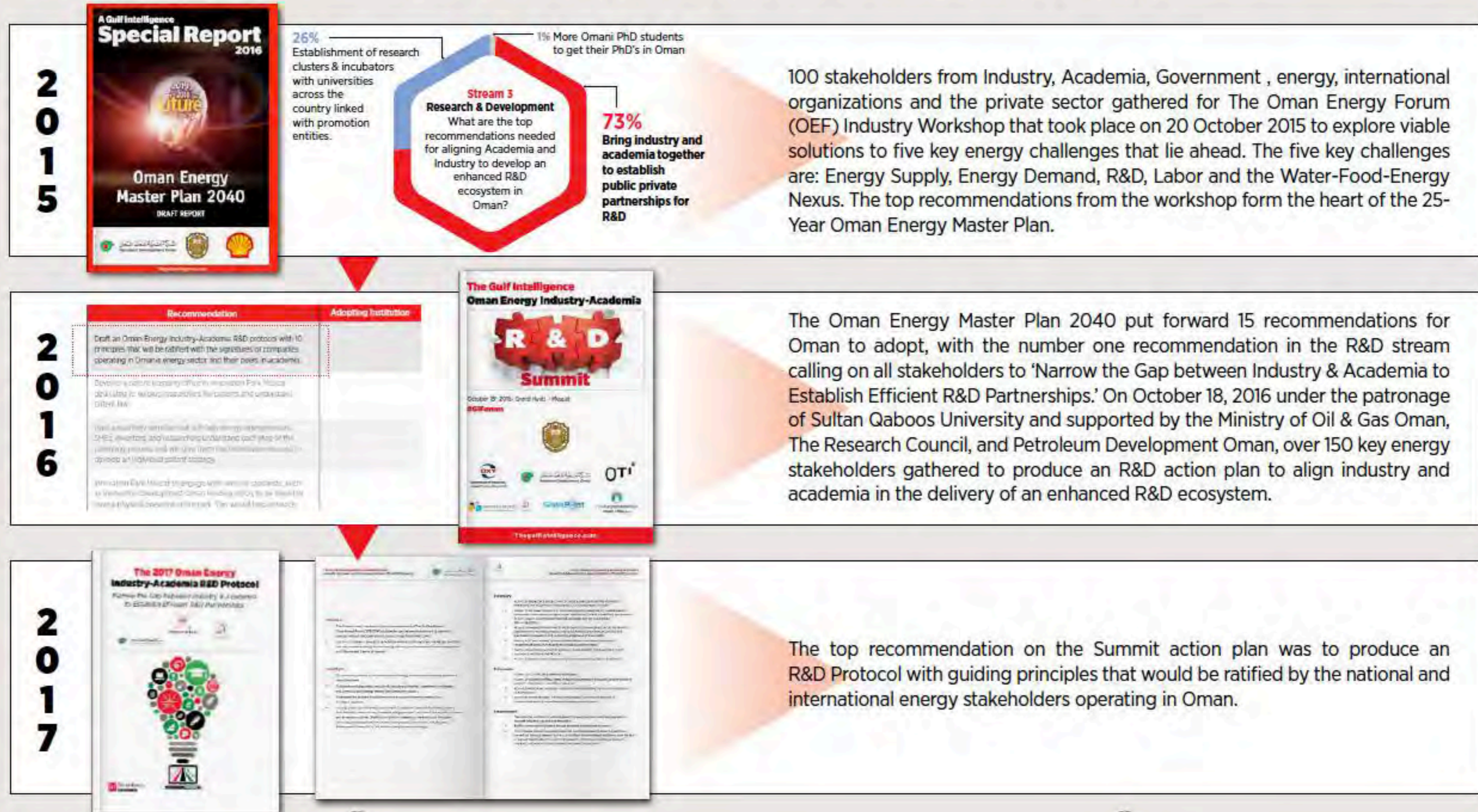
- A. Developing an easy-to-use facilitation, interaction and tracking mechanism
- B. Providing better access to existing industrial research challenges
- C. Providing better access to a national research network
- D. All of the above



Source: The 2017 Oman Energy Industry-Academia R&D Protocol - Ratification Seminar

The Origins of Today's Protocol

An active dialogue between all relevant stakeholders in Oman was held between 2015-2017 to narrow the gap between Industry and Academia and establish efficient R&D partnerships. Strategic communications consultancy and research firm Gulf Intelligence helped facilitating the delivery of the Oman Energy R&D Protocol. The Protocol was drafted by The Research Council (TRC) and Petroleum Development Oman (PDO). The Protocol was officially ratified and signed in June 2017 by H.E. Dr. Mohammed bin Hamad Al Rumhy, Minister of Oil and Gas; H.E. Dr. Hilal bin Ali Al Hinai, Secretary General of The Research Council; and Raoul Restucci, Managing Director, Petroleum Development Oman (PDO). Significant progress is evident with more than thirty signees of the Oman Energy Industry-Academia R&D Protocol as of December 14, 2017 (see page 16).



CASE STUDY: RECOMMENDATION No. 1 - PROJECT IMPLEMENTATION

OMAN ENERGY INDUSTRY-ACADEMIA R&D PROTOCOL - Narrow the Gap between Industry & Academia to Establish Efficient R&D Partnerships



June 2017

Oman's Ministry of Oil & Gas, Petroleum Development Oman (PDO) and The Research Council ratify The 2017 Oman Energy Industry-Academia R&D Protocol



2015

2016

2017

PROLOGUE

May 2015

Gulf Intelligence meets with the Ministry of Oil and Gas in Oman

"We need a long term Oman Energy Master Plan that delivers recommendations and solutions that are aligned with all stakeholders from Industry, Academia, and Government"
- Senior Government Official



Oct 2015

The 2015 OEF Industry Workshop

One hundred stakeholders from energy industry, academia, and government, gathered for The OEF Industry Workshop on 20 October 2015 to explore viable solutions to five key energy challenges that lie ahead which are: Energy Supply, Energy Demand, R&D, Labour, Water-Food-Energy Nexus. The workshop delivers the intelligence and wisdom required to deliver the Oman Energy Master Plan 2040.



Nov 2015

Oman Energy Master Plan 2040 - Draft Report Published

The top three recommendations harvested from the OEF Industry Workshop for each of the key energy challenges addressed form the heart of the Oman Energy Master Plan 2040.



Nov 2015

Special Leadership Briefing with H.E. Dr. Mohammed bin Hamad Al Rumhy, Minister of Oil and Gas in Oman.

R&D PROTOCOL Timeline

Dec 2015

Gulf Intelligence meets with Sultan Qaboos University and The Research Council to discuss the next steps in pushing forward the top R&D recommendation from the Oman Energy Master Plan 2040 - to 'Align Academia and Industry in the Delivery of an Enhanced R&D Ecosystem in Oman.'

Oct 2016

The 2016 Oman Energy Industry-Academia R&D Summit

The Oman Energy Master Plan 2040: Tackling the top R&D recommendation is the key focus of the 2016 forum hosted by Sultan Qaboos University:

"Align Academia and Industry in the Delivery of an Enhanced R&D Ecosystem in Oman. The alignment between Oman's Industry and Academia must be urgently improved in order for the country to deliver an enhanced R&D ecosystem that fosters efficient public-private partnerships."



Feb 2017

Special Leadership Roundtable Briefing with H.E. Dr. Mohammed bin Hamad Al Rumhy, Minister of Oil and Gas in Oman.

The top recommendation from the The 2016 Oman Energy Industry-Academia R&D Summit was to create an R&D Protocol to bridge the gap between Industry & Academia to establish efficient R&D partnerships.

H.E. Dr. Moahmmmed bin Hamad Al Rumhy selects PDO & TRC to champion the delivery of the Oman R&D Protocol for ratification.



March 2017 to May 2017

Gulf Intelligence, PDO and TRC collaborate and draft final R&D Protocol for ratification

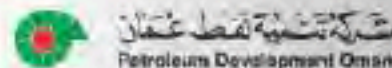




The Signed Oman Energy Industry-Academia R&D Protocol

The 2017 Oman Energy Industry-Academia R&D Protocol

Narrow the Gap between Industry & Academia to Establish Efficient R&D Partnerships



The 2017 Oman Energy Industry-Academia R&D Protocol

Narrow the Gap between Industry & Academia to Establish Efficient R&D Partnerships

PREAMBLE:

1. This Protocol takes cognizance of the recommendations of The Gulf Intelligence Oman Energy Forum 2015/2016 to bridge the gap between industry and academia to establish efficient R&D partnerships (Oman Energy Master Plan 2040).
2. This Protocol defines 'Energy' as all activities related to petroleum and natural gas, electricity, new and renewable energy sources, energy efficiency and conservation, water management and other related themes of interests.

OBJECTIVES:

1. To contribute positively in the development of energy research and innovation activities at the national level
2. To participate in organizing and actively engaging in seminars, conferences, workshops, and training to build energy research and innovation capacity
3. To leverage the available financial resources in supporting energy research and innovation activities
4. To participate in a membership-based virtual collaborative platform (hereinafter referred to as Platform) where industry, academia and government can interact and engage in research and innovation activities. The Platform shall be managed by the Institute of Advanced Technology Integration (IATI) formed by the Research Council (TRC) and Petroleum Development Oman (PDO). The Platform shall provide the following:

For industry:

- i. Access to researcher's directory which contains searchable profiles of research institutions and the profiles of more than -3,000 researchers in Oman
- ii. Access to the research electronic submission system where call for funded research proposals or consultancy services can be announced. Further, researchers can respond to such calls by submitting professional proposals that are endorsed by their organization.
- iii. Access to a well-established electronic system for a) developing contractual research agreements, b) handling proposal evaluation mechanisms (through national and international evaluators) and c) handling progress and final reports.
- iv. Access to a "staff mobility" scheme that facilitates secondment/training of researchers/experts from academia to industry and vice versa.
- v. Access to application process to utilize university facilities and equipment for the purpose of testing and verification.
- vi. Access to a list of research/admin focal points available in academic institutions.

For academia:

- i. Access to list of industrial research challenges.
- ii. Access to industrial funding; based on submitting research proposals tackling industrial research challenges or consultancy requests.
- iii. Access to application process to utilize industrial facilities for the purpose of research and innovation.
- iv. Access to a "staff mobility" scheme that facilitates secondment/training of researchers/experts from academia to industry and vice versa.

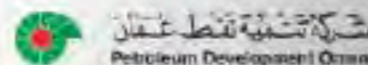
For government:

- i. Maximize the utilization of national research funding via fund matching approach to support industrial research and innovation
- ii. Fulfill the mandate of bridging the gap between industry and academia
- iii. To contribute towards the establishment of centralized research facility at IATI to be carried out through research funding. In addition, the centralized facility will cater for lack of standardized equipment, maximize utilization of existing equipment and avoid duplication of acquiring large or expensive research equipment.



The Signed Oman Energy Industry-Academia R&D Protocol

The 2017 Oman Energy Industry-Academia R&D Protocol
Narrow the Gap between Industry & Academia to Establish Efficient R&D Partnerships



The 2017 Oman Energy Industry-Academia R&D Protocol
Narrow the Gap between Industry & Academia to Establish Efficient R&D Partnerships

ROLES AND RESPONSIBILITIES:

For the purpose of realizing and accomplishing this Protocol, representatives shall:

Academia

- I. Provide to the Platform systematic information on the capabilities and capacities of respective laboratories/consultancies/resources.
- II. Provide to the Platform a list of completed and ongoing R&D and Innovation projects.
- III. Provide to the Platform a list of research facilities and equipment.
- IV. Facilitate access to university facilities and equipment whenever is needed subsequent to the fulfilment of an application process.
- v. Adopt a "staff mobility" scheme that facilitates secondment/training of researchers/experts from academia to industry and vice versa.
- vi. Encourage joint-supervision of Postgraduate Students with supervisors from industry and/or IATI.

Industry

- I. Assign a focal point to liaison with the Platform.
- II. Provide a list of industrial research challenges and aspiration.
- III. Support at least one R&D project initiative per year over the next three years. This will be on project bases and subject to the Technical Committee agreement.
- IV. Reasonable endeavor in deploying and commercializing the output of R&D activities into their respective industry, through developing plans or endeavor to adopt some of the outcomes.
- v. Provide possible industrial funding; based on submitting research proposals tackling industrial research challenges or consultancy requests.
- vi. Operators shall consider joint industry-industry collaboration on projects of common interest such as thermal applications, fracking, water shut-off technologies and others.
- vii. Endeavors to adopt possible "staff mobility" scheme that facilitates secondment/training of researchers/experts from academia to industry and vice versa.
- viii. Endeavors to engaging in joint-supervision of Postgraduate Students with supervisors from academia and/or IATI.

Government

- I. Support industry to introduce R&D and Innovation levy into major contracts and monitor performance.
- II. Steer, support and facilitate the collaboration between industry and academia.
- III. Promote and develop IATI as a center of research excellence.

INSTITUTIONAL MECHANISM

For the purpose of pursuing this Protocol, a Working Team (hereinafter referred to as Team) shall be established to be responsible for developing, improving and executing this Protocol. This Team shall comprise primarily of staff from The Research Council (TRC) and Petroleum Development Oman (PDO).

The Team shall have the following functions:

- I. Coordinate the national agenda and set the priorities for the energy-related R&D activities.
- II. Coordinate with different organizations in Oman to get them engaged with the platform.
- III. Establish procedure and criteria for the operation of the Platform (project posting, proposal selection, fund awarding, staff mobility, facility sharing, etc...)
- IV. Report the activities of the Platform to top management at MoG, PDO and TRC
- v. Produce a rating system that measures industry & Academia compliance with the protocol.

For each project to be tackled by the Platform, a Technical Committee shall be formed comprising representatives of the respective industry (i.e. company), academic institution(s) and member(s) representing the Team above. This Technical Committee shall be responsible to:

- I. Produce a practical work plan for each project to assure effective implementation of the project
- II. Drive measurable KPI for projects
- III. Monitor performance
- IV. Produce a commercialization plan for projects and align industry/academia for project success and value realization.

Roud Restucci, Managing Director
Petroleum Development Oman



5/06/2017
(Date)

H.E. Dr. Mohammed Bin Hamed Al Rumayh
Minister of Oil & Gas, Sultanate of Oman



5/June/2017
(Date)

H.E. Dr. Hilal Al Hinal
Secretary General, The Research Council



5/6/2017
(Date)

Signees of the Oman Energy Industry-Academia R&D Protocol

*as of 14 December 2017

- ✓ Ministry of Oil & Gas, Sultanate of Oman
- ✓ Petroleum Development Oman
- ✓ The Research Council
- ✓ A'Sharqiyah University
- ✓ Caledonian College of Engineering
- ✓ Dhofar University
- ✓ German University of Technology in Oman
- ✓ Muscat University
- ✓ University of Nizwa
- ✓ Higher Colleges of Technology
- ✓ Sohar University
- ✓ Sultan Qaboos University
- ✓ BP Oman
- ✓ Occidental Oman Inc.
- ✓ Daleel Petroleum LLC
- ✓ GlassPoint Solar, Inc.
- ✓ Gulf Energy SAOC
- ✓ Oman Oil Company Exploration & Production LLC
- ✓ Oman Tank Terminal Company LLC
- ✓ Oman Society for Petroleum Services
- ✓ Oman Oil Refineries and Petroleum Industries Company SAOC
- ✓ Port of Duqm
- ✓ Shell Development Oman LLC
- ✓ Sohar Aluminium LLC
- ✓ Tasneea Oil and Gas Technologies LLC
- ✓ Lloyd's Register Oman LLC
- ✓ Target Oilfield Services LLC
- ✓ Falcon Oilfield Services LLC
- ✓ Oman Gas Company SAOC
- ✓ MEDCO Oman LLC
- ✓ Vision Advanced Petroleum Solutions LLC
- ✓ Schlumberger Oman & Company LLC
- ✓ Oman LNG LLC
- ✓ Al Baraka Oilfield Services SAOC

THE NEXT STEP: Ejaad Emerges As An Innovative Product Of R&D Protocol



Ejaad has been established in response to a key objective in the Oman Energy Industry-Academia R&D Protocol

A Key objective of the R&D Protocol

To participate in a membership-based virtual collaborative platform (hereinafter referred to as "Platform") where industry, academia and government can interact and engage in research and innovation activities. The Platform shall be managed by the Institute of Advanced Technology Integration (IATI) formed by the Research Council (TRC) and Petroleum Development Oman (PDO). The Platform shall provide the following:

“ Significant progress requires a robust roadmap, which gives all stakeholders clear signposts for the next step. Therein lies the value of Ejaad. Oman has developed this world-class tool to help marry all the intellectual and practical skills and needs of Oman’s energy sector in a sustainable manner.” ”

H.E. AL RUMHY, MINISTER OF OIL AND GAS, MINISTRY OF OIL & GAS, SULTANATE OF OMAN

Ejaad: What is it?

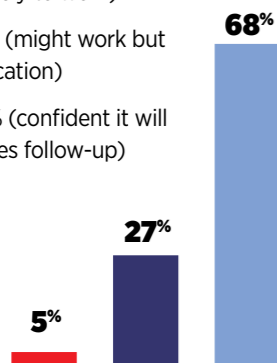
Ejaad is a virtual marketplace that is being hosted by Oman’s Institute of Advanced Technology Integration (IATI). Ejaad was developed in direct response to calls during the creation of the Oman Energy Industry-Academia R&D Protocol for a ‘membership-based virtual platform where Industry, Academia and Government can interact.’ Ejaad enables Industry to post challenges that Academia can see and propose solutions to these challenges. This common communications platform enables both Industry and Academia to clearly share ideas, track and apply solutions to

“ Oman is home to exceptional talent and natural energy resources – Ejaad is the platform that will unite these national treasures. Combining efforts between Industry and Academia on Ejaad will strengthen the sultanate’s economic and social growth for decades to come.”

RAOUL RESTUCCI, MANAGING DIRECTOR, PETROLEUM DEVELOPMENT OMAN

What is your confidence level that Ejaad is a step in the right direction to mitigate hurdles that confront efficient R&D partnership between Industry and Academia?

- A.** < 50% (unlikely to work)
- B.** 50% to 75% (might work but requires modification)
- C.** 75% to 100% (confident it will work but requires follow-up)



Source: The 2017 Oman Energy Industry-Academia R&D Protocol – Ratification Seminar



“ Ejaad is Oman’s R&D uber-like platform. It is a one-stop shop where academia and industry can capitalize on each other’s resources and fulfill R&D needs.”

DR. ALI AL SHIDHANI, DIRECTOR OF RESEARCH CENTERS & ICT RESEARCH, THE RESEARCH COUNCIL

major R&D challenges for Industry. Such a structured process means Industry can better harness the intellectual value of Oman’s Academia while giving researchers clear signposts for the main challenges that Industry needs resolving.

How does Ejaad work?

Once Industry have posted their challenge on the virtual platform for the attention of the research community, researchers will examine the information and post an expression of interest. The expression of interest will essentially detail how Academia would tackle the challenge, with Industry potentially receiving multiple proposals for a single challenge. Industry then chooses the best option – perhaps more than one – and corresponds with Academia to build a more detailed proposal that includes deliverables, timelines, milestones and so on. Thereafter, a research contract that TRC provides is

signed between Industry and Academia and Academia starts actively working to resolve Industry’s challenge. Each challenge has a technical committee, which comprises of one representative from Industry, one from Academia and one from Ejaad. This ensures there are no communication glitches between all parties and that both the research and commercialization of the challenge is aligned.

How do Industry and Academia sign up to Ejaad?

Ejaad is a user-friendly and unified process. Participants from Industry will receive a username and password to submit and monitor their challenge. Many participants from Academia already have their log in details as The Research Council has established data communication protocol with local universities.

How much information does Industry have to share?

When adding a challenge to Ejaad, Industry must put the title of the challenge and a description of the challenge. Other details include the sector, current practices and technologies associated to the challenge, the desired outcomes and the duration of the project. The latter relates to how long Industry wants the challenge to be hosted on the Ejaad platform. Ejaad has a default of one month, so Industry must actively adjust the duration if it is shorter or longer than four weeks. Industry can also use Ejaad to detail the budget for the challenge and attach supporting documents. If Industry wants to provide minimal information on the public platform to begin with – for intellectual property (IP) purposes, for example – researchers must sign a confidentiality agreement before receiving more information. The confidentiality document is then sent to IATI for endorsement.

What if Industry needs a very quick response to its challenge?

Industry has two options when sending a challenge. Option one is for Academia to give an expression of interest, as detailed



“ It is an honour and great pleasure to be part of Ejaad. This is a promising project that supports the enhancement of innovative research and will help sustain the production of energy for our future generations in the Sultanate.”

H.E. DR. ALI AL BEMANI, VICE CHANCELLOR, SULTAN QABOOS UNIVERSITY

above, before pinning down more details later. Option two accelerates the process by enabling Industry to ask for a full proposal straight away.

How to reassure Industry-Academia that the information and research is of world-class quality?

A researcher tackling Industry’s challenge will submit their workings and potential solution to a focal point in Academia. This means that the information is validated before being sent to Industry, which supports Oman’s ongoing transformation

into a world-class knowledge-based economy. This process hedges against the risk that a researcher may have overestimated their abilities, or is lacking necessary equipment to complete the challenge to the quality initially promised. Equally, Industry must have an internal focal point to efficiently review and feedback on the expression of interest from Academia. Having focal points in both Industry and Academia to double-check information will also accelerate the overall process by minimizing the need for back-and-forth queries later. Ejaad also facilitates

accountability by helping Industry approach researchers outside of Oman if they have queries on the initial feedback received from Academia in Oman.

How involved will The Research Council be?

The involvement of TRC will diminish in time as confidence and alignment between Industry and Academia using the platform continually strengthens. TRC currently plays a facilitating and educating role. Ejaad is an evolving system and additional improvements and suggestions may be integrated post-launch to continually enhance the quality of what is a unique offering. ■



OBJECTIVES:

- CONNECT:** Link academic research to industry needs
- PROMOTE:** Uphold industry-industry, academia-academia & industry-academia collaboration
- EXPLOIT:** Maximize ICV by routing business R&D requests to local academia
- ADD VALUE:** Deployment, commercialization and technology transfer of research outcome

SERVICES

- Industrial Challenges**
A marketplace for industry to present challenges and for academia to propose solutions
- Equipment & Facilities Database**
Comprehensive list of available research equipment in academia and industry
- Researcher Network**
Access to +3,000 researchers based in Oman
- International Collaboration**
Access to international academia and industry
- Workshops**
A one-stop-shop for training, short-courses and workshops
- Consultancy**
A hub of expertise for those who are seeking an advice within a particular field
- Staff Mobility**
Secondment of expertise from academia to industry and vice versa
- Research Ideas**
A mean to leverage fund and support for research ideas that may lead to groundbreaking solutions

Source: www.ejaad.om



EJAAD: SECURING SOLUTIONS IN THREE STEPS

1. Pre-award: posting challenges, call for solutions, evaluation and selection
2. Securing Award: research agreement between the parties
3. Post-award: fund release, technical committee, progress monitoring, review and feedback, commercialization

EJAAD: ADVANTAGES

- | | |
|--|---|
| <p>Strategic</p> <ul style="list-style-type: none"> ✓ Commercialization of research ✓ Linking academic research to Industry needs ✓ Maximize In-Country Value by routing business R&D requests to local Academia ✓ Promote Industry-Industry, Academia-Academia and Industry-Academia collaboration | <p>Operational</p> <ul style="list-style-type: none"> ✓ An easy-to-use platform ✓ Better access to the available research network ✓ A structured mechanism to track and report progress ✓ Readily available challenges, proposal and research contract templates |
|--|---|

EJAAD: MEASURING SUCCESS?

Key Performance Indicators for Ejaad in 2018 & 2019 with expected yearly growth of (5% - 10%)

- | | |
|---|--|
| <p>Year 2018</p> <ul style="list-style-type: none"> ✓ Number of local JIPs ✓ Number of challenges posted in Ejaad ✓ Number of training/consultancy agreements on Ejaad ✓ Number of awareness sessions on Ejaad | <p>2019 and beyond</p> <ul style="list-style-type: none"> ✓ Number of offered research services ✓ Number of offered training services ✓ Number of offered consultancy services ✓ Number of offered equipment testing services ✓ Number of staff secondments on Ejaad |
|---|--|

Source: TRC-PDO Task Force

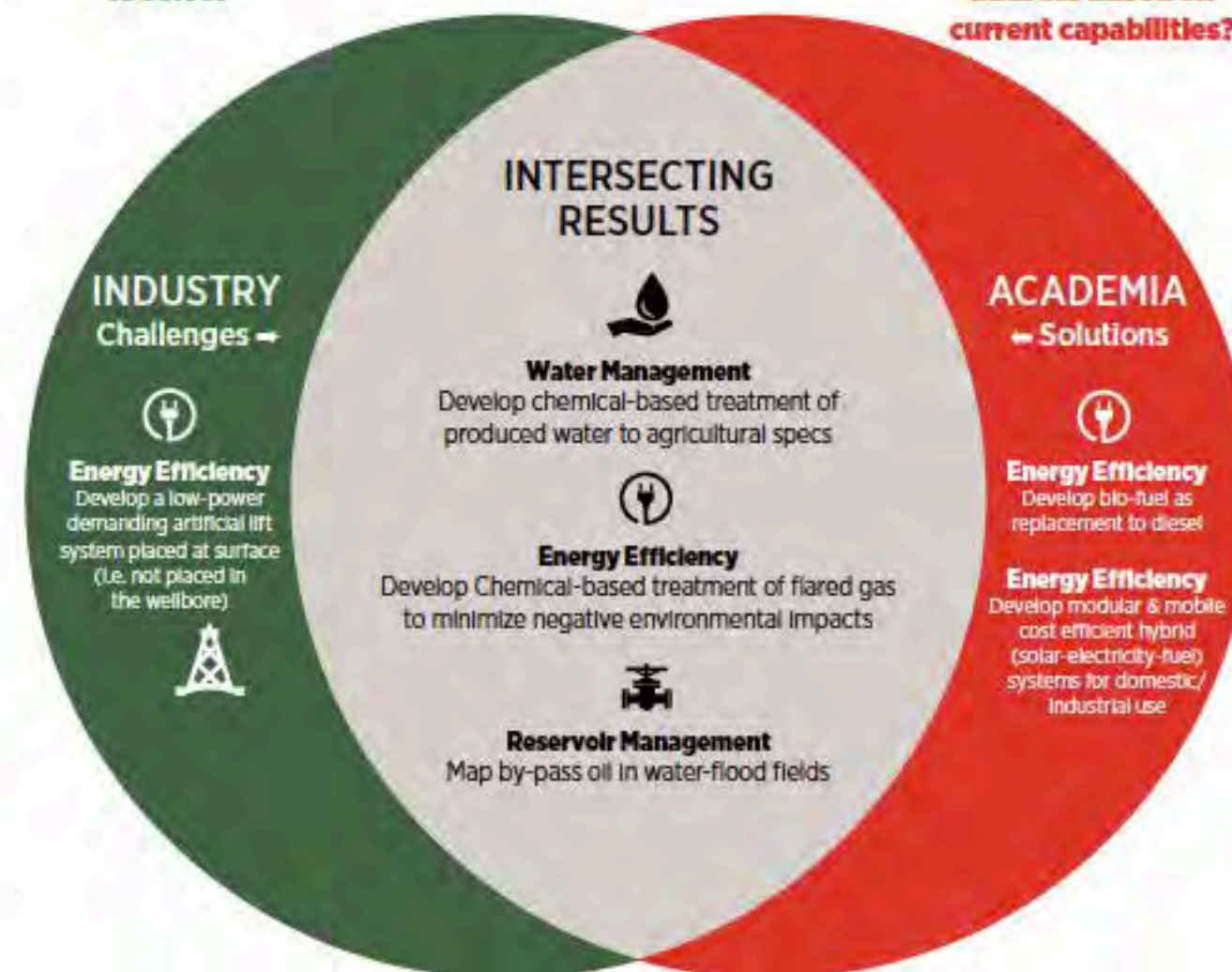
LOOKING AHEAD: TOP INDUSTRY & ACADEMIA RESEARCH CHALLENGES Survey Findings

The intersecting results below are a sample of key industrial R&D challenges, which Industry and Academia can start working on together following the launch of the Ejaad platform on December 10, 2017.

The results below were derived from a joint Industry-Academia survey taken in October 2017 to pin down examples of key industrial R&D challenges. Stakeholders in Oman's energy industry listed twenty hurdles that need urgent attention and from that list, Academia identified the challenges that can be tackled in a timely manner.

Identify the Top 5 Challenges that are most important to solve?

Identify the Top 5 Challenges that your organization can address based on current capabilities?



Industry & Academia Research Challenges - Survey findings taken from a sample of 70 Key Energy R&D Stakeholders in Oman in October 2017

How the teams for Ejaad interlink

Steering committee:

Steer, support and endorse the activities and way forward through monthly meetings

Ejaad Director:

Oversee the development of Ejaad and responsible to achieve Ejaad and R&D Protocol objectives

Advisors:

Give general advise on technical and operational issues

Technical committee:

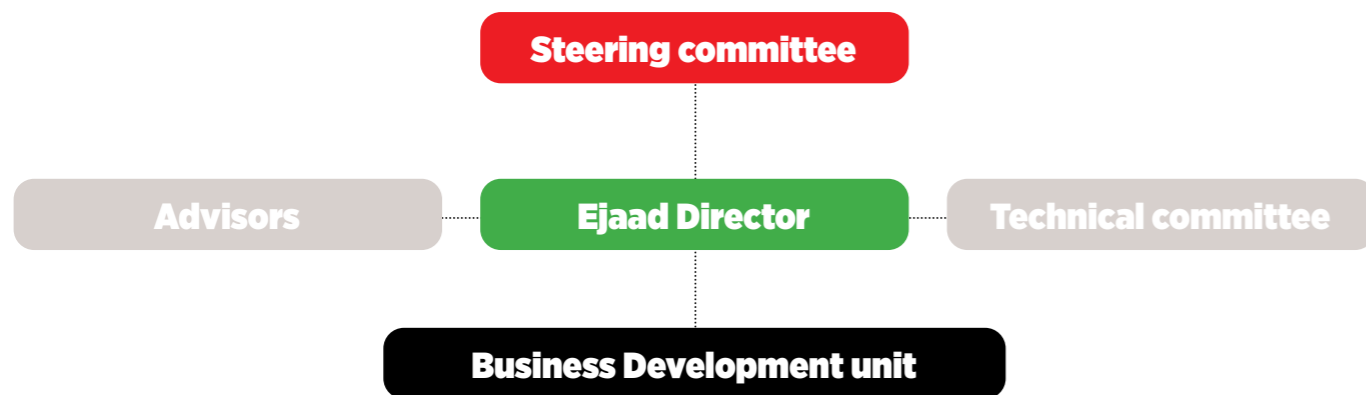
Monitor the progress of Ejaad projects and ensure commercialization plan in place per project

Business Development unit:

Engage with stakeholders and update Ejaad system and services

Industry Focal Point Roles and Responsibilities

- ✓ Become the organization's focal point in executing and fulfilling the Oman Energy Industry-Academia R&D Protocol requirements.
- ✓ Create awareness about Ejaad within the organization.
- ✓ Attend workshops/events related to Ejaad.
- ✓ Become the organization's point of contact on all matters related to Ejaad.
- ✓ Responsible for developing an "internal" system within the organization to support the operations of Ejaad



A PLATFORM FOR NATIONAL CHAMPIONS

Ejaad will play a significant role in deepening Oman's local vision and global reputation as an entrepreneurial nation. The potential of Ejaad is multi-faceted and touches many parts of Omani society and business.

- ✓ Job creation by establishing new industries as a result of solving industry challenges
- ✓ Building R&D capabilities in local academic institutions
- ✓ Cost-saving within industry by solving challenges and enhance the efficiency of its operations
- ✓ Ejaad will enhance human capital skills by:
 - Intense interaction
 - Staff mobility between industry professionals and researchers
 - Specialized training

www.ejaad.om

CONCLUSION



What's Next?

Detailed conversations, strategic brainstorming and open-mindedness have each played a fundamental role in establishing the Industry-Academia R&D Protocol – a roadmap of unprecedented clarity for Omanis today and for generations to come. The same ethos has been evident in the launch of Ejaad in December 2017, heralding a world-class tool that will help realize the Protocol's objectives in an efficient, sustainable and quantifiable manner.

Both the Protocol and Ejaad represent more than two years of dedication and hard work by stakeholders in Oman's Industry, Academia and Government, thus illustrating

the sultanate's entrepreneurial spirit. Both also mark a vital stepping stone - one with longevity - in Oman's transformation into a knowledge-based economy, while offering nations worldwide a clear template for achieving sustainable progress.

But, the journey does not end here – it has just begun. The Industry-Academia R&D Protocol and Ejaad represent the toolbox that Oman needs to make significant progress on key industrial R&D challenges. Now, Industry and Academia must leverage these new tools, open their intellectual doors to one another and focus on making quantifiable progress. A tool is only as good as those who wield it.



“Coming together is our beginning, staying together is our progress and working together is our success. Everyone is connected.”

DR. ABDULLAH AL ABRI, TECHNICAL LEAD, PETROLEUM DEVELOPMENT OMAN

A Gulf Intelligence
Special Report

2016



Oman Energy Master Plan 2040



شركة تنمية نفط عُمان
Petroleum Development Oman



Oman Energy Master Plan 2040

INTELLIGENCE HARVESTED FROM INDUSTRY WORKSHOPS

CONTENT

P.96	EXECUTIVE SUMMARY
P.97	THE 2015 OEF INDUSTRY WORKSHOP: STRUCTURE & FORMAT
P.98	FULL LIST OF PARTICIPANTS
P.100	STREAM 1: <i>ENERGY SUPPLY</i> SUMMARY & TOP THREE RECOMMENDATIONS
P.102	STREAM 2: <i>ENERGY DEMAND</i> SUMMARY & TOP THREE RECOMMENDATIONS
P.104	STREAM 3: <i>RESEARCH & DEVELOPMENT</i> SUMMARY & TOP THREE RECOMMENDATIONS
P.106	STREAM 4: <i>LABOUR</i> SUMMARY & TOP THREE RECOMMENDATIONS
P.108	STREAM 5: <i>WATER-FOOD-ENERGY NEXUS</i> SUMMARY & TOP THREE RECOMMENDATIONS
P.110	CONTRIBUTORS PAGE
P.110	FULL LIST OF RECOMMENDATIONS



EXECUTIVE SUMMARY

While the Sultanate of Oman has been able to use petro-dollars to fuel strong development over recent years, its economic and demographic growth is now poised to outstrip resources, posing a complex nexus of questions about how best to diversify its energy mix, while ensuring energy security and is it possible to do both without liberalizing the economy. There is no doubt Oman faces major energy challenges in the coming decades as conventional fossil fuel resources dwindle and its young population continues to grow rapidly.

Inevitably that leaves officials grappling about the long-term viability of the economy and the best energy sources and strategies to meet its needs and drive economic growth. Should Oman pursue clean coal, nuclear power or renewable resources? How important is R&D and the advent of new technology, what about addressing state subsidies that risk the frittering of cheap state energy. We need to ensure that industry-academia-government is adequately aligned to deliver the knowledge and labor force for overcoming tomorrow's challenges.

While there are divergent views on which of these questions are most important, a consensus emerges on the first step to resolving this riddle -- that is the need to draft a 25-Year Oman Energy Master Plan.

Rising domestic energy demand is presenting the country with a string of challenges and pressure on the Sultanate's already tight natural gas resources. Oman will have to devise a long-term strategy that considers adding alternative power generation sources such

as renewable energies, while also enhancing energy efficiency and improving demand-side management both on an individual and industrial level.

As the major contributor to the national GDP, the oil and gas industry and the energy sector in general are uniquely placed to drive innovation in all sectors of the economy. The private sector is of fundamental importance. For Oman to succeed in its long-term quest of becoming a diversified, knowledge economy that offers high-valued and sustainable employment for nationals and doesn't have to rely on the sale of hydrocarbons, the country may need to liberalize the economy and establish a much bigger private sector that serves as an economic growth and job creation engine – and provide incentives for Omanis to move into it.

One hundred stakeholders from industry, academia, government, energy, international organizations and the private sector gathered for The OEF Industry Workshop that took place on 20 October 2015 to explore viable solutions to five key energy challenges that lie ahead which are: Energy Supply, Energy Demand, R&D, Labour, Water-Food-Energy Nexus

Knowledgeable debates quickly yielded recommendations from leading figures, who then voted for the top five recommendations from each Stream. Then, the author of the five recommendations within each Stream promoted and defended the importance of their proposal. Three top recommendations were then shortlisted from each Stream to form the heart of the 25-Year Oman Energy Master Plan.



THE 2015 OEF INDUSTRY WORKSHOP - STRUCTURE

STREAM 1	STREAM 2	STREAM 3	STREAM 4	STREAM 5
SESSION A Shortlist Top 5 Recommendations <i>Energy Supply</i>	SESSION A Shortlist Top 5 Recommendations <i>Energy Demand</i>	SESSION A Shortlist Top 5 Recommendations <i>Research & Development</i>	SESSION A Shortlist Top 5 Recommendations <i>Aligning Academia & Industry</i>	SESSION A Shortlist Top 5 Recommendations <i>Water-Food-Energy Nexus</i>
Participants Move to Session B				
SESSION B Top 5 Recommendations Shortlisted to 3 <i>Energy Supply</i>	SESSION B Top 5 Recommendations Shortlisted to 3 <i>Energy Demand</i>	SESSION B Top 5 Recommendations Shortlisted to 3 <i>Research & Development</i>	SESSION B Top 5 Recommendations Shortlisted to 3 <i>Aligning Academia & Industry</i>	SESSION B Top 5 Recommendations Shortlisted to 3 <i>Water-Food-Energy Nexus</i>
OEF Workshop Final Declaration of Recommendations & Closing Comments				

STREAM RULES & FORMAT

The chatham house rule was invoked at the meeting to encourage openness and the sharing of information: When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.

SESSION A: SHORTLIST 5 RECOMMENDATIONS

SHORTLISTING 5 RECOMMENDATIONS:

- The Session was broken into
- Commentary from Host & Facilitators
- Open Mic with Recommendations Put Forward
- Voting on Recorded Recommendations with final shortlist of 5

SESSION B: REDUCE SHORTLIST FROM 5 TO 3 RECOMMENDATIONS

SHORTLISTING FROM 5 TO TOP 3 RECOMMENDATIONS:

- The Session was broken into 3 parts-
- Commentary from Host & Facilitators on shortlist of 5 recommendations from Session A
- Author of each of the 5 shortlisted recommendations was given 5 minutes to promote & defend their recommendation
- Voting on Recommendations to reduce Shortlist to 3

THE 2015 OEF INDUSTRY WORKSHOP – BUILD A 25-YEAR OMAN ENERGY MASTER PLAN PARTICIPANTS:

- H.E. Salim Al Aufi, Undersecretary, Ministry of Oil & Gas, Sultanate of Oman
- H.E. Talal Bin Sulaiman Al Rahbi, Deputy Secretary General, Supreme Council for Planning (SCP)
- H.E. Dr.Hilal Ali Zaher Al Hinai, Secretary General, The Research Council, Sultanate of Oman
- Raoul Restucci, Managing Director, Petroleum Development Oman
- Chris Breeze, Shell Oman Country Chairman, Shell Development Oman
- Abdullah Al-Hady, Acting CEO, Abraj Energy Services S.A.O.C.
- Alan Armstrong, Kuwait Operations Director - Middle East, Amec Foster Wheeler
- Qais Saud Al Zakwani , Executive Director, Authority for Electricity Regulation
- Praveer Chakravorty, CEO, Bahwan Engineering Group
- Abdulnasir Al Raisi, AGM – Corporate Banking, Bank Muscat
- Khalid Al Kindi, Deputy General Manager & ICV Manager, BP Oman
- Dr. Khalfan Al Barwani, Vice President, Central Bank of Oman
- Abduljalil Al Farsi, DNO
- Raid Al Salami, Chief Liaison Officer, Dubai Mercantile Exchange
- Jacob Nieuwenhuijze, Project Director, DUQM Refinery
- Eng. Omar Al-Wahaibi, CEO, Electricity Holding Company,
- Mohammed Ali Sulaiman Al Khaldi, Board Member, General Federation of Oman Trade Unions
- Prof. Dr. Michael Georg Modigell, Rector, German University of Technology
- Daniel Palmer, Vice President of Sales, GlassPoint
- Marwan Chaar, Director of Sales, GlassPoint
- Suhail Batoog, Communications Manager Middle East, GlassPoint
- Gary Ward, Operations Director, Hays Oil & Gas – EMEA
- Husain S. Al Lawati, CEO, Ibdac Tek
- Melissa Wimberley, Director Upstream Consulting, IHS Global Ltd Oman Branch
- Dr. Richard Soppe, Senior Scientist - Marginal Water Management, International Center for Biosaline Agriculture (ICBA)
- Arslan Khalid, IRENA
- Dr. Rabia Ferroukhi, Deputy Director for the Policy, Knowledge and Finance Centre, IRENA
- Faris Al Farsi, Director General for Investment, ITHRAA
- Eng. Nisreen Ahmed Jaffe, Economic Advisor, ITHRAA
- Albert Stromquist, Partner & Managing Director, Lanström Energy Advisors
- Michael Vredevoort, Chief Country Representative & Energy Business Development Manager, Lloyd's Register Oman LLC
- James McCallum, CEO & Chairman, LR Senergy Group
- Bader Al-Khrusi, Directorate General of Human Resource Development, Ministry of Education, Sultanate of Oman
- Soumaya Khamis Al Jashmi, Acting of climate affairs projects and techniques department, Ministry of Environment and Climate Affairs, Oman
- Zainab Mohammed Al Hashmi, Acting of renewable energy sources section, Ministry of Environment and Climate Affairs, Oman
- Saleh Ali Al Harthy, Director of Gas Revenue, Ministry of Finance, Oman
- Salma Al Oufi, Director of Oil Revenue, Ministry of Finance, Oman
- Dr. Halima AL-Badwawi, Assistant Director for Academic Affairs, Ministry of Higher Education, Sultanate of Oman
- Dr. Hamad, Director General For Planning and Development, Ministry of Higher Education, Sultanate of Oman
- Qasim Mohamed Al Aamri, Oil Marketing Department - Director General of Oil & Gas Marketing, Ministry of Oil & Gas, Sultanate of Oman
- Eng. Faiza Al-Wahaibi, Ministry of Regional Municipalities and Water Resources, Oman
- Dr. Syham Bentouati, Managing Director, NAFAS International LLC
- Abdul Rahman Humaid Al Yahyaei, Director - Arab Gulf Region, Occidental of Oman Inc.
- Amer Salim Al-Jabri, General Manager – Finance, Oman Gas Company

- Amor N Almatani, Deputy CEO and Chief Human Resources Officer, Oman LNG
- Hafidh Al Harthy, Chief Financial Officer & Deputy CEO for O LNG Affairs, NGF, Oman LNG
- Juma Al Araqi, Oman LNG
- Khadija Al Siyabi, Market Negotiator, Oman LNG
- Omar Al Mazroui, Snr. Manager Operation, Oman LNG
- Suleiman Al Zakwani, Chief Corporate Officer, Oman Oil E&P
- Ahmed Al Jahdhamy, CEO, Oman Power and Water Procurement Company
- Frits Ploeg, Business Development Director, Oman Tank Terminal Company (OTTTCO)
- Khalid Al Kalbani, Project Manager Floating Storage, Oman Tank Terminal Company (OTTTCO)
- Zahier Bin Khalid Al Sulaimani, Chairman, Oman Water Society
- Said Al Maawali, VP Petchem & Business Development, OTI
- Talal Al Awfi, CEO, OTI
- Yasser Al Fadhil, Trading Manager, OTI
- Ray Richardson, Senior Vice President and Oman Country Manager, Petrofac
- Abdul-Amir Ajmi, External Affairs Director, Petroleum Development Oman
- Hamed Hadhrami, Learning & Development Manager, Petroleum Development Oman
- Huda Aidid, External Affairs Legal Advisor, Petroleum Development Oman
- Maryam Al Maskari, Head of Public Relations & Event management, Petroleum Development Oman
- Nutayla Kindy, External Affairs Planning & Strategy Manager, Petroleum Development Oman
- Salim Al Sikaiti, Gas Director, Petroleum Development Oman
- Sami Baqi, Infrastructure Director, Petroleum Development Oman
- Saoud Al Jabri, Industrial Relations Manager, Petroleum Development Oman
- Suleiman Mantheri, External Affairs & Communication Manager, Petroleum Development Oman
- Suleiman Tobi, Oil Director – South, Petroleum Development Oman
- Reggy Vermeulen, CEO, Port of Duqm
- Dr. Andreas Stoerzel, Chief Executive Officer, RWE New Energy Ltd.
- Mohsin Al Hadhrami, Vice President & General Manager, Schlumberger
- Sana Bardawil, GM - External Relations UIN, Shell
- Dr. Ali Al Lawati, GM - External Relations, Shell Development Oman
- Irshad Al Lawati, Head of Corporate Affairs, Shell Development Oman
- Said Al Rawahi, Government Relations, Shell Development Oman
- Salima Al Masrouri, Communications Advisor, Shell Development Oman
- Timo Tjan, New Business Development Manager – Unconventionals, Shell Development Oman
- Yusuf Siddiqui, Director and Governance Manager, Shell Development Oman
- James McDonough, Plant Manager, Sohar Aluminium
- Abdul Aziz Al Hinai, CSR Specialist, Special Economic Zone Authority Duqm (SEZAD)
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- Dr. Svetlana Rudyk, Shell Chair– Oil and Gas Research Center, Sultan Qaboos University
- Dr. Abdul Aziz Al Hashmi, Associate Professor, Sultan Qaboos University
- Dr. Mohammed Al-Badawi, Sultan Qaboos University
- Dr. Rashid Al-Maamari, Head of the Department, College of Engineering, Sultan Qaboos University
- Prof. Saif Al-Bahri , Head of the Department of Biology, Sultan Qaboos University
- Dr. Slim Zakri, Sultan Qaboos University
- Talal Al-Hosni, Sultan Qaboos University
- Dr. Yahya Al-Wahaibi, Director of Oil and Gas Research Center, Associate Professor of Petroleum Engineering, Sultan Qaboos University
- Dr. Kathryn Chang Barker, Higher Education Expert Advisor, Supreme Education Council in Qatar
- Eng. Triq Mohammed Al-Mujaini, Electrical Engineer, Taweer Duqm
- Dr. Ahmed Said Al Busaidi, Director, Renewable Energy Research Strategic Program, The Research Council, Sultanate of Oman
- Dr. Yasmeen Al Lawati, Deputy Director of Institute for Advance Technology Integration (IATI), The Research Council, Sultanate of Oman
- Dr. Issa S. Al-Amri, Director of DARIS Center for Scientific Research and Technology Development, University of Nizwa
- Faten Hani, Project Manager - Oman University Project, University of Oman Project
- Ann Mason, Chief Commercial Officer, US Embassy, Oman
- Matthew Andris, Economic Officer, US Embassy, Oman
- Wouter Bijman, Managing Director, Witteveen+Bos EMEA



STREAM 1: ENERGY SUPPLY

WHAT ARE THE TOP RECOMMENDED STRATEGIES TO MAXIMISE BENEFITS TO OMAN OF ITS ENERGY RESOURCES?

Summary: There has been no shortage of ideas as to how Oman can harness its natural energy resources, from solar, wind and desalination projects to help ease the country's heavy economic reliance on oil and gas.

Most notably, there are calls to establish an energy ministry that can chaperone an energy action plan and regulate the industry. There are also calls for the participation of the public, including those in remote communities, to install small-scale rooftop solar power generation. Communities can also experiment with hybrid power generation to help guarantee their localised energy supply. There is an urgent need for more R&D of the energy sector in Oman and stronger communication between Industry and Academia. Reducing the level of bureaucracy would also be highly useful in speeding up decision-making so that renewable projects can get underway.

Many ideas to secure and develop Oman's energy status overlap with one another, which highlights the importance of a holistic approach. A more coherent regulatory framework could form part of an energy action plan for instance, while increasing public

awareness would be partially fulfilled by small-scale rooftop power generation. Interestingly, there was no support for exploring clean coal and nuclear power, as it is felt that they come with too many complications at too great a cost.

One of the most innovative suggestions was to develop renewable resources via the establishment of a secondary gas market, which narrowly missed becoming one of the top three recommendations. Incentivizing large-scale gas users who require gas supply to directly invest in renewable projects is key to this strategy.

While implementing this strategy is not possible under Oman's current regulation, there is considerable support for lifting the constraints and generating more foreign investment to back similar ideas. Fair concerns about the wealth of Oman being siphoned into the pockets of the few could be mitigated by royalties, or a taxation system. Whatever the best combination of solutions may be, the overarching concern is that not enough progress is being made. One discussion has led to many more discussions and little else. Now is the time for action.

STREAM 1: Top Three Recommendations

RECOMMENDATION ONE:

Create, Adopt and Implement a Comprehensive Energy Action Plan that can Facilitate the Immediate Implementation of Renewables

Increasing Oman's renewable energy activity requires clear targets and dedicated policy and regulatory frameworks, which nurture institutional coordination and nationwide capacity building. The time-consuming bureaucracy that those leading renewable projects in Oman often face must be overhauled, especially when it can take up to five years to secure land for relevant use. Solar and wind energy are two natural energy resources that Oman already has many of the tools required to make significant progress. Oman has the top three requirements for the development of solar energy; sun, land and access to ever-advancing technology. The country also has a relatively good resource of wind in Duqm – an area that is currently hungry for power – and in the south of Oman, especially during the Monsoon season. IRENA's Renewables Readiness Assessment conducted for Oman in 2014 illustrates how projects are already underway, but much more must be done and quickly. Oman's current pipeline of projects ranges from a 50 MW wind project being developed with Masdar to solar projects with an aggregate capacity of 200 MW near Adam, or Manah. Solar thermal power is a highly cost-effective alternative to using Oman's squeezed natural gas supply in the enhanced oil recovery (EOR) process, as demonstrated by PDO. Growth in reverse osmosis (RO) technology can also lead to small and large-scale desalination applications and potentially vast economic opportunities.

RECOMMENDATION TWO:

Establish a Ministry of Energy

Oman's Ministry of Oil and Gas is limited by its very name and it has no real stake in the development of renewables, which currently fall under the Public Authority for Electricity and Water (PAEW). PAEW comes under the executive authority of the Oman Power and Water Procurement Company (OPWPC), which is the responsibility of the Ministry of Finance. This means that the creation of an energy action plan that incorporates renewable ambitions currently requires the involvement of at least four ministries, or official bodies. This is a highly inefficient structure.

Establishing a dedicated energy ministry that is responsible for renewable energy and development in what is an increasingly diverse sector would mark a major step towards improving national energy and economic security. A new energy ministry could fold elements of PAEW and OPWPC into the operating framework to encourage a holistic decision-making process, bringing hydrocarbons and renewables under one roof. It would be considerably easier and faster to carve out the best energy mix for Oman if there are clear channels of communication between the relevant parties. This would also help fast track the renewable projects that have been postponed for years by bureaucratic delays

RECOMMENDATION THREE:

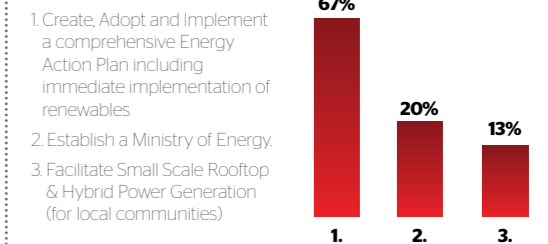
Establish Small Scale Rooftop and Hybrid Power Generation, which Also Support Local Communities

The cooperation of local communities is key to the success of any large scale energy campaign for two reasons: communities play a direct role in harnessing alternative energy and in raising awareness of energy efficiency within society. There is currently very little emphasis on the efficiency of consumption within Omani society, even though it is at the heart of Oman's energy plans. There are two possible solutions. Firstly, the government can encourage the development and application of small scale rooftop solar installations that are backed by an official regulatory body, which monitors policy, permits and building code and standards. Any power from these rooftops can be fed back into the system and the owners can be rewarded financially. Secondly, local communities can get involved in hybrid power generation – consisting of solar, wind, diesel and gas – which is particularly cost-effective and useful for remote homes. Hybrid power generation plants help counter the challenges posed by linear energy resources, thus enabling communities to be self-sufficient from the main grid. Diesel and gas can be used to compensate for energy shortages if seasonal weather impacts solar and wind availability, for example.

SURVEY FINDINGS: STREAM 1

Creating an Energy Action Plan tops 67 percent of participants' wish list. Only 20 percent believe establishing a new Ministry of Energy is worthwhile, while only 13 percent support the idea of small scale rooftop and hybrid power generation

Stream 1 - Energy Supply: What are the Top Recommended Strategies to maximize Benefits to Oman of its Energy Resources



STREAM 1 - HOST

Chris Breeze
Country Chairman, Shell Development Oman

Chris Breeze is Shell's Country Chairman in Oman. Before being appointed to this role, he was Senior Adviser for the Middle East and North Africa (MENA) at Shell's Government Relations department. Earlier, Chris served as a diplomat in the UK Foreign and Commonwealth Office, with postings in Egypt, Turkey, India, and Cyprus. He studied Modern History and Economics at Exeter College, Oxford University.





STREAM 2: ENERGY DEMAND

WHAT ARE THE TOP RECOMMENDATIONS FOR TACKLING OMAN'S DOMESTIC ENERGY DEMAND & CONSUMPTION OVER THE NEXT 25 YEARS?

Summary: Oman must urgently get its rapidly rising domestic demand under control in order to have a strong, balanced and sustainable energy portfolio drive its long-term fiscal health. Accordingly, there is growing support within Oman to reduce costly energy subsidies, boost energy efficiency through renewable projects and conduct a comprehensive national campaign to educate Omanis about the impending changes in their energy outlook.

So far, Oman has failed to embrace public transportation and the benefits that it can bring to the country's goal of energy efficiency. This is most clearly illustrated by the frequent congestion in Muscat's urban areas. Apart from a large fleet of taxis, Omanis usually have no option but to use their private cars for business and leisure.

The benefits of expanding a public transport network are globally recognised. Public transport reduces energy consumption and improves efficiency on a per passenger-kilometre basis. It also curbs air pollution, improves public health, reduces road congestion and can lead to vast improvements in road safety.

There are multiple environmentally friendly transport options that can be implemented relatively quickly, such as a Park & Ride service in heavily congested areas and an extensive bus network, which also supports more remote communities. Oman can also introduce high occupancy vehicle lanes and a commuter rail, all of which can be supported at least in part by electric charges, smart roadways and automated trains. Phasing out fuel subsidies would also trigger a

significant increase in the number of Omanis willing to take public transport, but these transport services must be made available to them before subsidies are reduced.

There is growing support for reducing energy subsidies in Oman, but there is an equally strong emphasis on introducing the cuts in a fair and even-handed way that protects the most vulnerable. The severity of subsidy cuts could be adjusted according to a means test, for example, while the windfall could be redirected into improving the general quality of life in Oman, such as healthcare, security and education.

Shifting the view of energy efficiency and subsidies in a way that Omanis can grasp the importance of adjusting their lifestyle will require a multi-pronged and long-term effort. One strategy involves integrating the economic and social issues surrounding ethical consumption into Oman's national curriculum across the entire education cycle in public and private schools from Grades 1-12.

The message of energy efficiency must be constantly reinforced. The nationwide campaign would help educate parents and teachers, but teachers must go a step further and undergo training so that their deeper awareness of ethical consumption is integrated into students' day-to-day studies. Plus, age-appropriate objectives and learning materials can be available in every classroom. This is not a new concept and Oman can seek inspiration for content, methodology and performance indicators from many classrooms and academic authorities around the world.

STREAM 2: Top Three Recommendations

RECOMMENDATION ONE:

The Structured Removal of Subsidies

Conversations in Oman to reduce, or cut energy-related subsidies have long been met with confusion and resistance. But with falling oil prices exerting considerable pressure on Oman's treasury and fellow GCC members taking bold steps to curb their spending – the UAE and Kuwait curbed their energy subsidies this year – Oman will soon have to follow suit. Muscat remains concerned that changes will spark a public backlash and calls for the government to reverse the cuts, which would wholly undermine the country's power hierarchy.

Two actions will significantly ease the public dislike of subsidy cuts. Firstly, cuts must be adjusted as per an individual's standing in society so that the lifestyle of those who are most vulnerable is not jeopardised. Secondly, Oman must gradually increase public awareness of the economic importance of subsidy cuts through a nationwide campaign over a matter of months, perhaps even up to a year. Plus, the government must provide transparent examples as to where the cash that is typically earmarked for subsidies will be spent – education, medical care, green transport?

RECOMMENDATION TWO:

Inducing Positive Human Behaviour on a National Scale

Reducing subsidies and government handouts may be seen as an ideal solution as falling oil prices squeeze Oman's economy, but there are also other supporting options. Inducing a nationwide change in behaviour is essential in boosting the level of energy efficiency in homes, workplaces and modes of transport throughout Oman. Both short and long-term initiatives can be implemented by the government to bring about a widespread change.

Oman could almost immediately embark on an aggressive nationwide marketing campaign that focuses on the merits of ethical energy consumption and offers practical alternative solutions for Omani consumers. The use of alternative energy resources could be encouraged by educating the public about domestic solar panels and the day-to-day benefits of using energy efficient domestic appliances.

A campaign could also highlight the financial burden that subsidies place on the government and how a widespread change in Oman's energy use could reinject that cash flow to improve education, for example. The immediate value of this approach is hard to quantify, but a bottom-up approach will be the most effective way to permanently change the nation's psyche.

RECOMMENDATION THREE:

Centralize Oman's Energy Policy under a Single Authority

There are many demands on Oman's government to establish a coordinated energy policy that is driven by a single and empowered body. The entity must have the authority to determine the right energy mix for the country - one that incorporates oil, gas and renewables - and the power to establish a mandate

for the efficient use of that energy portfolio. Oman's current approach is undefined and fragmented, but formal research and proposals can help outline the next step.

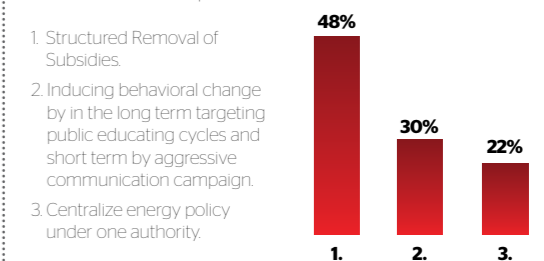
An energy authority would need to have a holistic view of all the activities and stakeholders in Oman's energy industry and understand both their short and long-term plans. Using this knowledge and other relevant data, the authority can comprehensively integrate guidelines that support Oman's Vision 2020 and Vision 2040. The guidelines would show how to execute ideas, to monitor performance and to streamline tactics amongst the stakeholders in the energy sector and the related authorities.

An authority would also need to ensure that Oman's energy goals are underscored by a sense of accountability; the country's economic and energy ambitions will crumble without it. Key performance indicators can help monitor progress, with those leading the programmes to be rewarded for their successes and penalized for their failures.

SURVEY FINDINGS: STREAM 2

Falling oil prices have clearly eroded years of resistance as subsidy cuts get support from nearly half the participants, while a third agree that the country's psyche can be overhauled. Appetite for a centralised energy authority was evident, but far from strong.

Stream 2 - Energy Demand: What are the Top Recommendations for Tackling Oman's Domestic Energy Demand & Consumption over the Next 25 Years?



STREAM 2 - HOST

Albert W. Stromquist
Senior Partner and Managing Director, Lanstrom Advisors



Albert has a distinguished career in the international energy industry as a scientist, executive, and business innovator. His work with leading brands including Amoco, Amerada Hess, Total and Enron has spanned the energy value chain. In 2004, Albert was invited by Abu Dhabi government to join Mubadala Development Company at its inception where he engaged from concept to execution in the Dolphin Gas Project, and was an architect and inspiration for Masdar and Mubadala Petroleum LLC.

Presently, Albert is Founder, Senior Partner and Managing Director of Abu Dhabi-based Lanstrom Advisors, leaders in corporate strategy, public policy, and bespoke investments in socially conscientious alternative energy technologies.

He earned a Bachelor of Science in Mechanical Engineering from Worcester Polytechnic Institute and a Master of Science in Geology from the University of Massachusetts.



STREAM 3: RESEARCH & DEVELOPMENT

WHAT ARE THE TOP STRATEGIES NEEDED TO ALIGN ACADEMIA AND INDUSTRY TO DELIVER AN ENHANCED R&D ECOSYSTEM IN OMAN?

Summary: A mix of three factors will determine the success of the relationship between Oman's Industry and Academia as they push independently to establish the country as a world renowned R&D hub: transparency and communication, research clusters and keeping Omani PhD students in Oman.

With this in mind, Oman could establish a 'Ministry of Science, Research and Technology' that oversees indigenous technology development, promotes and markets innovations and supports the immediate implementation and transfer of the best ideas. The ministry could also investigate ways to decentralize research, reduce bureaucracy and give researchers more freedom to manage and fund their projects.

There are also multiple benefits to developing regulations for effective IP and technology transfer management; notably the speed of transforming theoretical knowledge into practical value. Clearer processes could also improve how Oman's innovative research and spinoff investments are funded and commercialized, both domestically and globally.

Much more should be done to raise the global awareness of Oman's leading research and enhanced oil recovery (EOR) technological developments, for example. Oman is amongst the world's top innovators in EOR, with many home-grown technologies designed and tested by Omani engineers and researchers. Yet,

none of these technologies is currently owned by an Omani institution, or company. This highlights a big waste of effort and resources.

Establishing more knowledge-based companies within Oman could help. Innovation Park Muscat is making headway in its aim to provide an enabling environment for researchers, scientists, start-ups, small and medium-sized enterprises (SMEs) and multinationals. Its work could provide a blueprint for other companies and official bodies in Oman.

Another way of realigning the disjointed worlds of Industry and Academia is by setting up a 'Chair in Enhanced Oil Recovery', which would require a holistic view of Oman's energy innovation. Single research projects may not yield specific answers to long lasting problems within the field of EOR and heavy-oil recovery, which means researchers have to seek Industry insight to tackle the problem from multiple angles. A 'Chair in EOR' could promote a collaborative learning and practical environment, creating cohesion between the country's research bodies and strengthen the existing collaboration with national and international institutions.

Oman's R&D ecosystem would also benefit from clarifying and loosening import regulations for research tools. Waiting for approval for the import of R&D infrastructure causes big delays to research projects.

STREAM 3: Top Three Recommendations

RECOMMENDATION ONE:

Narrow the Gap between Industry and Academia to Establish Efficient R&D Partnerships

The alignment between Oman's Industry and Academia must be urgently improved in order for Oman to deliver an enhanced R&D ecosystem that fosters efficient private-partner partnerships. Academia cannot do research for research sake; efforts have to be focused in order to deliver results that are useful to the Industry and to Oman as a whole. Academia needs to fully understand the challenges that the Industry faces – legislative and economic hurdles, for example – and work with private and public companies to find solutions.

Equally, the Industry needs to appreciate the capacity and limits of local universities and research institutions. Industry must also be ready to come to the aid of institutions to help propel their learning and research capabilities to help ensure that Oman's Academia has the tools it needs to facilitate world class R&D. The benefits of such academic growth will feed back into the Industry and Oman's economic growth.

Regular workshops held by an overarching body, such as the Research Council, could nurture the relationship and help create a joint roadmap that sets clear and measurable targets.

RECOMMENDATION TWO:

Establish Research Clusters and Incubators with Universities across Oman that are Linked with Promotional Entities.

The establishment of research clusters and incubators across the country will aim to promote R&D in all parts of Oman, bringing together the various stakeholders and facilities across the country such as universities, private-sector institutions, multinational corporations and the public sector. Their goal will be to foster collaboration and to leverage knowledge of the local, regional and global market.

The establishment of research clusters will also help facilitate more private sector funding, which in turn will produce the highly qualified and skilled local workforce of engineers, technicians, scientists and researchers that Oman desperately needed.

RECOMMENDATION THREE:

More Omani students need to get their PhDs in Oman.

Encouraging a higher number of PhD students to study and work in Oman is vital - they represent the intellectual value and driving force behind top-level research. However, two main challenges mean that much of Oman's research does not currently get the attention it deserves.

Firstly, the majority of Omani graduates move abroad to complete their PhDs, with many studying topics that have no relevance to the country's research needs, or key industries. Secondly, foreigners studying for their PhDs in Oman usually move abroad following graduation.

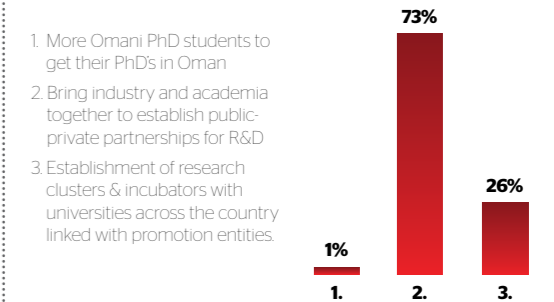
If more Omani PhD students can be persuaded to stay, then more may focus their research on issues that fall within Oman's oil, gas and renewables sector. Oman could also develop learning platforms for students to practically apply their newfound knowledge and innovative thinking. Students' inventions, if any, would be the property of Oman and not a foreign university, while more academic publications will boost the country's university ranking on regional and global listings.

Oman's PhD students could carry out short-term internships abroad to gain international exposure, but they must return to Oman to defend their thesis. Plus, employees of Oman's energy companies should be allowed access to part-time PhD studies.

SURVEY FINDINGS: STREAM 3

Three quarters of participants want to narrow the widening gap between Industry and Academia, while a quarter would support new research centres. Surprisingly, there was almost zero appetite to persuade Omani PhD students to study locally.

Stream 3 - Research & Development: What are the Top recommendations needed for Aligning Academia and Industry to develop an enhanced R&D Ecosystem in Oman?



STREAM 3 - HOST Dr. Yahya Al-Wahaibi Director of Oil and Gas Research Center, Sultan Qaboos University

Yahya Al-Wahaibi is associate professor of petroleum engineering and the Director of Oil and Gas Research Center at Sultan Qaboos University. Prior to this he served as Head of the Petroleum and Chemical Engineering Department. His research interests encompass the enhanced oil recovery of heavy and conventional oils and multiphase flow in pipelines. He performs experimental, theoretical and numerical research into many aspects of flow and transport in porous systems. He has over 100 scientific publications in these fields. He served as main supervisor/co-supervisor for 25 MS students and 15 PhD students who received number of regional and international awards. Since he started at SQU, his research has attracted over US \$9 million in grants and contracts, which were used mainly to establish/develop number of research and service laboratories at SQU. He was awarded by SQU the "best researcher" award in 2010. Al-Wahaibi holds a BS degree from Sultan Qaboos University, an MS degree from Heriot-Watt University, and a PhD degree from Imperial College London, all in petroleum engineering.



STREAM 4: LABOUR

WHAT ARE THE TOP RECOMMENDED STRATEGIES THAT NEED TO BE ADOPTED TO ALIGN INDUSTRY AND ACADEMIA TO MEET OMAN'S FUTURE LABOUR MARKET REQUIREMENTS?

Summary: Oman's private sector represents a fundamental building block in the country's long-term quest to transform into a diversified, knowledge economy. Oman faces three key challenges in managing its human capital.

The first challenge is identifying the portfolio of skills that it needs and how to recruit the right employees. The second challenge is retaining well educated and high quality individuals by keeping them motivated. Employees need to constantly expand their skills, knowledge, expertise and career progression within an organization. The third challenge is the question of what do with employees that have been fired, or made redundant. Should they be assigned to roles that they are not necessarily qualified for as an interim solution, or retrained?

Achieving the innovation required for a knowledge and energy efficient economy demands a greater effort by Industry to identify the skill sets that it requires, followed by Academia's effort to develop and nurture the education and careers of a skilled and expert indigenous work force. This is especially important in the oil and gas sectors, which are the major contributors to Oman's GDP.

The demand for new jobs are continuously materializing across Oman's energy sector – such as technology and science - but the skills required to fill these positions have not yet been developed by Oman's academic institutions, or by potential employees. Academia finds it difficult to design learning programs that nurture specific skills when they do not know what the Industry requires in the medium to long-term. This mismatch also applies to the current job market. Many university graduates this year and next will not be equipped with the qualifications that employers in Oman's energy sector urgently need.

Oman needs to ensure that a steady flow of students are learning about subjects that relate to science and technology in the hope that they choose relevant careers, be it as a petroleum engineer, or geologist. The standard of education are always rising in today's interconnected and technology-driven world. Companies increasingly not only want graduates with strong qualifications, but also those that can think critically, with strong communication, collaboration and creativity skills.

Greater interface between Industry and Academia is also required. There is very little discussion, if any, over the skill sets that the Industry needs today, or in five and fifteen years from now. There is also very little said about what the academic institutions are capable of producing. Both parties seem to be working on different sides with no bridge to connect their common goals. Consequently, government and



industry often waste time, staff and cash resources.

There is an element of mistrust between the Industry and the training bodies in Oman, which could partly be because of poor governance. Some companies do not have total confidence that programmes being hosted by academic institutions and those teaching them are well accredited. This lingering doubt means that companies seek in-house training solutions instead, but these often ad hoc and small scale programmes are not cost efficient and lack standardised practices.

To narrow the widening gap, companies must carefully specify the skill sets that they need Academia to focus on today and those that they expect to be relevant over the next twenty years. In turn, Academia can invest in developing new learning pathways and recruiting more high qualified teachers.

To support this initiative, the government must also continue to regulate education and ensure that no school, university, or vocational institute is established unless it meets certain criteria and standards. Government, however, should not act as the service provider. The academic institutions alone must be responsible for developing and overseeing the curriculum, only incorporating feedback from the Industry when appropriate.

STREAM 4: Top Three Recommendations

RECOMMENDATION ONE:

Establish a Coordinating Committee with an Operational Mandate that Comprises of Senior Representatives from the MOM and the MOE, as well as selected Industry Leaders.

A coordinating committee could target the creation of 50,000 vocational job opportunities across Oman's private sector within two years, costing an estimated OMR220 million. Efforts would focus on aligning the existing training programmes with industry and ring-fencing dedicated and more effectively deployed finance. Plus, the committee would target self-sufficient funding by 2020 and the replication of PDO's successful National Objectives programme in other industry sectors.

PDO has illustrated how rapid progress can be made. The company has already developed the delivery of internationally certified vocational training programmes through its National Objectives programme and through consultation with the Ministry of Manpower and Ministry of Education, leading to over 14,000 employment opportunities in 2011-2014. In 2015 alone, PDO is helping establish up to 7,000 employment and up-skilling opportunities in the energy sector and across PDO's contractor community.

PDO is also working on shifting the Omanization agenda from a 'push' to a 'pull' approach. The push approach includes imposing compliance targets that the industry has generally failed to meet. Alternatively, a pull approach adopts a bottom up strategy, which places value on training and career development for semi and fully skilled Omani vocational graduates.

RECOMMENDATION TWO:

Bolster the government's role in regulating education and reduce its influence in delivering education.

The role of the government in Oman's education system should be solely as a regulator and not as a service provider. The government can play a vital role in making sure Oman has clear and comprehensive requirements and processes to ensure that new universities and educational institutions meet high and international standards. There are already many training institutes in Oman and not all of them succeed.

Government also needs to facilitate a greater level of trust and communication between the Industry and the training bodies that already exist in Oman. Industry, in particular, initiates and develops a high number of training programmes instead of communicating its requirements and shortages to those in Academia.

For example, PDO has developed a welding program to meet its labour requirements instead of approaching an educational institute, which could develop a programme under a common and national standard. BP is setting up its own training institute for a 2018 operational programme, as opposed to using an existing training institute in Oman. The government needs to bridge this disharmony so that Industry supports formal learning in the classroom rather than developing its own training frameworks.

RECOMMENDATION THREE:

The mismatch in skill sets between Oman's Industry and Academia and the Importance of Streaming Students into Vocational Training early on.

The mismatch between the number of Omani students in higher education and the job requirements set by the labour market is a major challenge facing the country's economy. The problem will be exacerbated by the rising demand from Industry for skilled technical labour, with such workers expected to account for 80 percent of Oman's labour market within the next few years.

With not enough Omani graduates to satisfy such demand for years to come, the country must work quickly if it wants to boost Omanization.

Oman will soon have to hire considerably more expatriates in order to match the Industry demand, especially as the majority of Omani students who are currently in higher education have opted against technical and vocational subjects. There needs to be an urgent push to get Omani students interested in vocational, technical and applied training, especially after Grade 10 as this is typically when students start to mull over their career choices.

Nearly half the participants would welcome a new operational body that aimed to boost job creation, with the early streaming of students into vocational training close on its heels at 39 percent. Just under 20 percent thought the government must rethink its role in education.

SURVEY FINDINGS - STREAM 4

Nearly half would welcome a new operational body that can boost job creation, with 39 percent supporting the need for early vocational training. Just under 20 percent think the government should rethink its role in education.

Stream 4 - Aligning Academia & Industry: What are the Top Recommended Strategies that Need to be Adopted to Align Academia & Industry to Meet Oman's Future Labor Market Requirement?

1. Establish a coordinating committee (with an operational mandate) comprising of senior representatives from the Ministry of Manpower and Ministry of Education plus selected Industry leaders to address the alignment, funding, and replication of Vocational Training programmes for employability and capacity building. **43%**
2. Reduce the government role in delivering education and bolster its role on regulating education. **18%**
3. Early streaming of students into vocational training. **39%**

STREAM 4 - HOST Raoul Restucci Managing Director, Petroleum Development Oman

Raoul started his career in Shell International in 1980, following his graduation from Nottingham University in the UK with a degree in mining engineering. After working in The Hague in production technology, he held several positions in Brunei in the areas of well-site operations, production engineering and economics, before moving to Qatar Petroleum as head of Economics and Planning, followed by Production Technology and later as Petroleum Engineering Manager at Al Furat, Petroleum Company in Syria. Following this, Raoul served Shell in several other senior positions; he later was appointed Executive Vice President for Middle East, Russia and CIS, of Shell E&P Middle East based in Dubai, and was a member of PDO's Board of Directors representing Shell. He assumed the role of Managing Director in October 2010 and in this position is responsible for the day-to-day management of the Company in accordance with the programme and within the budget approved by the Board of Directors. Raoul is married with three children. He enjoys sailing and playing golf 'off the fairway'.





STREAM 5: WATER-FOOD-ENERGY NEXUS

WHAT INNOVATIVE ENERGY SOLUTIONS SHOULD OMAN EXPLORE TO IMPROVE ITS LONG-TERM ENERGY SECURITY?

Summary: The need for more renewable energy projects has started dominating conversations within Oman's energy circles, as falling oil prices squeeze the country's hydrocarbon revenues. Creating and applying renewable technologies on a localised basis is gaining particular traction, with considerable benefits on the horizon for remote communities to be able to generate electricity independently.

The vast opportunities that using electricity for water purification – be it for the desalination of ground water, or waste water from sewage – are also gradually being explored. Oman could also take advantage of its 1,740 kilometre coastline; an ideal platform to leverage the country as a regional, if not global, leader in the R&D of desalination.

Ambitions to pursue a renewable energy portfolio must be backed by an official entity, be it governmental, or a joint government-industry body. The body must abide by a clear mandate to achieve renewable projects and output targets within specific timeframes, as well as fostering communication between representatives and advisors from Oman's academic institutions.

Lessons on renewable frameworks can particularly be gleaned from Europe, which has long spearheaded environmental policy and regulation. The blueprint can be adapted to suit Oman's economy, culture and ambitions. There is little point in inventing renewable policies when workable examples are already easily accessible.

In the United Kingdom, for example, the government's oil and gas taskforce has typically embraced the participation of large energy, oil and gas companies, as well as suppliers. The United Kingdom's holistic approach – one that fosters collaboration and reviews best practice – is particularly valuable when energy prices move sharply and unexpectedly. The turbulent nature of today's oil and gas industry makes

such cooperation even more vital to Oman's economic security.

Oman's plans to develop innovative energy resources and boost renewable projects must be built on a strong foundation of knowledge and support within the Omani community. Accordingly, improving and deepening young Omanis' education and awareness of the country's changing energy outlook will help innovative ideas flourish for decades to come. Capturing Omanis' attention when they are still young is a precious opportunity that Oman's private energy sector must increasingly seize upon as it will help to fill job vacancies, strengthen R&D and generate wealth in the long-term.

Oman's youngsters and the wider community cannot be expected to embrace energy efficiency and renewable projects unless the country's leaders and officials do so first. The government represents around 65 percent of energy consumption in Oman, with many government buildings in Muscat left fully lit day and night and in full view of the public. The allocation of personal automobiles for government employees has also been raised – another example of conspicuous government consumption.

If the government champions the benefits of energy efficiency, academic institutes from primary schools to universities can reinforce the message in the classroom. Elements of the Oman's formal education can focus on how energy efficiency can ease the financial drain of subsidies on the government and be reinjected into vital sectors, such as education and technology.

Alternatively, the government could offer subsidies in the entrepreneurial space to help incentivise innovation and vocational training for renewable and sustainable industries, such as fisheries. Norway, for example, has earmarked a portion of the finances generated by its traditional energy to develop a large and sustainable fish farming industry.

STREAM 5: Top Three Recommendations

RECOMMENDATION ONE:

Establish and Mandate an Executive Authority that Focuses on Water, Energy and Food. Identify Linkages between the Three Sectors, Develop Knowledge and Induce Behavioural Change.

The decision-making process for water, energy and food sectors tends to occur in isolation, without the sufficient co-ordination and consideration of how changes in one sector can impact another. This singular approach to managing such valuable resources can lead to unsustainable policies and rising costs. An executive authority must be established to fulfil three main responsibilities to create a coordinated and integrated strategy.

Firstly, the authority must enhance Oman's knowledge and understanding of the challenges posed by the interconnected nature of the water, energy and food systems through research and the dissemination of best practices around the world.

Secondly, the authority must communicate with stakeholders in the energy, water and food sector to design integrated strategies that achieve diverse objectives, while always optimising scarce national resources. The authority must ensure that legislative bodies are included, such as the Consultative Assembly and the Council of State, so that proposals can quickly be translated into concrete laws and regulations.

Finally, a monitoring and evaluation system will ensure that the legalities are appropriately implemented and that the executive authority is held accountable to the highest levels of decision-making, such as the Cabinet of Oman.

RECOMMENDATION TWO:

Renewable Energy Based desalination should be key to Address the Issue of Water Security on a Small and Large Scale with A Focus on Cost Competitive Technologies.

Global demand for water is in continuum while freshwater sources are in decline due to increase in demand for natural resources and impacts of climate change. Desalination of water – a necessity in the Middle East – can be used to augment the increasing demand for fresh water supplies.

However, the process of desalination, even though necessary, is an extremely energy intensive process often using conventional energy resources like diesel. But these are not sustainable options as they are often subject to volatile to global market movements, such as including prices and supply-demand dynamics. This means that renewable energy can be seen as a valuable economic investment for necessary desalination processes that reduces environmental and operational costs with sustainable fiscal mechanisms.

RECOMMENDATION THREE:

Enforce Building Codes and Standards for Sustainable Homes to Promote Water Savings and Energy Efficiency, such as the Development of Green Homes.

An official and nationwide programme that promotes, develops and regulates green homes in Oman must be based on well-defined building codes and standards that encompass four key points: economic efficiency, energy efficiency, sustainability and the minimal use of water. High quality building standards should be

mandatory, or strictly adhered to at the very least. A far-reaching campaign must include incentives to encourage Omanis to embrace green homes and highlight the benefits of cleaner living, such as preserving Oman's limited national resources and curtailing carbon emissions.

Oman's green homes and office buildings should focus heavily on the efficient use of energy on a day-to-day basis, such as standardized limits on the amount of water per flush in toilets and the rate of flow per minute from faucets and showerheads. Waste water from bathrooms and wash basins can also be reused in the garden.

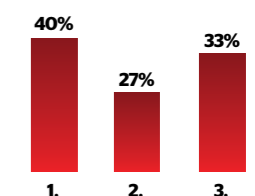
Omanis without green homes must be shown alternative ways to save energy and water, from energy efficient home appliances to solar panels on the rooftop and in the garden.

SURVEY FINDINGS - STREAM 5

The Water-Food-Energy nexus raised a relatively even spread of opinions. Forty percent believe that desalination will help counter the water shortage, just over a third backing the idea of green homes, while 27 percent would support an executive authority.

Stream 5 - Water-Food-Energy Nexus: Oman is reaching, and many would say has already exceeded, the sustainable limit of resource availability – What are the Top Recommended innovative solutions to achieve sustainable growth?

1. Renewable energy based desalination should be key to address the issue of water scarcity at small and large scale – focused on cost competitive technologies.
2. Establish and mandate an executive authority focusing on water energy food nexus to identify linkages, develop knowledge, transform ideas and induce behavioral changes.
3. Enforce building codes and standards for sustainable homes to promote water savings and energy efficiency – create green homes environment



STREAM 5 - HOST James McCallum CEO and Chairman, LR Senegy Group

In 2005, James McCallum became CEO and co-founder of Senegy. He is responsible for providing direction and leadership to implement Senegy's strategy and achieve its vision – to be one of the most respected brands associated with the supply and delivery of energy. James has over 20 years' experience in well engineering, well construction management and business management, including 14 years with UK and international operators. He was founder and president of the North Sea's leading turnkey wells project management company, GMIS, an active member of the joint industry/UK government task force scheme Pilot from 1997-2002, and co-creator of Scotland's renewable energy task force FREDs. In September 2013, the UK's Lloyd's Register Group (LR) acquired a controlling share of Senegy, making James the CEO and Chairman of the LR Senegy Group. James is also a Fellow of the Institute of Civil Engineers and Professor of Energy at Strathclyde University.



Oman Energy Master Plan 2040 - Draft Report

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COMPLETE LIST OF RECOMMENDATIONS FROM THE 2015 OEF INDUSTRY WORKSHOP

* Asterisks indicates one of the top five recommendations per stream

STREAM 1: Energy Supply - What are the top recommended strategies to maximize benefits to Oman of its energy resources?

- Maximize Hydrocarbon value.
- * Implement Renewables Strategy.
- Gas Efficiencies.
- Comprehensive Energy Mix Policy.
- Develop local R&D with emphasis on Renewables.
- Capitalize on what is available in existing market.
- * Create & Adopt & Expedite an Energy Supply Master Plan.
- * Incentivizing Renewables through Secondary Gas Markets.
- Better co-ordination between all stakeholders.
- Regulatory Framework - a Combined Government/ Industry Body.
- * Establish Ministry of Energy / Body / Council.
- Import Gas from Iran.
- Energy Storage - use of hydro.
- Subsidy Reform.
- * Facilitate Small scale Rooftop & Hybrid power generation.
- Energy Pricing Reforms including targeted subsidies.
- Optimize Gas fired Power Generation.
- Reduce Bureaucracy - speed up government decision making.
- Optimize Renewable Use.
- Increase Public Awareness.
- Increase Power Grids Efficiency.

STREAM 2: Energy Demand - What are the top recommended strategies for tackling Oman's domestic energy demand & consumption over the next 25 Years?

- Phase out incandescent lighting 75 % by Dec 2018 and 100 % by Dec 2023.
- Minimizing and controlling demand by Structural reduction of subsidies.
- Power saving initiatives.
- * Behavioural Change.
- Long term - Investing in education and targeting education cycles from a young age.
- Short term – Aggressive communication campaign.
- Measured approach to remove subsidies.
- Increase the tariffs independently from any other policy.
- * All government should lead by example, such as introducing solar panel in rooftops of government buildings.
- * Centralize Energy policy under one authority.
- A policy to reduce demand which has a specific target.
- Country wide communication program.
- Accelerate decision making process.
- Set KPIs for government.
- Develop national policies to manage the sector.
- Emission taxation for major industries.
- * Developing public transportation.
- Consumer behaviours.
- Incentivize good behaviours.
- Punish/fine – bad behaviours.
- Cost reflective tariffs.
- Establish green zones.
- Engage the public in removing the subsidies – Awareness campaign.

STREAM 3: Research & Development - What are the top recommended strategies that can align Academia and Industry to deliver an enhanced R&D ecosystem in Oman?

- * Bring industry and academia together to establish clear motives and deliverables.
- Understand current environment, focus on R&D outside of EOR such as renewable energy.
- Enhance R&D culture with youth & utilize the international markets.
- * Establish public-private partnerships for R&D funding.
- Transfers & exchange knowledge to industry.
- Create a body consisting of government, academia, and industry with focus on fundamental and applied research for the future.
- Encourage a culture shift with youth that creates & promotes creative attitudes.
- Government to act as an enabler for R&D.
- * Establishment of research clusters & incubators with universities and across the country linked with promotion entities.
- Focus on the R&D funnel and streamline corporations and R&D mandates.
- Create centres excellences for specializations.
- Take advantage of GCC and commercialize Oman's R&D.
- * Incentivize private sector to establish its own R&D hubs.
- * Omani PhD students to get their PhDs in Oman.
- Establish a Ministry of Science, Technology, and Research.
- Appoint a national champion to be accountable to His Majesty for research & innovation.
- The Research Council to conduct a survey with industry to see what they want and how they can contribute to R&D infrastructure.
- Government to issue mandate that makes companies achieve one success in R&D every five years.
- Purchase patents that are available in the market that pertain to Oman's needs.
- Create platform for internationalization of local innovations in Oman.

STREAM 4: Aligning Industry & Academia - What are the top recommended strategies that need to be adopted to align academia & industry to meet Oman's future labour market requirements?

- * Establish a coordinating committee (with an operational mandate) comprising of senior representatives from MOM and MOE, plus selected Industry leaders to address the alignment, funding, and replication of vocational training programmes for employability and capacity building.
- Deploy education budget programs over the next three years to focus on high impact on economy.
- * Reduce the government role in delivering education and bolster its role on regulating education.
- Reform education program to 21st century competencies to develop value based education at early stage.
- Expatization: Create a pathway to retain the long-term expatriates that support & add value to Oman 2040 vision.
- Legislation reform to mandate industry needs with academia.
- Industry to provide a job road map for 2040 and share with academia.
- * Entrepreneurship at early school level.
- Setup an industrial advisory board with access to an endowment fund that provides feedback & coordinates the requirements of industry & academia. The board should consist of experienced industry executives & academics with the participation of students.
- * Early streaming of students into vocational training.
- Reform education aligned with industry needs from Primary stage.
- Coordinating body lead by PDO to align with academia.
- Industry to draft top ten lists of their requirements to share with Education sector.
- Expose students to "non-curriculum" programs such as industrial conferences & exhibitions.
- * Make "On the Job Training" mandatory to acquire University degree.
- Have industry secondees participate on "Career Guidance" programs in schools. These programs should also use relevant social media programs to attract students.
- Accelerate higher education reforms to meet economy/industry needs.
- Forge long term strategic collaboration between industry & academia by incorporating industry professionals into academia.

STREAM 5: Water-Food-Energy Nexus - What are the top recommended strategies to achieve sustainable growth?

- * Enforce building codes and standards for sustainable green homes to promote water savings and energy efficiency.
- * Shift subsidies from the consumer side towards a fund to implement renewable energy (direct subsidy).
- Focus on trade as source of employment.
- Promote entrepreneurial activity.
- Foster creativity in students.
- Focus on building tourism.
- * Eliminate electricity subsidy to the agricultural sector and improve groundwater use efficiency.
- Direct subsidies to promote entrepreneurial activities – fisheries, IT, agricultural trade.
- * Renewable energy based desalination should be considered as a key solution to address the issue of water scarcity both at small and large levels.
- Eliminate subsidy from agriculture and improve groundwater use.
- Monitor groundwater pumping through smart metres.
- Establish strict building codes for water energy efficiency.
- * Establish and mandate an executive authority focusing on water energy food nexus to identify linkages, develop knowledge, transform ideas and induce behavioural change.



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