

Special Report

The Saudi Arabia 4.0 Industrial Revolution?

Outlook for Energy, Industry & Minerals



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Saudi Arabia 4.0

EXECUTIVE SUMMARY

Energy security enables civilizations to thrive, to push intellectual and geographical boundaries. The need for an unshakeable foundation of supply – of fossil fuels and increasingly, renewables – binds us all. Therein lies the deep-rooted relevance of the how the 4th Industrial Revolution (4IR) is unfolding in one of the world's most successful and influential energy economies: the Kingdom of Saudi Arabia.

Data science. Mobile supercomputing. Intelligent robots. Industrial Internet Of Things (IIoT). Predictive Analytics. Self-driving cars. Electrification. All these are possible because of the 4IR; a digital overhaul that is reshaping the global energy market and how we work within it. Have no doubt: the transformation will be unlike anything humankind has experienced. For nearly half a century, since the 1970s and in alignment with Moore's law, computer power has doubled every year. This means more data has been generated over the past two years than in all previous recorded history. At this staggering rate of positive disruption, one fact is clear: slow movers will be left behind.

Energy markets must be agile, creative and collaborative. Cornerstones of society in Saudi Arabia and beyond – government, industry, academia and the public – must work together to leverage this digital gold dust. If managed

“ Our country is witnessing a giant transformation, which requires doubling the size and diversity of the national economy, including the mining sector, to meet the increasing global and domestic demand for energy through the development and diversification of the energy mix. This includes traditional hydrocarbon sources, as well as renewable energy sources and nuclear energy.”

H.E. KHALID AL FALIH
MINISTER OF ENERGY, INDUSTRY & MINERAL RESOURCES, KINGDOM OF SAUDI ARABIA

correctly, it will make the value chain much safer and more efficient, affordable and environmentally-friendly than ever – all invaluable features amid escalating market pressures. For one, BP Outlook expects energy consumption in the Middle East alone will rise by 55% by 2040. Adapting and thriving amid this overhaul will not happen automatically. Hard but rewarding graft lies ahead.

Game changers

This is especially pertinent as the 4IR coincides with the greatest paradigm shift in the energy markets for more than a century: the energy transition towards a lower-carbon world. As per the ambitious and much-needed Paris Agreement, Saudi Arabia and other governments in the Middle East have bolstered their environmental agendas to promote renewables, energy efficiency

and green financing, among many other efforts. This is an inspirational period for youngsters in the Middle East and North Africa (MENA), many of whom are seeking job opportunities and modern career paths. The same applies to more experienced staff as this uncharted territory enables them to flex their wisdom and knowledge, garnered over decades.

Saudi Arabia pioneered its way to the top of the global energy league table throughout the 20th century, reaffirming its pole position ever since. The question marks that lie ahead abound; many successful energy entities are understandably left scratching their heads over the how to merge fossil fuels and renewables affordably and efficiently. But as highlighted in this Special Report, Saudi Arabia has already taken innovative strides towards a larger yet environmentally sustainable energy market. As we near the 2020s, the kingdom's pace will only accelerate, carving out an entirely new roadmap that can act as a beacon to other countries still finding their way. Watch this space.

Definition: 4th Industrial Revolution

It is a new chapter in human development, enabled by extraordinary technology advances that commensurate with those of the first, second and third industrial revolutions. These advances are merging the physical, digital and biological worlds in ways that create both huge promise and potential peril. The speed, breadth and depth of this revolution is forcing us to rethink how countries develop, how organizations create value and even what it means to be human.

World Economic Forum (WEF)

The Saudi 4.0 Industrial Revolution

TOP 10 RECOMMENDATIONS

These Top 10 Recommendations were harvested from the brainstorming sessions held with 350 stakeholders during the Gulf Intelligence Saudi Arabia Energy Forum: *The Next Best Steps for Saudi Energy Sector to Leverage the 4th Industrial Revolution?*

1. One Size Does Not Fit All

Digital tools should be leveraged and positioned specifically to suit business needs; this results in tangible added value and a sharpened competitive edge. Companies should acquire a full understanding of the 4IR to decide on their speed and depth of adoption.

2. Achieve 100% Real-Time Visibility

This requires the installation of digital support systems under the umbrella of the 4IR to bolster immediate connectivity and clarity on all parts of the value chain. This leads to increased safety, revenues, environmental efficiency and reputational value. Transparency pays – literally.

3. Market Forces Dictate Implementation

Adoption of the 4IR is best done via commercial pressures, leaving public policy to focus on incentives that encourage the growth of new industries and small and medium-sized enterprises (SMEs). Following this dual structure creates sustainable market growth, including coveted higher value jobs.

4. Invest in Cybersecurity

Digital protection cannot be overlooked; companies must always be one step ahead of cyberhackers. Companies must carefully consider how much enhanced external connectivity is absolutely required and try and limit unnecessary exposure.

5. Standardization Matters: Spur Application

The greater the uptake of the 4IR, the greater the need for standardized systems and criteria. This ensures all entities along the value chain are on the same page and most importantly, it safeguards operational and public safety.

6. Implement Smart Meter Data At Power Utilities

Maximizing efficiencies and managing consumption and production requires a consistent and accurate feed of information. Therein lies the value of smart meter data and a digitalized and decentralized electricity sector, which more accurately marries demand with supply and also increases customer choice.



7. Talent Development: Ignore at Your Peril

The successful application of a digital toolbox requires continual education. This encompasses coordination between academia, government and industry on educating, training and developing a multidisciplinary, curious and digitally fluent workforce. There is no finish line to our ability to learn and adapt.

8. Increase Advisory Centers and Digital Platforms

Such establishments and platforms can showcase, advise on and lease the application of latest technologies available in the kingdom. This is especially valuable for SMEs, which typically operate on tight budgets.

9. Bolster Cross Border Collaboration

Energy markets are becoming increasingly interconnected and Saudi Arabia lies around the heart of these supply-demand flows. Deeper collaboration across the Gulf and wider Middle East would be a win for the region as it seeks to improve energy security while reducing reliance on international imports.

10. Inspire a Culture of Innovation

Smarts and creativity are required in equal measure to be a digital leader, especially in the energy transition. An ability to innovate – the commercialization of novel ideas – requires a supportive ecosystem. This encompasses promoting critical thinking in education to improving financial channels for SMEs and entrepreneurs. Today's students and employees must evolve into tomorrow's energy champions.

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SURVEY – INDUSTRIAL REVOLUTION 4.0

Golden Opportunities for Positive Disruption?

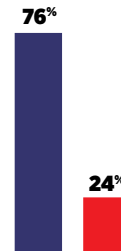
The more Saudi Arabia's industrial companies adopt the 4IR Toolbox – such as big data science, predictive analytics, artificial intelligence, robotics, automation, blockchain and 3D visualization – *the faster the kingdom will achieve the goals of Vision 2030?*

- A. Agree
- B. Disagree



Speed is the defining factor for success in this 4.0 digital transformation. Lagging behind is simply not an option.

- A. Agree
- B. Disagree



Is Saudi industry doing enough to be ahead of the digital transformation curve?

- A. Yes
- B. No

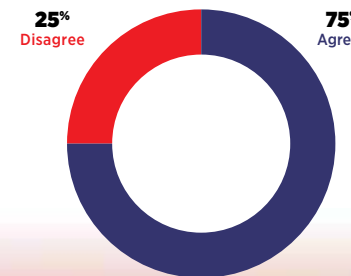


Apple CEO Tim Cook told his shareholders in January that the company had been completely blindsided by “the magnitude of the economic deceleration” in China in 2018. *Hands up, if unlike the Apple CEO, you knew China was experiencing slowest growth since 1990?*

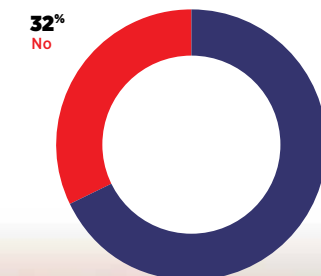
- A. My company/institution knew it was coming and so we are prepared
- B. My company/institution is not prepared for a significant China slowdown in 2019



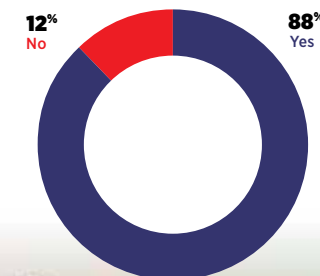
Downstream industries in Saudi Arabia and across the Middle East are not moving fast enough to take advantage of the new 4.0 digital tools available



NIDLP have established Capacity Development Centers specialized in Industry 4.0 technologies to enable leading industrial players to use modern technologies that will assist them to increase competitiveness and productivity. *Do you think it would be useful to go one step further and introduce a rating system to measure and rank companies and institutions on their success in adopting 4IR tools?*



Downstream industries in sectors, such as power, mining, refining and petchems, all have the potential to harvest massive amounts of new data points. Should companies look to monetize this to develop new business opportunities?





MINISTERIAL INTERVIEW

H.E. Khalid Al Falih

Minister of Energy, Industry & Mineral Resources
Kingdom of Saudi Arabia

Moderator: Manus Cranny, Anchor, Bloomberg TV

Mannus Cranny (MC): Your Excellency, is the Saudi Aramco deal to buy PIF's stake in SABIC one of the seminal moments of transformation for Saudi Arabia?

Khalid Al Falih: The kingdom is going through a phenomenal transformation. You see it in social activities, in economic activities, amongst the youth, amongst business enterprises. You see it present in the reforms and every government agency. And you see it in the sound strategies that have always been on paper but that have previously found difficulty in getting implemented. Vision 2030 is now making it

#1

Saudi Aramco is the world's largest company.

\$69bn

The volume of finance that Saudi Aramco will supply as part of its purchase of PIF's stake in SABIC.

x2

There are two dimensions to the kingdom's gas plans. Firstly, to increase domestic production, including shale gas reserves, and to leverage gas as the preferred feedstock for the rapidly growing petrochemicals market. Secondly, to sharpen the kingdom's competitive edge in the global gas markets.

2025

The kingdom, already the world's biggest oil producer, plans to be a significant gas exporter by 2025.

9.8bn

The global population will climb by more than 2 billion - a 27% increase - by 2050 to 9.8 billion. This is the equivalent of nearly duplicating the entire population of China and India, the world's most populated nations, by mid century. What does this mean? Investing in lower-carbon energy - gas, LNG and renewables, for example - to meet rising demand is a safe bet.

possible to implement these and one of those has been the dream to create the world's largest oil and energy petrochemical companies. As a former CEO of Saudi Aramco, we had a vision within the company to create an integrated energy petrochemical giant that would add value to the hydrocarbon value chain. SABIC is the way to do this because there is a lot of overlap geographically and in terms of the molecule flow from upstream to midstream to downstream, as well as complementarity between the two portfolios. It would have been unthinkable a few years ago because SABIC has always been seen as a national champion with a standard of their own. But with the vision of breaking barriers and paradigms, it is now turning into a reality. This acquisition will realize synergies and integration opportunities not just for Saudi Aramco, but more importantly for SABIC and its minority shareholders. So, it is value creation all round and we hope to close the SABIC deal in the coming six months.

MC: Will the funds that flow from this deal reenergize the ambitions of the kingdom to deliver on Vision 2030?

Khalid Al Falih: The vision of the PIF is very bold and goes way beyond the \$69 billion that Saudi Aramco will provide through the SABIC deal. The vision is both domestic and global. It's about the mega projects that will turbo charge many of the pillars of our future economy. This will need capital also from other assets that are non-strategic, that the PIF may own that they choose to exit.

MC: What kind of assets?

Khalid Al Falih: It's premature to specify, but my point is that the PIF is going to be an active and not a passive investor. The objective is to create value for the kingdom, first and foremost, through in-country investments and also by looking globally and strategically to acquire emerging companies and industries, creating value for them. At the same time, leveraging those acquisitions and investments for the benefit of the kingdom's strategy.

MC: Was the recent Saudi Aramco bond roadshow a curtain raiser to perhaps coming back to the bond market again?

Khalid Al Falih: I think Saudi Aramco will establish a permanent presence in the capital markets that will have both debt and capital. It is the world's largest company and is obviously going to have all the tools at its disposal to access capital markets. Paying for the SABIC deal was not the primary or only reason for accessing the bond market; the company needs to lever up and have some debt and instruments on our balance sheet.

MC: In terms of the kingdom's economic transformation, what are the ambitions for gas?

Khalid Al Falih: There are two dimensions to gas. One is domestic where gas is the feedstock of choice for our petrochemicals. It's low cost to crack and it's plentiful and it's reliable and we need to increase that. There is also a second wave of gas development that has emerged over the last few years by Aramco, which is to develop our own unconventional resources, mostly shale gas, in eastern Saudi Arabia, but also other formations in the north that have been used to fuel phosphate mining and manufacturing development. Gas is also the fuel of choice for power generation, so dry gas or natural gas will be used to displace 600,000 – 800,000 barrels of liquids that are going mostly to power, but some to water desalination. Both sectors will be reformed, and their efficiency improved dramatically, by changes in the fleet and power generation by switching a lot of our water desalination to reverse osmosis technologies. The second dimension for gas is global. We realize that oil will continue to grow, but gas will grow faster.

MC: Does that mean that you'll have to buy assets globally?

Khalid Al Falih: Anything in excess of our domestic needs in power, water and petrochemicals, will be exported. We do see an opportunity to be a significant gas exporter.

MC: How soon can you achieve that?

Khalid Al Falih: I would say by 2025 is realistic. We're already in discussions with our brothers in the GCC about interconnection through pipelines, all the way from Oman to Kuwait and Iraq.

MC: Have you committed a capex number to that?

Khalid Al Falih: Not yet, but we've dedicated the teams from our side and our colleagues from the

IN FOCUS: OPEC+

MC: Will the group extend output cuts beyond June this year?

Khalid Al Falih: Our objective to bring inventories back to a reasonable level remains unchanged. We have seen how sensitive oil markets are to inventories and how when production is increased in the second half of the year for the usual reasons, how quickly markets react. We want to avoid that scenario materializing again. Given the kingdom's financial position and our scale, our volumes can probably withstand some of these shocks more than others. We have seen companies having to change investment plans and some of the poorer countries hurt, so we want to stabilize markets. We are getting to a stage where inventories are starting to stabilize and come down, but they're still significantly above what I would consider a normal level.

MC: Is 1.2m barrels still your baseline to balance the market?

Khalid Al Falih: The 1.2m barrels was based on certain

other countries keeping their October 2018 production level. So, we have to watch them. We need to see what happens with Venezuela and with the sanctions, which the US waived in November. All these factors will impact the fundamentals. Ultimately, the 1.2m barrels was a balancing based on assumptions of demand and supply and US production. The closer we are to June, the more informed our decision will be on the next steps.

MC: Is Russia on board in general about a possible extension?

Khalid Al Falih: The dynamics in Russia are different from any other country. It also has different geopolitical considerations than most other producers, so it has to weigh all of those factors. But I believe strongly that the OPEC + agreement has been good for Russia from multiple angles. As a key producer, it holds a lot of resources, not just oil but gas as well. The value of gas in the international markets is impacted by the oil outlook and oil prices.

MC: You've been producing 9.82m barrels, which is a four-year low. Many people are applauding you and saying you have done the big job. Are you prepared to cut further to achieve market balance?

Khalid Al Falih: If you look at 2017-2018, by the time it was all said and done, the kingdom was almost exactly on the dot with the voluntary production level that we agreed to back in December 2016. During that two-year period, we were able to stabilize the market's response with market dynamics that changed unexpectedly. But at the end of the day, we were on track and we met our obligations. The kingdom is the world's largest exporter and the country that has, by far, the largest spare capacity. With our policy and the relationship that we have with the industry within the kingdom, we're able to swing production faster than ever, so we're driven by our policy objectives of stabilizing markets. Sometimes we do more than others, but it goes both ways.

MC: Would you be prepared to do more if you needed to?



Khalid Al Falih: The market is on its way towards balance. We've obviously done a lot more than others, but I've been assured that they're catching up with their obligations. I was in Iraq a few days ago and the Minister reassured us that Iraq will do more and would be on track. Russia has reached its objectives on its commitment and the UAE and Kuwait have too. The majority of countries have met their obligations and

the implementation is moving in the right direction.

MC: Are you comfortable with the recent speed of recovery in the oil price?

Khalid Al Falih: Our policy has never been, nor will it be, driven by price objectives and we always need to look at what the appropriate baseline is to measure from. We can feel it when the market is healthy. We can feel it when investors

are comfortable. You saw in early April that for the first time in almost two months, the number of rigs in the US rose. Many would consider this bearish, but I would consider it as one of the vital signs that the market is coming back to health.

MC: What is the most under-priced risk for the market in your mind? What's the next shoe to drop?

Khalid Al Falih: Geopolitical risk. There are times when the market overprices this and times when it under prices it. It's unfortunate that many countries – from Venezuela to Algeria and Libya, Syria and Yemen, all of which have oil – are in civil and security distress. That could squeeze supply in the mid to long term if things don't improve. But given the fact that we have a glut today, the market seems blind to that risk. The saving grace is that the spare capacity that the kingdom has means we can always reduce the level of cuts like we did last year.

Up, Up and Up

We see strong demand in the emerging economies of Asia. The US' economic GDP growth can drop by a percent or two, but the underlying drivers for oil demand will continue. The demographics are there, the urbanization is there, people are moving from rural to big cities and acquiring modern modes of transport and lifestyles. That's not going to be dented significantly by GDP growth on a sustainable basis. I think where demand could flatten and weaken a bit is in the Organization for Economic Co-operation and Development (OECD) countries, where manufacturing and trucking and industrial activity are the main drivers. And there are a lot of incentives that are being put by governments to reduce demand (through taxation). But there's a limit to that too and it is not a line that is going to remain linear indefinitely. Even in the US, which is a highly industrialized economy, demand will continue to grow. **Khalid Al Falih**

GCC have indicated that they're ready to start undertaking the technical studies. I think what will happen after that is the commercial framework through which gas is traded through pipelines in the region and this will be a significant move forward that the kingdom will enable because we are the country that interconnects most of the GCC countries and Iraq as well. The next phase beyond this is LNG trade. We know that growing and sizable economies around the world, from China to India and other countries in Asia, will need to displace a lot of their existing coal generation facilities to meet their climate change targets. But we also know that there are billions of

people who don't have access to clean energy and with population growth set to increase by another 2 billion, the demand for this is set to increase. Clean energy is going to be a combination of gas and renewables and the kingdom is ready to play a leading role in these emerging economies.

MC: What has changed that Saudi Arabia now wants to make the commitment to be a gas exporter in a few years? Has there been a significant shift in terms of policy?

Khalid Al Falih: The resource base has changed for us. We have always looked at conventionals as

“ We realize that oil will continue to grow, but gas will grow faster”

800,000bbls
Leveraging the kingdom's natural gas reserves can save 600,000 – 800,000 barrels of liquids that are currently being used for power generation, as well as some water desalination projects.

the limit of resource availability and we've always thought of ourselves as resource constrained. With the unconventional gas resources going deep into the shale formations in the kingdom, we are not only able to access natural gas, but wet rich gas that is going to power our growth for the petrochemical industries as well as give us these resources. We are also able to produce some associated gas at higher levels now. ■

*Edited transcript

Leadership Insights

How the 4th Industrial Revolution Toolbox can Propel the Saudi Vision 2030?

- H.E. Dr. Khaled Bin Saleh Al-Sultan, President, KA-CARE
 - Yousef Abdullah Al-Benyayn, Vice Chairman & Chief Executive Officer, SABIC
 - Darren Davis, Chief Executive Officer & President, Ma'aden
 - Mohammad Abdullah Abunayyan, Chairman, Arabian Company for Water & Power International (ACWAPower)
 - Adam Sieminski, President, KAPSARC
- Moderator:* Sean Evers, Managing Partner, Gulf Intelligence



Sean Evers (SE): Does industry in Saudi Arabia need to access the tools available under the 4IR umbrella and is it doing enough to stay ahead of the digital transformation curve?

H.E. Dr. Khaled Bin Saleh Al-Sultan: The 4IR can be harnessed effectively to improve the energy sector, and in particular the power sector.

We can manage the electricity sector better by predicting energy consumption and production through data accumulation. The electricity sector in the kingdom is already becoming more digitalized and decentralized and consumers are able to select from different sources, such as renewables and fossil fuels. They can use the 4IR to manage their demand and costs more

efficiently. Today, 18%-20% of total energy consumed in the world is for electricity. By 2030, this number is expected to reach 26%-30% and 50% by 2070.

SE: Aramco, SABIC's new partner, recently opened the first 4IR Center in the kingdom, announcing in doing so that it was not an option to be left behind. What are your thoughts?

Yousef Al-Benyayn: There are a lot of people that don't have clear definitions of what exactly the 4IR is all about and we need to make sure we are speaking the same language when we judge whether we are moving fast enough. At the same time, we need to also be candid with ourselves and manage expectations. There are many countries that have still not even benefited from the previous three industrial revolutions – the light industry, heavy industry and technology, computers and the internet. There is no doubt traditional industries in Saudi Arabia are being disrupted and we need to be mentally prepared as to how we are going to manage our organizational research and development (R&D) and organizational competence. If we just look at the chemical industry, it has had 4% year-on-year growth, producing 100mn tons of chemicals. What is the energy source for this? It's national gas and we have a national mandate to increase our efficiency. Today, we are only using 30% of our asset data, so the challenge for chemicals in this space is that we don't have real time visibility of our assets liability nor a proven digital support system. This is where the 4IR is going to be very crucial. It can provide clear forecasted outcomes and will enable us to reveal the hidden relationship between our assets.

SE: Is SABIC actively pursuing this?

Yousef Al-Benyayn: We are but we have not yet reached deployment. If you look at the research, we are talking about a minimum 8%-12% of improvement in EBITDA. For the last three years, we were able to generate more than \$7 billion revenue from investments in technology innovation. But as of today, we still don't have a connected, general information system for our assets. If we can achieve that, this is where the real improvement will be for our companies and for the market.

SE: ACWA Power seems to be doing everything very fast and making headlines in recent years with its innovative and pioneering pricing records on power generation, and solar to power. Would you say that speed is the defining factor for success in the 4IR digital transformation? What are your thoughts on the accelerator that the 4IR can be?

\$7bn

For the last three years, SABIC said more than \$7 billion in revenue has been generated from investments in technology innovation.

30%

Despite this significant economic value, SABIC is only using less than a third of its asset data. The challenge is creating more real time visibility and a proven digital support system.

#1

Saudi Aramco's Uthmaniyah Gas Plant (UGP) has been recognized by the World Economic Forum (WEF) as a "Lighthouse" manufacturing facility; a leader in technology applications of the 4IR. The company is the first energy company globally to be included in this select group of manufacturing sites.

2070

Up to 20% of the total energy consumed worldwide is for electricity. By 2030, it could reach 30% and 50% by 2070. Rolling out digital awareness and implementation as per the 4IR is pertinent to efficiently meeting this demand, as well as economic and environmental targets.

Mohammad Abunayyan: Our industry does not have an option. Organizations should have a dedicated department capable and knowledgeable to lead the impact. Who would have believed a few years ago how far we have come with solar and renewables. We have to be part of the 4IR because it is an enabler to competitiveness and value addition. We have two operation centers, one in Jeddah and one in Dubai. Why? Because we want to have all our 49 plants operating today, connected in real-time, with real data, to enable us to monitor information, to benchmark and share knowledge more efficiently. Thirteen of ACWAPower's plants are currently connected to these two centers. By the fourth quarter of this year, all 49 assets will be.

SE: What is the consequence of lagging behind?

Mohammad Abunayyan: Either you want to be proactive, engaged and invest in the future and really commit to change and ride this wave and advantage. Or not, and possibly be bankrupted. It's also about how to leverage it for your own business to improve competitiveness, reliability, and serving your customer in a timely manner. That is the key to keeping ahead. People have to be open-minded and accept change. There are industries that are going to retire and new ones that are going to be realized. If you look at the disruption happening in the private sector in Saudi Arabia today, we are sitting on a bullet train. If you don't take that risk, you will be left behind. What we do need to do is have the right positioning to be able to synchronize appropriately with all this change.

SE: KAPSARC is a major knowledge center here in Riyadh. Clearly, a lot of people are still struggling with the concept of industry 4.0 as part of the 4IR. Can you play a facilitating knowledge role?

Adam Sieminski: For a non-governmental organization like KAPSARC that is involved in doing research in the field of energy, we need continuous learning and to make sure that the skillset of researchers are updated. It's no longer about getting your degree and going to work; the toolbox keeps changing. This is what we're trying to promote. Training and development that will help enable the industry and others to fulfill the goals of the 4IR.

H.E. Dr. Khaled Bin Saleh Al-Sultan: Like many ideas in the Vision 2030, the human resource aspect is extremely important. We can always purchase technology, put in rules and regulations and encourage the industrial sector to use industry 4.0. But we will always be short of well-prepared people. The challenge is to prepare young people in the skill of lifelong learning. If there is one value

to industry 4.0, it is that it is very interdisciplinary. You won't find an electrical engineer or a physicist, or a biologist who can do all of this. We need to introduce more interdisciplinary courses and training to make sure people can fit because most likely you will find that it is teams implementing projects in the future, rather than individuals.

SE: The National Industrial Development and Logistics Program (NIDLP) has established capacity development centers specialized in industry 4.0 technologies to enable leading industrial players to use modern technologies that will assist them and increase competitiveness and productivity. Would it be useful to go one step further and introduce a rating system to measure and rank companies and institutions on their success in adopting the 4.0 toolbox? How would Ma'aden react if they were informed they would be rated on the use of 4.0 technologies today?

Darren Davis: Commercial pressures are the best way to implement industry 4.0 in companies. Government can certainly help enable, but it would be best focused by encouraging new industries. We already see initiatives to finance SMEs, for example. That is what is going to create the new jobs. That's where these people of the future, the young, will find jobs that don't yet exist. One concern in industry 4.0 at a national level is that there's a danger there could be fewer jobs as a result. That's the opposite of what's needed in the kingdom. We need more jobs here and that's why there should be a focus on encouraging new industries.

Mohammad Abunayyan: It's not just about the number of jobs we create – it's about quality and better value jobs. 4.0 is great news. We should create roles that can bring young talented Saudis to jobs that they can aspire to. Of course, we must always bear in mind 4.0 cannot be adopted in all industries. But Saudi Arabia's economy is changing and we need to have the latest technology so we can transition and become a player on the global market.

Yousef Al-Benyan: I would not be supportive of the idea that governments should be checking companies on innovation nor for increased regulations for 4.0 or any future technology transformation. It's the market, commercially, that has to pressure companies and they need to be judged based on the value they bring.

SE: But government could take away the inefficiencies that delay the implementation of 4.0.

Yousef Al-Benyan: That's a different angle. That could be part of an incentive program, like



“ We can always purchase technology, put in rules and regulations. But we will always be short of well-prepared talent.”

H.E. DR. KHALED BIN SALEH AL-SULTAN, PRESIDENT, KA-CARE

enabling efficiency and pushing companies to leverage technology and innovation. For example, in our case, we have excellent incentivizing energy efficiency programs. Everything that we do is basically about risk management but as we enter into the 4.0 race, we should also bear in mind that it is not necessarily the big fish who win, because they can be rather slow. This is where SMEs are going to be crucial for the future transformation of technology. At SABIC, we have an executive reporting to the CEO, taking into account digitization and innovation and assessing how this can influence not only our assets, but everything that we do. We need to look at the business – oil refineries, petrochemicals and chemicals – as an connected system and not just from one angle.

Adam Sieminski: What we really want to measure is how companies are performing financially and within the social context in the kingdom. We need to be careful on what we pick from the industrial 4.0 toolkit; not everything is appropriate for each company. The main drivers of the thought process behind Vision 2030 are a thriving economy, a vibrant society, and an ambitious nation. That includes creating space for non-governmental organizations like KAPSARC and others. Everyone in the kingdom – industry, academia and government – has to be jumping on this and making it work. I sense that there's a strong feeling, certainly among the young people, about making this a success. ■

**Edited transcript*

49

ACWAPower wants to have all its 49 plants that are operating today connected in real-time with real data to monitor information, benchmark and share knowledge more efficiently. Thirteen of the plants are currently connected to two such operation centers - one in Jeddah, one in Dubai - with all connected by the end of this year.

x3

The main drivers of the thought process behind Vision 2030 are: a thriving economy, a vibrant society and an ambitious nation. Digital excellence is pivotal to the kingdom achieving these goals.

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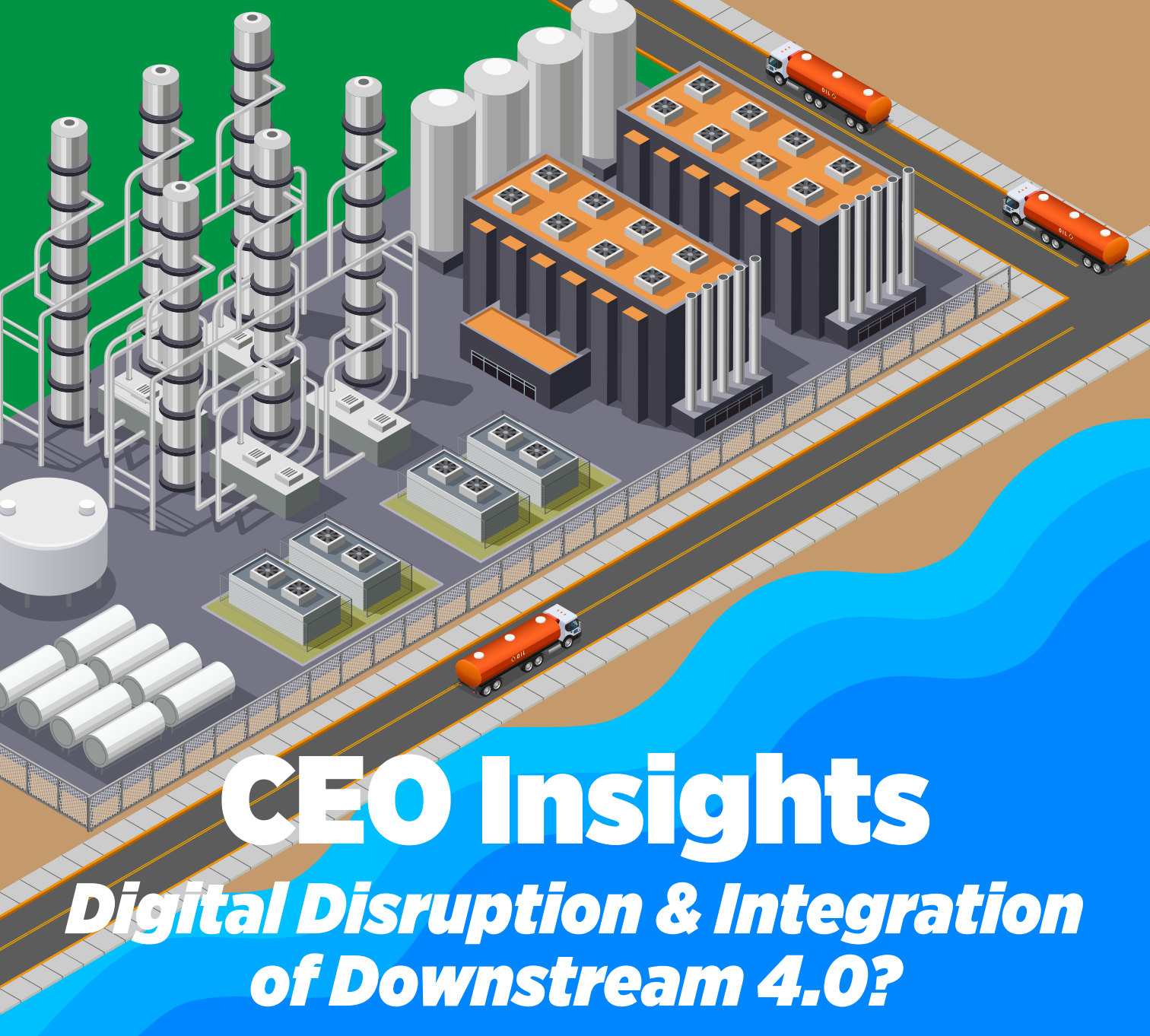
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CEO Insights

Digital Disruption & Integration of Downstream 4.0?

- Michael Train, President, Emerson & Chairman, Emerson Automation Solutions
 - Mutlaq H. Al-Morished, Chief Executive Officer, TASNEE
 - Fahad Al-Sudairi, Chief Executive Officer, Saudi Electricity Company
 - Sulaiman M. Ababtain, President & Chief Executive Officer, Saudi Aramco Total Refining & Petrochemical Company
 - Eng. Rasheed Al-Shubaili, Vice President – Communications, National Industrial Development & Logistics Program
- Moderator:* Dyala Sabbagh, Partner, Gulf Intelligence

Dyala Sabbagh (DS): How significant is the speed of adoption of digitization in Saudi Arabia? Are downstream industries moving fast enough to take advantage of the new technologies available?

Mutlaq H. Al-Morished: I've been in the industry long enough to see these things come and go. We have to be careful and make sure it always adds value to

our business. Yes, digital technology can be used for efficiencies but it's not for everybody. You have to assess if it really brings tangible improvements.

DS: The regional petrochemical industry has faced a major competitive challenge in the last few years with its natural feedstock advantage disappearing versus its global competitors. It also struggles to compete

internationally on high value products. Would adoption of industry 4.0 tools not make a difference?

Mutlaq H. Al-Morished: The chemical industry is, in fact, ahead on technology in many ways. We deploy thousands of transmitters, for example, which add value to processes and communication, but again, we should not look at this with one brush stroke. Not everybody needs to adopt this technology and there is also still a lot of ignorance on what industry 4.0 actually represents.

DS: From the refining perspective, what impact are these technologies having on profitability?

Sulaiman M. Ababtain: SATORP (Saudi Aramco Total Refining and Petrochemical Company) is a relatively newly-built facility. What is important is that when we develop a strategy for digital transformation, we understand what value it brings and how to then achieve it. I agree that application will not be at the same level for all industries. What fits one refinery may not fit another. But it is very necessary. Digital transformation is not automation. It's much more than that. It's the change in the way we do business and a total ecosystem between stakeholders that will need to be developed. The technology we are going to witness in the next 20 years is going to move fast and it's going to touch a lot of businesses. We must be ready.

DS: From a commercial point of view, does integrating these tools into operating systems give enough of a timely payback?

Sulaiman M. Ababtain: Today, we may look at digital transformation as a commercial investment but later, it will be a necessity to survive. As a refinery, our only concern is reliability and that comes with the safety of our most valuable assets. The other factor is productivity. We want to ensure that our plants satisfy demand.

DS: How important is it that the C-suite incorporates digital technology into strategic decision-making? Should it be a top-down approach or should operations managers on the ground dictate what's needed?

Michael Train: The answer is yes to both. The C-suite has to provide the vision and has to have a dialogue with the organization. On the one hand, they have to give their people permission to consider change and on the other, they have to push for some change themselves. A lot of this activity is a change in management exercise and the middle of an organization is often resistant to

10mn
The Saudi Electricity Company (SEC) expects to add nearly half a million new customers every year (400,000) to its existing customer base of 10 million. Accordingly, the company has developed comprehensive partnerships with leading universities in Saudi Arabia to explore how best to use harvested data to continue a safe, reliable and affordable service amid rising demand.

3x
Industries in the Middle East are vulnerable to cyberattacks; between two to three times more than the global average.

\$6trn
Cybercrime damages will cost the world \$6 trillion annually by 2021, up from \$3 trillion in 2015, reported Cybersecurity Ventures. Such attacks worldwide already cost the world \$600 billion in 2017, 0.8% of global GDP, according to McAfee. Sharpening digital defenses must be a continual effort.

change. It's a space with up to 50 years of operative experience, and when we make a mistake, it could kill people. So, there's a good amount of reluctance there. But we do need the change, as ultimately it will bring more uptime and safety.

DS: Saudi Electricity Company (SEC) is the largest electricity distribution company in the region. How is all of this impacting the sector? Is there a negative to implementing 4.0 technology into your systems? We have seen how the more sophisticated the linkages in operations, the more exposure there is to having malware attacks. As a huge provider of a very important resource, how fast do you think we should be moving ahead with adoption?

Fahad Al-Sudairi: SEC is serving ten million customers, so we are quite unique in this way, but we are also behind in digitization and in transforming to using smart solutions to serve our customer base. We're still operating mechanical meters to read the electricity consumption of each consumer. The customer wants accuracy and to be able to manage his energy needs with confidence. Smart meters would also help the utility company to project demand and to run operations and transmission into the distribution network more efficiently and control costs. The power sector today has been given a big mandate to restructure, so in line with that, we have to introduce a lot of digital solutions into our operations.

DS: In terms of cybersecurity exposure, statistically industries in this region are being attacked 2-3 times more than the global average. Why is that? Do they not have protective systems in place?

Sulaiman M. Ababtain: The cyber security issue has always been a concern, and this will increase with digital transformation, so we are preparing the infrastructure and security measures required for this. At the same time, we need to remember the advantages that technologies like machine learning, data collection and artificial intelligence bring. More dialogue between humans and the machines leads to stronger safety and efficiencies.

Michael Train: Everybody has cyber security concerns and we do need to be on our guard. But before companies expose themselves to remote connections, they should consider the balance of how much of this enhanced connectivity is needed externally versus internally and I would say that 70% of the benefits would be for the latter.

DS: At the National Industrial Development & Logistics Program (NIDLP), you are working with the Saudi Vision 2030 strategy. How much direction is being given to the various industries on their restructuring and should they



all be working in tandem in terms of the speed of digital change?

Eng. Rasheed Al-Shubaili: In my previous industry role as CEO of Dussur – an industrial investment company created by the Public Investment Fund, Saudi Aramco and Sabic – the installation and integration of 4.0 tools was always an area of focus with potential partners. At NIDL, we are primarily focusing on integrating and synergizing four key sectors in Saudi Arabia: energy, mining, industrial and logistics. One of the key pieces of our strategy is to introduce and enable industry 4.0. There are many elements to put together: the legal framework, capacity centers, labs, etc. And also helping existing industries transform operations to becoming more digitized via the '100 Companies Program'.

DS: The more industries digitize, the more they accumulate valuable data. Are companies using this to monetize new business opportunities?

Fahad Al-Sudairi: There is a gold mine of huge data that can be transformed to generate additional revenue. Our customer base is growing by nearly 400,000 annually and we already have comprehensive

“Data is a treasure. It hits the triple bottom line: via operational maintenance, environmental efficiency and people.”

partnerships in place with leading universities in the kingdom to look at how we can add value to the company with this data.

DS: Saudi Aramco generates billions of data points a day on surface and sub-surface operations. The technology is there and already capturing this, but is it being used or integrated to make decisions on efficiencies?

Sulaiman M. Ababtain: Data is a treasure. When we can monitor compressors for example, it not only protects equipment and avoids the cost of repair, it also helps us avoid the commercial consequences of unplanned shutdowns and improves safety. So, it hits the triple bottom line via operational maintenance, environmental efficiency and people. In cooperation with our partners, we will continue to explore how we can add value with all of this information. ■

**Edited transcript*



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The Saudi Industrial Revolution 4.0

BY DR. MOHAMMED AL-MAJED

Senior Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia

When we talk about Saudi Arabia and technologies as part of the 4IR, we should focus on digitizing mechanisms in production systems, particularly within manufacturing. Digitalization is spreading across all sectors; in the banking sector, it has advanced to a point that we now have digital currencies. But when it comes to manufacturing, we see much less application.

Manufacturing is capital intensive and is also one of the most labor intensive industries, so applying 4IR tools is hard as it requires getting through many layers. Ironically, this same toolbox should enable us to leapfrog into the future of production processes. It can help manage supply chains for example; factories in Saudi Arabia use both locally manufactured and imported parts. The 4IR allows vertical and horizontal communication to occur between suppliers and operators to monitor and track when products are needed to be replaced.

The manufacturing system in Saudi Arabia has traditionally targeted low value, low margin products. But we need to be focusing on higher margin, high value items similar to the ones we see in the defence, medical and healthcare sectors. How do we go about establishing 4IR capabilities in industry in Saudi Arabia? How can we facilitate individuals to learn about it, investors to use it and government to support it?

We have developed a strategy that focuses on one important pillar – contact between government and industry. We have identified five ‘capability centers’, which will be built and financed by the government and located mostly in MODON (Saudi Authority for Industrial Cities and Technology Zones). These centers will have four main functions.

Firstly, they will be a place where individuals and companies can enquire and learn about 4IR technologies and how they could be adopted in Saudi Arabia. The second purpose will be to function as a RD&I (research, development and innovation) system where academics and students can connect their laboratories in an interactive way. The third function is to showcase examples of the latest global Industrial

Revolution 4.0 technologies. Lastly, we want to model a ‘future factory’, which will demonstrate how SMEs can use these technologies in a shared manufacturing facility. 3D printing equipment is very expensive to purchase and maintain for example, so if we can provide these machines to be shared by SMEs and start-ups, they could have time to build enough demand for their product before committing to investing in their own equipment. With these four elements, we are building a strong interface between the government and the industrial sector with a focus on production.

Embracing Unknowns

Industrialization encompasses around 50% of Saudi Arabia's Vision 2030, which also aims to create 1.6 million new jobs. How do we reach these targets? We need to use technology and train the workforce to use it. The current generation, both in the kingdom and around the world, is simply not getting the same focus of manufacturing training that others did in previous decades. If we are not careful, countries will lose their capacity for production. Let's also remember that the need for a service sector is built on the back of manufacturing. If you lose the latter, you could start losing your RD&I ecosystem.

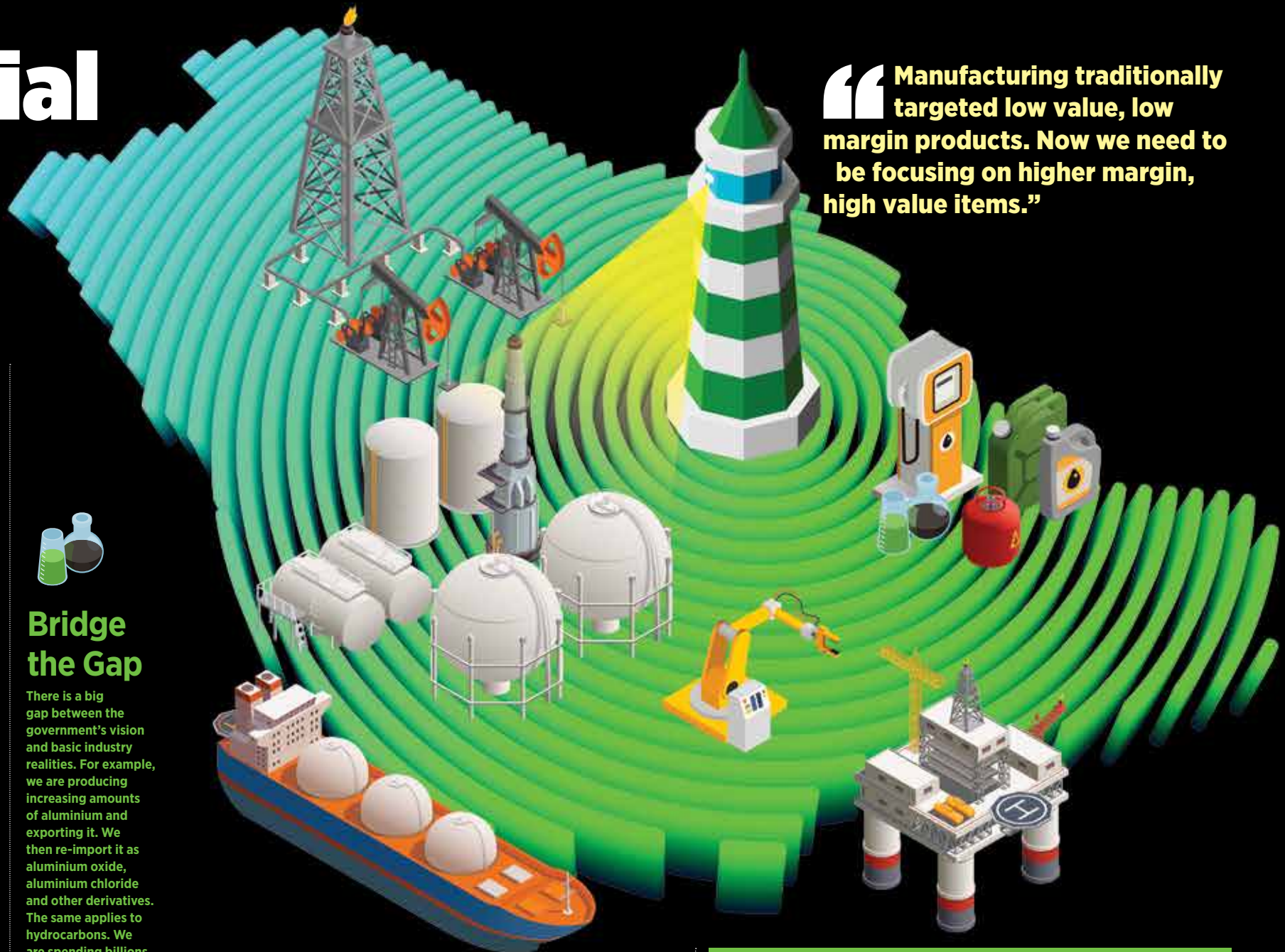
Initiatives to address this are under way, but the challenge remains that investors are often reluctant to switch from established processes. MODON is leading a very interesting ‘lighthouse’ project, to transform 100 factories by helping them digitize under a process of assessment and accreditation and so they know what can be achieved with new technologies at hand. This project will likely face delays and difficulties, but we need to persevere as we simply don't have a choice. If we are serious about realizing Vision 2030 and diversifying our economy, production systems and investment in industry is the key.

A foundation of our strategy is a concept called ‘Product Life Management System’, which is a digital platform where an idea can be translated into engineering drawings that can be used by individuals, SMEs and government for analysis or production.



Bridge the Gap

There is a big gap between the government's vision and basic industry realities. For example, we are producing increasing amounts of aluminium and exporting it. We then re-import it as aluminium oxide, aluminium chloride and other derivatives. The same applies to hydrocarbons. We are spending billions of Saudi Riyals re-importing materials that we export at higher value. Maybe 4IR can also help address this gap. Millions of dollars of investment initiatives in the kingdom have been made in big data and AI, for example, in the last decade. Yet, very few people are aware of this. We should have a knowledge-sharing hub that lists and shares this information.



“Manufacturing traditionally targeted low value, low margin products. Now we need to be focusing on higher margin, high value items.”

The tools that we establish at King Abdulaziz City for Science and Technology (KACST) will be available, in addition to an incubation system. In essence, we are creating a virtual industry before we realize it on the ground. This should also help the development of human capital. We have started aiding universities to establish this. At Prince Sultan University, there are two courses and a lab for students. This example of contact points between technology, strategy and students can be replicated and scaled up. We can get vendors to supply e-learning platforms and make them available for students and SMEs, helping them navigate the otherwise very expensive access to these tools. This digital mapping, which shows where resources are needed, can also guide investors in the right direction. ■

Simplicity wins

From a legal point of view, harnessing 4.0 tools such as artificial intelligence (AI), the industrial internet of things (IIOT) and robotics into a factory or production system is not straightforward. It took Samsung, Google and Apple about 15 years to agree on a common USB interface for their devices, used by millions around the world. Imagine what it will take to standardize the use of these technologies in a whole factory system. If we take 3D printing as an example, it is usually associated with harmful chemicals. So, as a factory, you would have to know how to deal with customs when the component parts are entering the country. Another health and safety executive (HSE) example are robots that move around and interact with technicians. There may be accidents, so where does the liability lie? Is it with the manufacturer, the installer, the user or the factory owner? The same thinking applies to data security in the banking system. All these are examples of the need for common standardization.

US Shale Revolution Part 2

Implications for OPEC and Saudi Arabia?



BY DR. ANAS ALHAJJI
Managing Partner, Energy Outlook Advisors

The production of shale oil in the US has been a revolution, turning all conventional wisdom on its head. Shale output has increased by about 7m b/d in seven years. By contrast, it is going to take electric vehicles (EVs) 30 years to lead to a decrease in demand for oil of 5m b/d to 6m b/d. So, it's easy to see which of the two technologies have been most disruptive.

Putting technology aside, the real secret of shale oil's growth has been private ownership. Even when oil prices declined in 2015-2016 and cashflow dropped, production continued to increase on the hope that higher reserves and production will yield large profits when the company is sold. The stars are aligned for shale producers, who are blessed with massive reserves, technology, know-how, a strong legal and institutional framework and established infrastructure.

This also explains why the majors are moving in. With conventional

production, there's a risk of drilling a dry hole whereas with shale, at the right price, operators can deliver within six weeks. Companies like ExxonMobil, Chevron and BP have made significant moves into the Permian basin, creating a shift in capital from longer to shorter investment cycles. Another incentive is that most of the risk is above ground, whereas internationally, especially with conventional resources, there is both above and below ground risks. Shale oil reduces risk and accelerates cash flow. Majors can also achieve economies of scale through their large integrated supply chains, enabling them to easily market the oil, especially outside the U.S.

International oil companies' (IOCs) investment in US shale is also positive for several countries around the world. They have large refineries worldwide and can send all and any excess shale oil overseas. In turn, this helps Saudi Arabia lower oil storage costs in the US. Another benefit of the entry of IOCs into the shale market is

that it lowers production volatility, which helps price stability in those areas.

Misconceptions about Shale

What is the right price for shale oil given the cost factors? You may be surprised to hear that it is in fact lower than the price that OPEC members seek to finance their economies. We should not compare the cost of producing or extracting oil in Saudi Arabia to the cost of shale oil extraction. Instead, we need to compare what prices are needed for that economy to grow versus the total cost of production in shale. That is what has made the difference in the global argument for shale.

The regulatory environment in the U.S. has also made a big difference to the economics of shale. When oil prices went into severe decline four years ago, the general conception worldwide was that there would be major bankruptcies amongst shale oil companies. But that didn't happen. One reason is the conditions and time frames around booking reserves. When a company wants to acquire another, in most cases they must pay a premium of between

20%-40% due to the reserves value, even though they are not allowed to be accounted on the books. So, you can actually have a situation of negative cash flow and a low stock price, but you know that those reserves exist. There is a misunderstood negativity towards shale based on these financial and accounting structures.

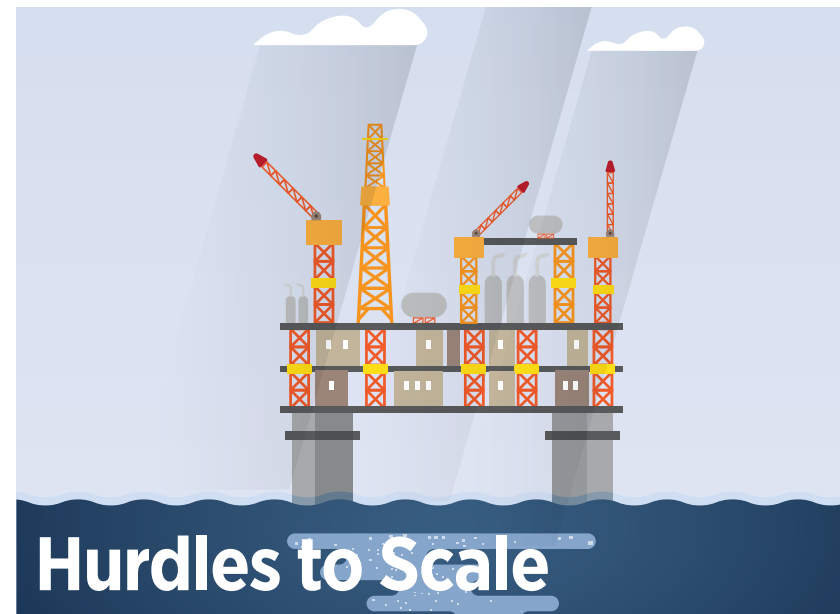
Another misconception comes from when we judge through averages. Average price or average breakeven for the U.S. shale industry is meaningless. Averages must be replaced by ranges. The cost of producing oil from shale varies widely, even within the same basin. Some oil companies were making profits at oil prices that were way lower than the report average breakeven cost.

Another misconception is related to the cost that matters during downturn. During a downturn in the economy and lower oil demand, what matters is not your total cost, but rather the operating cost. The operating cost for shale is between \$18/bl and \$22/bl. So, generally speaking, as long as prices are above \$22/bl, companies can continue to operate and survive.

Can shale be developed outside the U.S.?

When we look at whether other countries can consider developing shale deposits like the U.S., the general belief is that the U.S. shale experience and results cannot be replicated, especially on the oil side, for several reasons. But on the natural gas side, we see that Saudi Arabia is considering opportunities. The justification of developing shale gas in certain areas, such as in the northwest of the country near Tabuk, is similar to the justification of building renewable power plants in these areas: the cost of shipping oil from Ras Tanoura to these areas is very high. The higher cost of shale and renewables is way lower than the cost of oil when considering the shipping costs: products must be shipped all the way around the Arabian Peninsula to Yanbu and trucked for 400 kilometers just to reach power stations.

The other challenge is water. For example, in Libya and Algeria, there is plentiful shale gas, but it is in areas where it only rains once a decade. New technologies that negates the need to use water are needed. ■



On the negative side, sheer abundance is killing shale. We have on occasions seen natural gas coming out of the Permian Basin in West Texas at negative prices (average prices in the U.S. have been around \$2.70/bl). We also have a high decline production rate; it used to be around 70%-80% and is currently probably in the 60s% because of improvements in various technologies and management. But we need to be constantly reinvesting, even at those lower rates. The IEA expects shale oil to peak and then plateau by 2025. Taking the average capital expenditures in recent years into account, and assuming that continues, we will reach a point where investments will only go to compensate for the rate of decline. But with higher capital expenditures than in the past, shale can continue to grow, as long as there is a market for light sweet crude and condensates.

Shale oil deposits are also getting gassier. The deeper you go, the more gas there is, and this then risks having more gas at negative prices, thus driving down company values.

The other issue is multi-pad drilling where too many holes are drilled in the same area, creating 'parent child' wells, which are connected and therefore cumulatively reduce pressure and productivity. In some cases, all of a sudden, instead of having an oil well, you could end up with a natural gas well, which is calamitous if oil is at \$70/bl and yet gas prices are very low.

Another challenge is crude quality. Shale is a light sweet crude – good for gasoline, naphtha and some other products. This crude quality creates two problems: mismatch between the additional crude produced and refining capabilities to refine it, and another mismatch between products produced profitably from shale and petroleum products demanded. We've already reached saturation point or what we call 'the refining wall' in the U.S., which is why we are exporting any excess to the rest of the world. The only way shale production can keep growing is to export all the additions. We will also at some point hit a similar wall with global refiners. Shale oil will continue to grow by more than a 1m barrels year-on-year for the foreseeable future, but most of the growth in demand is in Asia. This will be

for heavier products, so this will eventually limit the growth of shale oil as crude price differentials could widen substantially.

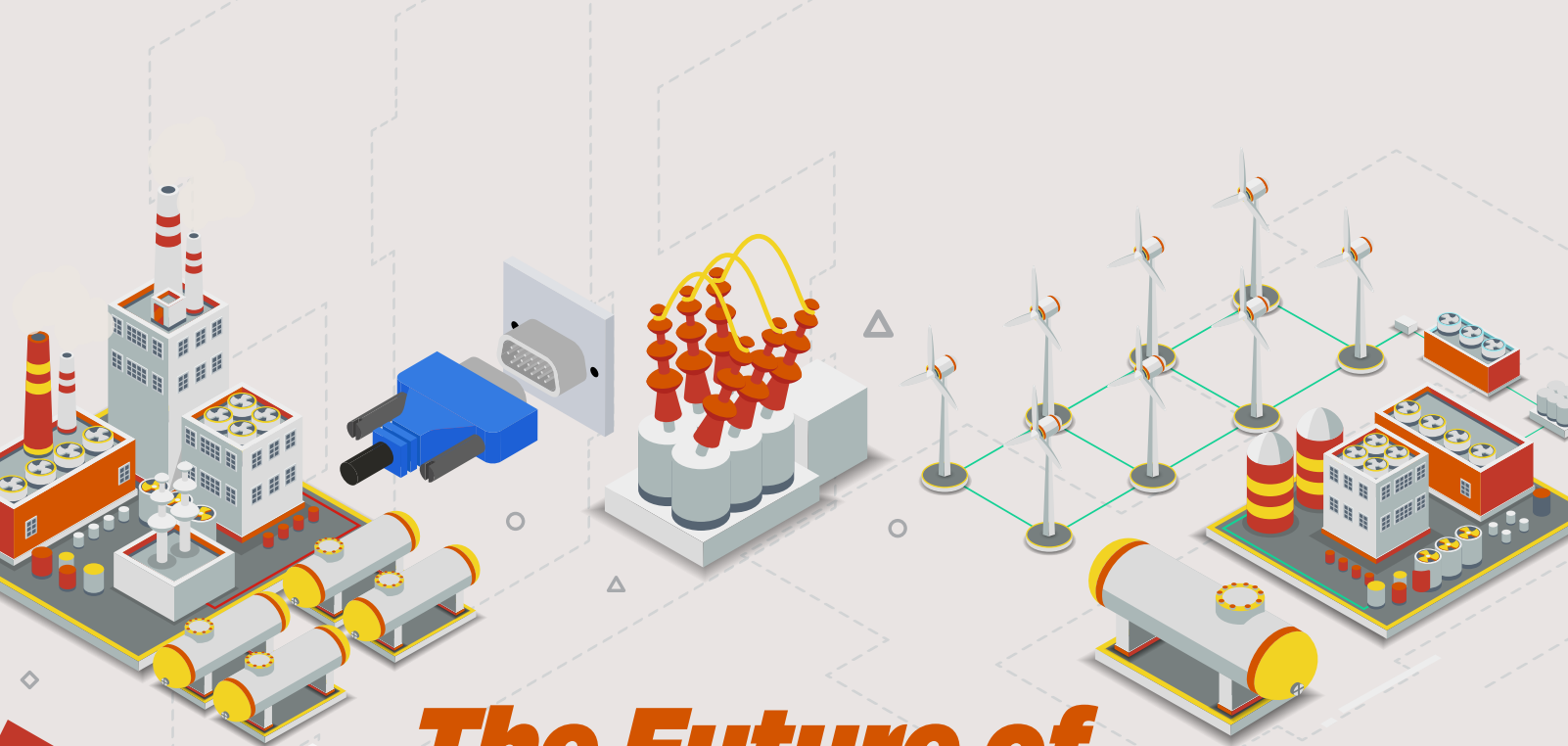
Ironically, the shale revolution did not reduce U.S. dependence on crude oil imports from the Middle East (the recent reduction was caused by OPEC cuts). Since shale reduces light sweet crude, it replaced imports of similar quality, especially under the U.S. crude export ban that ended in 2015. Shale production replaced oil imports from Nigeria and Algeria, but did not replace the heavier more sour grades from Iraq, Kuwait, and Saudi Arabia.

The most important impact of shale on OPEC is that it split OPEC into two halves: those who lost market share vs. those who did not, based on crude quality. As a result, shale caused OPEC-on-OPEC competition. Prices declined.

Those who lost market share in the U.S. had to look elsewhere for market share, and the only choice was to compete with other OPEC members. This has been compounded with a simultaneous drop in world oil demand growth. In the medium to long term, there will be a bigger market for Gulf crude quality, which will play into those countries' favor.

Another obstacle in the U.S. that few pay attention to is the fact that post deregulation in 1980, the industry was separated into producers, pipeline operators, distributors and exporters. It became widely segmented. With shale oil, you have all kinds of crudes. Coupled with new environmental regulations for products and the fact that the pipeline systems and storage facilities in the U.S. have not adapted, there is a risk of contamination for exports that is ultimately not acceptable to foreign refineries. If the system in the U.S. was integrated, you would not have this problem.

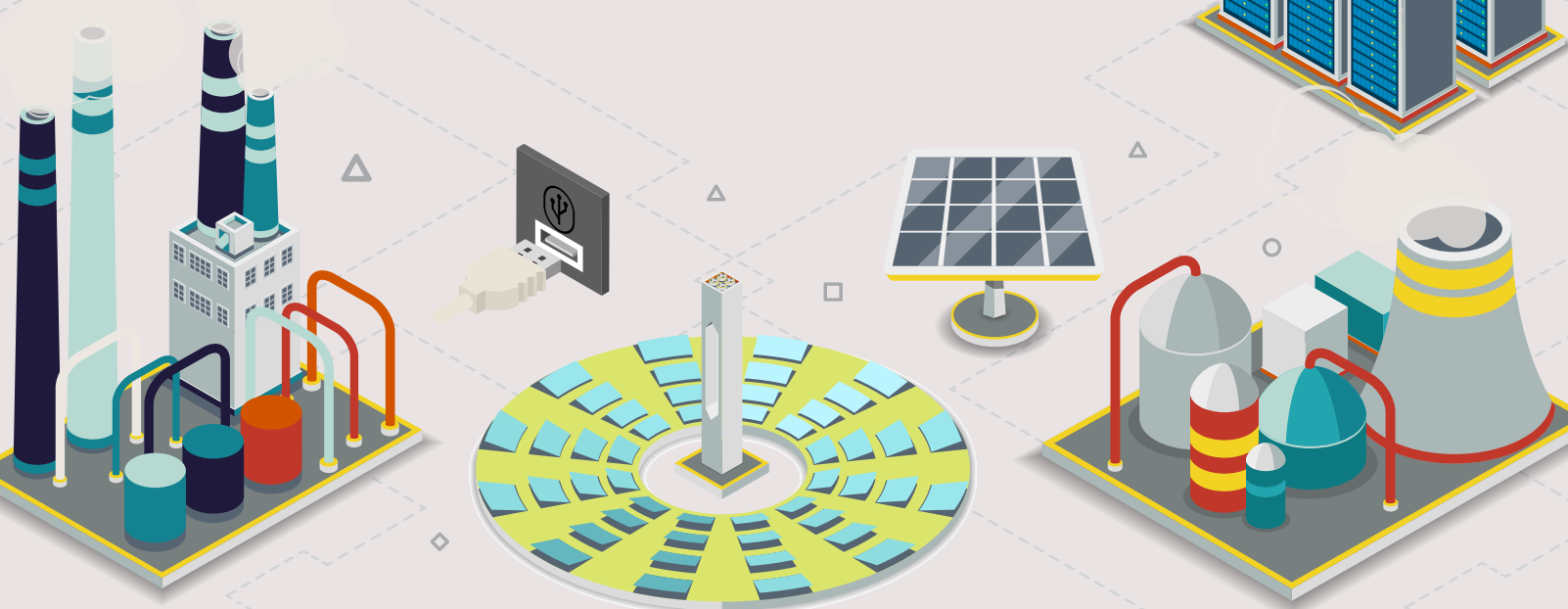
In the Arabian Gulf and other places by contrast, there are dedicated pipelines for different crudes. Asian customers have used this system for the last 50 years or so, but when they started shifting to take product from the U.S., they found they were getting contaminated oil. How long can this continue?



The Future of Electricity Markets?

CREATIVITY

BY ADAM SIEMINSKI
President, KAPSARC



A growing, energy-hungry and increasingly prosperous population means the impressive growth in the trajectory of Saudi Arabian electricity demand might accelerate without a strong commitment to price reform and energy efficiency measures. Up to \$20 billion must be invested in the kingdom's power sector over the next five years to meet demand, detailed Apicorp. Aside from industrial demand, the United Nations (UN) said the population will climb by nearly 40% to 45 million by 2050. More people, more industry, more demand – and greater the need for creativity.

Reforming the electricity market is a key part of Saudi Arabia's economic transformation agenda, as set out in the Saudi Vision 2030 goals. Accordingly, new pricing models and tariffs are being proposed and set to be tested in order to be able to reflect true network costs, with the aim of sending the correct signals to network users and informing network investment decisions. And new business models are beginning to take shape with restructuring and privatization plans under consideration, including services that offer enhanced reliability, convenience and flexibility to better address consumer needs and preferences (see: *Speak Customers' Language*). The same applies to providing testbeds for trialling new business models (see: *Calling all Regulators*), as explored in one of KAPSARC's workshops on integrated approaches to decentralized systems in February this year.

Digital aid
Transformational technologies under the umbrella of the 4IR – advanced robotics, predictive analytics, automation, Industrial Internet of Things (IIoT) and many more – are reaping the value chain. This encompasses more direct

and real-time feedback from customers, self-guided autonomous devices in remote inspection areas, maintenance in plants and greater energy efficiency in the distribution network. Many have already clocked the opportunities, with global investment in digital electricity infrastructure and software rising by more than 20% annually since 2014, reaching \$47 billion in 2016, according to the IEA. The 8th Saudi Arabia Smart Grid Conference (SASG 2018) held last December illustrates how this topic has long topped boardroom agendas in the kingdom, a country globally lauded for its digital expertise.

Transparency and ease of access to data is key. Lacking analytical expertise runs the risk of being blinded by the massive volume of data generated by the 4IR. Improving the level of digitally fluent talent in the kingdom, especially those who can decipher the key trends revealed by data, is pertinent. More dialogue between government, industry and academia is also imperative to creating a relevant workforce in the 2020s and beyond, therefore supporting the Saudi Vision 2030 to become a knowledge-based economy. One of the most recent examples of progress is Saudi Aramco's new 'Fourth industrial Revolution Center' to enhance technical skills. Easy digital access is also critical; again, huge progress is underway. Dawiyat Integrated Telecommunications & Information Technology Company, wholly-owned by SEC, now has more than 70,000km of fiber optics – nearly the distance of circumnavigating the globe twice – at more than 1,500 locations. The kingdom is home to aspirational and creative talent and a swathe of the latest technologies. Ensuring the positive trajectory of supply-meets-demand continues, means leveraging this intellectual and digital gold dust. ■

Calling All Regulators

Regulators worldwide must think innovatively rather than traditionally. Mindsets must keep changing in accordance with modern-day economic and environmental demands and technologies. For example, how best to install smart meters, use customers' personal digital technology for real-time

supply-demand reporting, create policies that incentivize a steady flow of funds in the 2020s, and so on. Regulators must also invest time and money to distinguish between the value of retrofitting existing infrastructure and building new infrastructure. On a more ambitious note, the GCC would benefit from

an interconnected, regional power grid. The complexities involved in realizing this aim are vast. It requires further price reform throughout the region, cross-border safety nets to prevent any black holes in supply, frequent reviews of regulation to reflect the region's ever changing energy dynamics and of course, cohesion between industry and government in all six countries. Is this possible? Yes.

Will it be hard-won? Yes, but the positive domino effect on the region's energy security – and reputational value as a template for collaboration worldwide – would be invaluable. As with any reform, lessons can be drawn from international experience to better inform policymakers and regulators in the kingdom about the best evolutionary pathways for the industry.

Speak Customers' Language



Customers, utilities and businesses in the value chain cannot operate in a vacuum of information. Clear and concise communication is essential. For example, a customers may find it more challenging to manage consumption if they are simply told their total KWh used and amount due. Instead, utilities could show retail customers their projected bills for the summer months and suggest ways to reduce those bills through improvements in air conditioner efficiency, thermostat settings, or other measures. This gives customers more accountability and the associated transparency enables utilities to better pin down supply-demand flows, therefore locking in greater efficiencies in generation. For example, up to 16% of electricity use in industry worldwide could have been saved in 2017 if countries had adopted the strongest electric motor standards, highlighted the IEA. Introducing an insurance model where a commercial customer has a package crafted to their preferences is another option i.e. they accept limited-duration power outages in return for lower rates. Matching the electricity service with customers' needs essentially turns a liability into a tailored choice and the acceptability of the potential outages significantly reduces customers' frustration. In order to achieve this, you need data and smarts – lots of numbers and the intelligence to decipher what the numbers mean. Identifying data trends more accurately can summarize consumption behaviors, thermal efficiency of buildings, the appliances most used and so on.

Digital Transformation Drives Operational Excellence: *What's Next?*

BY MICHAEL TRAIN
President, Emerson & Chairman, Emerson Automation Solutions

20,000

years of progress on innovation could be crowded into the 21st century alone, predicted Ray Kurzweil, Futurist and Chief Engineer of Google. While the outlook seemed ambitious when it was made, the astonishing pace of progress thanks to the 4IR has surpassed all expectations. Ray's comments now seem almost prophetic. Endless opportunities await, but they must be managed correctly.



The effectiveness of the digital transformation is not just in the application of tools – from artificial intelligence (AI), predictive analytics, advanced robotics and many more – but also how processes and people must evolve to seamlessly use and integrate the tools. The human side of digital transformation must keep pace with the technological perspective – a unique and demanding goal. Therein lies the importance of creating, nurturing and spurring a culture of innovation in industry, government, academia and society. In turn, this creates a competitive and inspired 21st century workforce in Saudi Arabia.

Oil and gas operators can accelerate from average to top quartile performance and capture up to \$7 billion in profits annually, through advanced automation technologies and new processes, studies by Emerson revealed. Overall, digitalization has the potential to unlock up to

\$77.6bn
The International Data Corporation (IDC) said spending on cognitive and AI systems will reach \$77.6 billion in 2022, more than three times the \$24 billion forecast for 2018.

\$12bn
Wood Mackenzie said a better use of technology could save the industry \$12 billion a year on drilling, mostly in onshore and shallow waters, and \$24 billion a year overall on operating oil producing assets.

2,000
Increased automation and digitization could lower the number of days of rig usage for offshore drilling by 2,000 and accelerate drilling rates by 15%-20%, Wood Mackenzie detailed. Another solution is using seismic imaging instead of the traditional 3D imaging, so that operators can measure and predict fluid changes in reservoirs, typically increasing recovery rates by 40% and boosting upstream revenue by up to 5%.

\$2.5 trillion in industry and societal value for the global oil and gas markets in the medium-term, according to the World Economic Forum (WEF). SAP and Oxford Economics Digital Transformation Executive said 58% of the region's digital leading organizations cite digital skills investment as the most important profit growth driver in 2018 and beyond. A digitally naive and creativity stumped workforce means falling behind.

Stay Sharp

If managed correctly, the 4IR is a job creator – not a job destroyer. A study of nearly 1,000 organizations worldwide with revenues over \$500 million by Capgemini, a leader in consulting and technology services, found that 83% of

“Energy companies, regardless of their size, must embrace a start-up culture. In part, this means hiring youngsters with an entrepreneurial mentality that can be nurtured in a corporate environment.”

\$50bn
Interconnected emerging technologies can unlock \$50 billion in savings in the global oil and gas sector. AI, blockchain, robotics, sensor technology, machine learning, deep learning and edge computing can cut capital expenditure by 20%, operating costs in upstream by 3%-5% and 1%-3% in downstream, detailed McKinsey.

\$11trn
The value that could be generated by combining the physical and digital worlds by 2025, McKinsey has estimated.



Let's Talk

Energy companies must increasingly build partnerships to bolster cross-sector knowledge exchange. Emerson's memorandum of understanding (MoU) with Saudi Aramco focuses on bridging advanced digitization and automation technologies. This includes a \$25 million technology and innovation center in the Saudi city of Dammam's Dhahran Techno Valley,

which provides technology expertise to stakeholders in the kingdom. Looking further afield, ExxonMobil is partnering with Microsoft to crunch trillions of bits of data into readable information as the oil major seeks to more than triple shale-oil production in the Permian Basin in less than a decade. Plus, seven global petroleum corporations, including ExxonMobil, have created the Oil and Gas

Blockchain Consortium with one aim being a pilot project to identify applications for industry. As tech giants like Amazon and Microsoft become more eager to work with energy stakeholders – data dissemination, for example – how best to thread cross-sector talent together? One route is tech-sponsored centers of excellence in energy hubs and secondments so staff from both 'worlds' can

gain hands on experience. Creating an ecosystem is vital to giving energy companies much-needed guidance on what they can – and sometimes should – do. Many cannot hire 50 data scientists on a whim to restructure their digital management. Their capacity is already stretched navigating the great energy transition, unpredictable oil prices, geopolitics and economic trends.

Speeds Matters

Saudi Arabia's public investment fund has made external investment commitments worth \$95 billion since 2016, with a high concentration on technology, according to the International Monetary Fund (IMF). The kingdom's economic intent is clear (and building), but the pace of progress needs to accelerate. More than three quarters (76%) of respondents to a GIQ Industry Survey in Saudi Arabia agree that speed is the defining factor for success in the 4IR. So, it is perhaps a wake-up call that 82% don't believe the Saudi industry is doing enough to be ahead of the digital transformation curve. The seemingly endless opportunities of the digital revolution also have a global dark side: the rise of cyberattacks, the world's fastest growing mafia. Cybercrime cost the world almost \$600 billion, or 0.8% of global GDP, in 2017, estimated McAfee. 'Digital sheriffs' in house, or hired via third parties, will be integral to reinforce the digital brick walls protecting operations, sensitive data and intellectual property (IP). Ignore their importance on your payroll at your peril.

2.1%
Global energy demand grew by 2.1% in 2017 and CO2 emissions rose for the first time since 2014, according to the IEA. The message? Meeting rising energy demand and increasingly ambitious low-carbon targets is very, very demanding. Digital tools to boost efficiencies and cut costs are indispensable.

respondents have created new jobs because of AI. Three-quarters of firms have seen a 10% uplift in sales directly tied to AI implementation and 63% said that AI has not destroyed any jobs in their organization. But this transition must be properly managed to ensure employees' skills are upgraded – the pace of change is faster than ever. For example, inspection engineers are increasingly having their jobs replaced by drones, so are there enough drone pilots?

Energy companies, regardless of their size, must embrace a start-up culture. In part, this means hiring youngsters with an entrepreneurial mentality (the sort who could be working on the 'next' Careem) that can be nurtured in a corporate environment. Many professionals today, including some 'aged millennials' who think

“The seemingly endless opportunities of the digital revolution have a dark side: the rise of cyberattacks.”

they are digitally orientated will be amazed – and easily outpaced – by the digital fluency of younger generations. Hiring such talent is a competitive business that the energy industry still isn't winning. Equally, the focus on the human side shouldn't be on millennials only. It should also be on retraining the existing workforce and upskilling their digital knowledge and introducing change management programs that can keep pace with rapidly changing tools and skills ■

CYBERSECURITY

Think Hackers Out of the Game

BY RONNIE RAHMAN

Director of Cyber Security, Honeywell EMEA & APAC

The world's new, largely invisible and well-armed cyber "mafia" has its eyes on the mountains of hackable data being generated every millisecond in the energy industry, spurred by the 4IR. Energy stakeholders must master three defensive skills quickly: coordination, cooperation and speed.

The 4IR is not just a case of purchasing digital protection and injecting it into the operational fabric of a company. The response to cyberhackers, armed with deep pockets and sophisticated capabilities, must be far more sophisticated to safeguard Saudi Arabia, a regional hegemon and one of the world's biggest energy producers.

This is especially pertinent as threats worldwide escalate from online harassment that may have once temporarily shut down a website, to advanced cyber weapons that can paralyze a nation's energy grid. Attacks on cross-border digital infrastructure could also trigger a domino effect.

It pays to think long-term, which means building cybersecurity indigenously into the system now with the acceptance that you can't escape working with multiple vendors later. Nobody has the full spectrum of protection, so collaboration gives

“We all have the same problem; hackers do not respect budgets or borders. Our combined minds must be brighter than theirs.”

companies as much of an educated view as possible. Key questions that companies new to the cyber game need to ask include: What are the cybersecurity consequences for the technology the company has adopted and is it enough to buy insurance as protection, especially as it is increasingly part of regulatory compliance? Or must I do more?

Collaboration also creates a more centralized view. The more data you have, the more you can correlate trends targeting certain sectors at certain times. Some attacks target organizations on Friday afternoon. Why? Because the staff has gone to Friday prayer. A centralized security intelligence center can address more predictable attacks, allowing resources to focus on preventing the most damaging digital assaults.

Communication is key to our defensive ability and speed of innovation. Feedback from clients, knowledge-sharing within industry and engagement with academia on skill development must be continual efforts. It also pays to learn from other sectors that have already had decades of trial and error, such as banking.

This is not a sprint nor a marathon; this road has no end and one solution does not fit all. But we do all have the same problem; hackers do not respect budgets or borders. Protection means working together; our combined minds are brighter than theirs. ■



Adjust Your Lens!

Cyber resilience when – not if – a company gets attacked means continuing operations at even a basic level to preserve business continuity while the disaster recovery gets underway. Building this resilience is not an overnight effort; it requires proactivity. Managers' viewfinders tend to be restricted to the cost implications of training, installation and monitoring, especially as there is no direct return on investment (ROI). But the negative financial impact of a cyberattack on an organization's health and safety executive (HSE), reputational value and the willingness of other companies to partner could easily exceed the cost of installing defensive measures now. Plus, the complexities of operational technologies (OT) will exponentially grow alongside intensifying market pressures and energy demand. Laying a solid foundation now will pay dividends in the 2020s and beyond.

70%

The percentage of Saudi citizens who rely on a fast and reliable internet connectivity to access government and business services, communicate socially and for education, according to the kingdom's National Cyber Security Center (NCSC). Persistent defense of this infrastructure is essential to a productive and secure economy.

200

The National Cybersecurity Authority (NCA) held a workshop in Riyadh with more than 200 governmental and representatives of vital sectors last December to discuss the state of cybersecurity in the kingdom and to showcase projects and initiatives. Reducing opacity through knowledge-sharing is essential to building companies' cybersecurity confidence.

13th

Saudi Arabia's ranking in the UN Global Cyber Security Index. This is especially impressive considering the kingdom only started taking significant action in recent years. This is a good start; the challenge of staying safe will only intensify.

1st

Honeywell opened its first Industrial Cybersecurity Center of Excellence (COE) at its Middle East

headquarters in Dubai. More such centers are integral to combating the fast-moving mafia.

3.5mn

There is a global shortage of cybersecurity staff; 3.5 million such jobs will open globally by 2021, said Cybersecurity Ventures. The career path needs a marketing campaign to transform the perception that it means being lost.

To Spur Saudi's Innovative Spark – COLLABORATE

An environment conducive for innovation is borne through a symbiosis where technological development

drives a positive disruption of science, balanced by entrepreneurialism and commercial vision. This must be supported by pioneering and enabling government policies. This encourages investments to be channeled into human capital and governments to actually put pen to paper, to drive economic and social incentives. But the most important ingredient is collaboration between the three cornerstones of a sustainable innovation ecosystem; academia, industry and government.

A culture of innovation is of course not new in Saudi Arabia and the Middle East region, where for centuries development has been driven by novel approaches to meet a demand for constant adaptation to a rapidly changing world. Today, at the onset of the 4IR, the kingdom's penchant for ingenuity and creativity can be pro-actively applied to the context of the Vision 2030 and beyond. A successful adaptation to 4IR requires sustainable, affordable and efficient routes through the unchartered territories of the great digital transition for the energy industry, unpredictable oil prices, talent shortages and constantly fluctuating economic trends.

Tough questions need answering. How to affordably and efficiently meet the 55% rise in the Middle East's energy consumption by 2040, that

BY OLOF ARNMAN

General Manager, Saudi Arabia & Bahrain, McDermott International

“Exciting times lie ahead. Few countries are in a better position than the kingdom to quickly leverage on 4IR to strengthen their competitive standing on the global energy stage.”

the BP Outlook anticipates? How to leverage R&D policies and incentives to spur innovative technologies? How to educate the next generation of skilled workers to embrace the work of the future – i.e. digital fluency? How to create effective communication and dialogue between industry, academia and government, to ensure that they all understand and consider their respective drivers for innovation and the challenges they each face?

Part of the answer lies in stakeholders collaborating through innovation partnerships for a more applied research approach – efforts that aim to answer specific questions – and in making associated data and technical breakthroughs more transparent and accessible. Opaque information may result in inefficient allocation of time and resources. It is better to collaborate on the next step with a credible partner that may have carried out a similar process recently, or that may have valuable input on how to bring

innovation forward to implementation and, as applicable, commercialization.

Managing risk while challenging the status quo also needs careful management of change, for example when recruiting and integrating millennials in the workforce. Equally, the experience and wisdom of the older generations must be sustained to manage expectations, guide progress and ensure legal and regulatory safety nets are in place through the change process. Whatever the generation, there must be a sense of ownership and pride in an idea to reinforce cultural and national pride in pioneering R&D.

The kingdom has the advantage of being able to support a culture of innovation partnerships, sound R&D, and commercialization more readily than other nations. Few countries are in a better position than the kingdom to quickly leverage on 4IR to strengthen its competitive standing on the global energy stage. Exciting times of innovation and transformation lie ahead. ■

61st

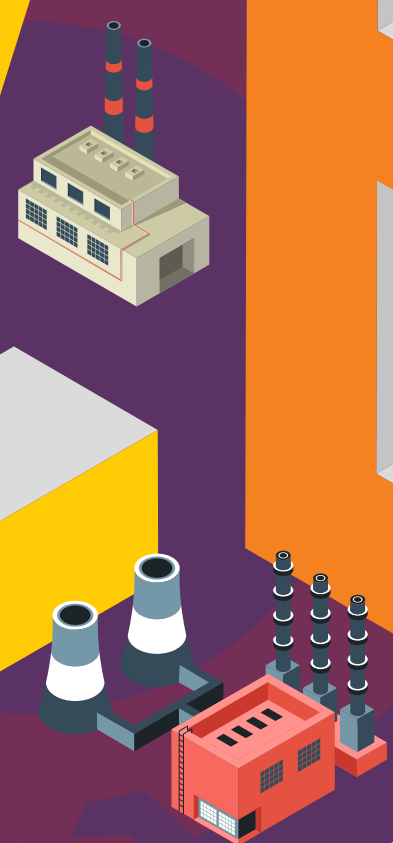
Saudi Arabia's ranking in the Global Innovation Index (GII), with a particularly competitive 24th ranking in the sub-category of human capital and research. The GI encompasses 126 economies, representing 90.8% of the world's population and 96.3% of the world's GDP.

10

You cannot produce ten patents and expect ten technologies; the odds of commercializing an idea are far harder. The stronger the R&D ecosystem and the greater the unity, the more favorable the chance of success.

1930s

There's a default assumption in the Middle East that R&D must be publicly funded. But science was almost completely privately funded in the 1930s; a time that spawned some of the greatest scientific revolutions in the history. The lesson? Embrace multifaceted finance avenues.



WASTE

CIRCULAR ECONOMY *Why Should Energy Markets Care?*

BY MAZIN ALBAHKALI
President & CEO, GE Power Services, Saudi Arabia & Bahrain

\$138 billion

in savings is one driver of energy stakeholders' appetite for a

'circular economy'. The multi-billion benefit of this economic model equates to nearly 1% of the GCC's cumulative GDP between 2020 and 2030, as detailed by the World Government Summit and Strategy&'s Ideation Center. Another big incentive is Gulf countries' commitment to the Paris Agreement, the world's most comprehensive climate-related agreement.

But these are just two factors in a regional effort that resembles an octopus. There are many 'legs' – from economic growth, government will and public buy-in – that must all move in harmony to achieve progress (see: *What is a Circular Economy?*). This is a very tall order and good stewardship – a healthy mix of both private and public – of finite resources is critical amid an ever energy-hungry world.

The kingdom is playing an active role as per the aims of Saudi Vision 2030. Saudi Aramco is supporting a research program on the Sustainability of Bio-based Materials in a circular economy at the Aachen-Maastricht Institute for Biobased Materials (AMIBM) in The Netherlands

and the kingdom's petrochemical giant SABIC has signed a memorandum of understanding (MoU) with chemical recycling experts to supply recycled plastics waste for production facilities in Europe.

Through this, the company has developed plans for a commercial refining plant for recycled low-quality, mixed plastics waste in The Netherlands. And as part of its sustainability initiative, Ma'aden commits to facilitating responsible and innovative product design, use, re-use, recycling and disposal of products. The company has embedded circular economy principles into its operations and has developed measurable key performance indicators (KPIs) to monitor progress.

The growth of a circular economy is a fine line to tread. Existing energy capacity – from production, storage, downstream, transport and so on – must lower its carbon footprint rather than pulling back on operations. Cutting capacity now would be perilous; BP Outlook expects the Middle East alone to have a 55% rise in energy consumption by 2040 and Saudi Arabia's population to climb by 37% to 45 million by 2050. Such pressure points do not point to reducing capacity but increasing it – just much more intelligently. ■

1st

In one of the most comprehensive oil field carbon intensity (CI) studies ever published, a global team led by Stanford University has calculated the CI of 8,966 of the world's active oil fields across 90 countries. This represents 98% of the world's 2015 global crude oil and condensate production. How did Saudi Arabia fare? Very well; the kingdom ranks the lowest in CI of any major producer to extract, process, and transport its crude oil to the refinery gate.

#2

Saudi Arabia ranked second overall in the aforementioned CI study; Denmark, which produces near 150,000 b/d, took first global position.

62%

The Circularity Gap Report 2019 calculates that 62% of GHG emissions (excluding those from land use and forestry) are released during the extraction, processing and manufacturing of goods to serve society's needs. Just 38% are emitted in the delivery and use of products and services. Stakeholders now have a clear focus where to direct their efforts.

What is a Circular Economy?

A circular economy means changing processes and mindsets to enable companies and countries to do more with less. It seeks to replace today's linear 'take-make-dispose' approach to resources and aims for materials, including energy, to be re-used and recycled through the value chain. The result? It gives companies and countries more gold stars for what is an increasingly strict environmental check list, it creates a sustainable job and manufacturing market and has the potential to narrow the global wealth divide in the long-term. Also, on the long list of benefits are cost effectiveness and optimization of supply chains.

The purpose of the circular economy is to protect the environment while maintaining a market driven economy. There are two main channels to achieving this. One is letting the market dynamic work through incentive mechanisms, as seen with subsidy reforms and the rise of renewables. The other is regulatory changes, such as reducing high public and industrial

consumption of energy to products, like household utilities.

Under this umbrella, there are a range of application options: waste-to-energy, fuel conversion, recycling materials from energy production plants, utilization of the energy industry and other industries' excess energy. Another popular method to spur a circular economy is improving existing technologies, like efficiency for internal combustion engines (ICE), carbon capture and storage (CCS) for hydrocarbons in the power sector and renewables in enhanced oil recovery (EOR). Plus, capturing the billions of cubic meters of natural gas flared at oil production sites worldwide to use onsite, or reuse in operations, would be a major leap towards a circular energy economy. This would be especially meaningful in Saudi Arabia and the wider Gulf, the global epicenter of hydrocarbon production. Progress will also give the energy markets some much-needed career kudos for the more environmentally aware millennial generation; good news amid a global talent shortage.



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- Abdelrahman Hijazi, Sales Manager
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- Abdul Muthaleef, Managing Director & Head of Research (Oil & Gas Mine exploration UAS/ Aerial Platforms), Celestain Technologies
- Abdul Wahab Al Ahmari, Chief Executive Officer, Saudi Geophysical Consulting Office
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- Abdulaziz Al Duailej, President & Chief Executive Officer, Advanced Electronics Company
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LIST OF ATTENDED AND CONFIRMED GUESTS – SAUDI ARABIA ENERGY FORUM 2019

- Eng. Adeeb Al-Aama, Governor for OPEC, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Eng. Ahmad Abulfaraj, Vice President, Saudi Center for International Strategic Partnerships (SCISP)
- Eng. Ahmad Al Khowaiter, Chief Technology Officer, Saudi Aramco
- Eng. Ahmed Al Ghamdi, Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Eng. Ahmed bin Mohammed Faqih, Deputy Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Eng. Basim Tawfeeq, Managing Director, BASF Saudi Arabia Co. Ltd.
- Eng. Hisham Sumayli, Director of Localization Technology Department, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Eng. Hussain Shibli, Assistant Head of Renewable Energy Sector, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Eng. Jad H. Abdulsalam, Director, Cybersecurity and ICT Governance, Risk & Compliance, Ma'aden
- Eng. Khalid Al-Salem, Director General, Saudi Authority for Industrial Cities and Technology Zones (MODON)
- Eng. Mohammad Zakri, Researcher, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Eng. Mohammed AlHassnah, Vice President, Saudi Center for International Strategic Partnerships (SCISP)
- Eng. Muhammad Alsaad, Head of Engineering and Projects Sector, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Eng. Nasser Bin Ibrahim Al Fawzan, Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Eng. Raad AlBarakati, Vice President, Saudi Center for International Strategic Partnerships (SCISP)
- Eng. Rasheed Al Shubaili, Chief Executive Officer VP Communications, National Industrial Development and Logistics Program (NIDL)
- Eng. Sami Said Ali Al Angari, President and Chief Executive Officer, AlGihaz Holding Company
- Eng. Zeiad Altuwayjiri, Projects Engineer, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Esam A. Al Ghamdi, Senior Sales Account Manager, Honeywell
- Ezzat Eid, Commercial Manager, S&P Global Platts
- Fadi Mhaini, Director, Technology Licensing, Chevron Lummus Global
- Fahad Abu-haimed, ED, Corporate & Strategic Planning, Saudi Electricity Company (SEC)
- Fahad Alfifi, Executive Director, National Strategy at General Authority for Statistics - GASTAT
- Fahad Al-Sherehy, Vice President, SABIC
- Fahad Al-Sudairi, Chief Executive Officer, Saudi Electricity Company (SEC)
- Fahad A. Alhamwah, Director, Human Resources, Administration & Government Relations, Modern Chemicals & Services Company
- Fahad Al Toryf, Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Fahad Alajlan, Saudi Country Director, Honeywell
- Fahad Alotaibi, Petrochemicals Executive Account Manager, Saudi Electricity Company (SEC)
- Fahad Batem Ha'adi Al Enazi, Head, Budgeting, Planning & Performance, Ma'aden
- Fahad M. Al Nasser, Director of Logistics & Management Support, President and CEO Office, Ma'aden
- Fahad Mohammed Al Nasser, Director, Logistics & Management Support, Ma'aden
- Faisal Aldhorgham, Project Analyst
- Faisal Al-Shehri, SABIC
- Faisal A. Al-Subhi, Vice President of Manufacturing, Yanbu Aramco Sinopec Refining Company Ltd. (YASREF)
- Faisal Mohammad Al-Lazzam, Vice President, Legal Affairs, Saudi Electricity Company (SEC)
- Falwah Alrasheed, Specialist, Saudi Center for International Strategic Partnerships (SCISP)
- Fares Eidhah R Al-Zahrani, Senior Business Planner, Advanced Petrochemical Company
- Farhan Alshahrani, Head of Innovation Partnerships, King Abdullah University of Science and Technology (KAUST)
- Faris M. Algarawi, Assistant Financial Analyst, Argam News
- Farouk Soussa, MENA Economist, Goldman Sachs
- Fatima AlHajari, Director, Head of Riyadh Office, U.S.-Saudi Arabian Business Council
- Fawaz Shnan Didan AlAnazi, Senior Advisor, Finance, Ma'aden
- Fayez Al Jabri, Director General, Electricity & Co-Generation Regulatory Authority (ECRA)
- Fayez Saeed Al Zahrani, Brand Specialist, Ma'aden
- Francis Goh, Political Officer, Embassy of Singapore, KSA
- Francis Patalong, Senior Associate, Corporate Commercial, Projects, Al Tamimi & Company
- Frank Kane, Senior Business Columnist, Arab News
- Gaith M. AlBalawi, Business Development Director, Saudi Arabian General Investment Authority (SAGIA)
- Ganesh Pattabhiraman, MEA Plantweb Sales Director, Emerson
- Gani Aslam, Managing Director, Consultancy Firm Advisors
- George Elghossain, Vice President – Business Development Industrial Cooperation, Lockheed Martin Global Inc.
- Georgios Andreadis, Director of Business Development, KBR - AMCDE
- Ghazali Inam, Senior Vice President / Head of Project Finance, Global Banking & Corporate Finance Dept., Riyadh Bank
- Giuseppe Paladino, Vice President Sales Middle East, North Africa and Far East, Fincantieri S.p.A.
- Grahame Nelson, Partner, Head of Office - Riyadh, Al Tamimi & Company
- H.E. Dr. Fahad Al Tekhaifi, President, General Authority for Statistics (GSTAT)
- H.E. Dr. Khalid bin Saleh Al-Sultan, President, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- H.E. Joost Reintjes, Ambassador, Embassy of the Kingdom of the Netherlands, KSA
- H.E. Abdulrahman M. Abdulkareem, Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- H.E. Dr. Majid Al-Moneef, Chairman, International Advisory Committee, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- H.E. Eng. Abdulaziz Al-Abdulkarim, Vice Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- H.E. Eng. Abdullah Al-Saadani, President, Royal Commission for Jubail and Yanbu
- H.E. Eng. Khalid bin Saleh Al-Mudaifer, Vice Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- H.E. Faisal Alibrahim, Vice Minister of Economy and Planning, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- H.E. Ibrahim Al Omar, Governor, Saudi Arabian General Investment Authority (SAGIA)
- H.E. Khalid Al Falih, Minister of Energy, Industry and Mineral Resources Kingdom of Saudi Arabia
- H.E. Lawrence Anderson, Ambassador, Embassy of Singapore, KSA
- Hakim Benabdallah, General Manager, Element Materials Technology
- Hamad Al Abdulaziz, Project Manager, Saudi Electricity Company (SEC)
- Hamad Bin Quraya, Chief Executive Officer, Bin Quraya Holding
- Hani AlSaigh, Director General, Strategic communication & Marketing, National Center for Privatization & PPP
- Haresh Patel, Process Engineering Section Head, Advanced Petrochemical Company
- Hasan Al-Shehry, SABIC
- Hasan El Okdi, Commercial Director, F&H Platforms, Middle East , Africa & South Asia, GE Power Services
- Hassan Shakhs, Communication Manager, Saudi Aramco Total Refining and Petrochemical Company (SATORP)
- Hassan Madani Mohammed Al Ali, Senior Vice President, Phosphate & IM Business (Acting), Ma'aden
- Hatem Alatawi, Researcher, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Hatem Hamad Al Zamil, Senior Sales Engineer, Alfanar
- Hatim Aseeri, Rotating Engineer, Saudi Aramco Shell Refinery (SASREF)
- Hazem Midani, Director, Jumana House
- Hesham Sewaify, Global Strategic Account Leader, Emerson
- Hisham Akhonbay, Research Fellow, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Hisham Bahkali, President & Chief Executive Officer, GE Saudi Arabia & Bahrain
- Hosam Alsayyed, Director Front End Technology, FRONT END
- Hossah Al Motairi, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- HRH Prince Abdulaziz bin Salman Al Saud, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Humam Fadel, Senior Account Manager, GE Renewable Energy
- Humoud Odah Al-Ghobaini, Vice President, Communications and Public Relations, Saudi Electricity Company (SEC)
- Hyungmin Song, Senior Associate, Litigation, Construction, Al Tamimi & Company
- Ibrahim alameer, Engineer, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Ibrahim Albaloud, Chief Executive Officer, Fathom
- Ibrahim AlJarbou, Vice President, Maintenance, Saudi Electricity Company (SEC)
- Ibrahim Aljomaih, Chairman, Aljomaih Automotive Company
- Ibrahim Babelli, Chief Executive Officer, Sami Holding
- Ibrahim alameer, Engineer, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Ibrahim Alquraishi, Research Assistant, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Ibrahim Mohammed Al-Kenizan, Chief Executive Officer, Projects Development Company
- Imad Nassar, Client Development Manager, S&P Global Platts
- Imran Yousuf, Partner, Professionals Executive Search (PES)
- Imtenan AlMubarak, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- James Baxter, MA OBE, Chief Executive Officer, NT&S Oilfield Services
- Jamil Al-Dandany, Advisor to the Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Jean-Christophe Vasseur, Business Development Manager, Rockwell Automation
- Jitendra Roychoudhury, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Jo Byung Wook, Embassy of South Korea, KSA
- Joan S. Sanromà, Sales Director India, Middle East & Europe, Visual MESA, KBC (A Yokogawa Company)
- Joost de Bakker, Regional Wells Manager, Lloyd's Register
- Joseph Walker-Cousins, Director of Business Development, KBR - AMCDE
- Kevin Robertson, Business Strategy Manager, McDermott
- Khadeejah Al Ghadeer, Engineering Physicist, N/A
- Khaled Al-Ofaysan, Account Manager, Schlumberger
- Khaled Mostafa, CSM Country Manager, Rockwell Automation
- Khaled Saad Al-Rashed, Vice President, General Services, Saudi Electricity Company (SEC)
- Khalid Al-AbdulKarim, Chairman and Chief Executive Officer, Al AbdulKarim Holding (AKH)
- Khalid Alkalali, Market Development Manager, Wartsila
- Khalid Alsulami, Senior Consultant, Business Incubators and Accelerators Company (BIAC)
- Khalid Bin Saheim, General Manager, Aldrees Petroleum and Transport Services Company
- Khalid Abdulrahman Al-Tuaimi, EVP, Generation, Saudi Electricity Company (SEC)
- Khalid Al Tuaimi, Executive Vice President For Generation, Saudi Electricity Company (SEC)
- Khalid Arif Al Sharief, Director, Strategy & Business Planning, Ma'aden
- Khalid Hamad Al-Gnoon, Executive Vice President, Distribution and Customer Services, Saudi Electricity Company (SEC)
- Khalid I Almutlaq, Executive Director, Khobar Office, Jacobs
- Khalid M. Abuleif, Sustainability Advisor to The Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Kim Pringle, Director of Capacity Development, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Kwanghee Shin, General Manager; R&D Center Head (at Al-Khobar), Doosan Heavy Industries & Construction Co., Ltd.
- Laith Ahmed Al-Bassam, Chief Executive Officer, National Grid
- Li Wei, Energy Attaché, Embassy of China, KSA
- Liam Hurley, VP & General Manager for Saudi Arabia & Bahrain, Emerson
- Mahmoud Chaudhry, Managing Director, Lazard Saudi Arabia Limited
- Mais Salameh, PMT Marketing Leader, Honeywell
- Majed Al Obaid, Public Relations Specialist, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Majed AlDuraibi, Corporate Cooperation-Department Manager, Saudi Electricity Company (SEC)
- Majed Alotaibi, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Majed Suwailem, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Majid Alghaslan, Chairman and Chief Executive Officer, FRONT END
- Manish Manchandya, Chief Financial Officer, Saudi Electricity Company (SEC)
- Mansour Al Khudhair, Assistant Deputy Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Manus Cranny, Anchor, Bloomberg TV
- Mark Stumpf, Vice President Chemical and Refining, ExxonMobil Saudi Arabia Inc.
- Marwan Ergesoos, Country Sales Lead, OpenText Middle East
- Masha'el Al-Shalan, Founding Partner, Aeon Strategy
- Maurice Woo, Political Officer, Embassy of Singapore, KSA
- Mazen Abdullah Al Shudoki, Public Relations and Media Manager, King Abdullah City for Atomic and Renewable Energy (KACARE)
- Mazen Gani Aslam, Project Executive Officer, Consultancy Firm Advisors
- Mazin Albahkali, President & Chief Executive Officer, GE Power Services, Saudi Arabia & Bahrain
- Mehmet Soytaş, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Michael Train, President, Emerson; Chairman, Emerson Automation Solution
- Mike Sutherland, Vice President Operations Offshore, McDermott
- Mishal Alharbi, Vice President, Strategy and Planning, Research Products Development Company, Research Products Development Company (RPDC)
- Mishel Awaid Helail AlMutairi, Head of Phosphate & Ammonia Marketing-Phosphate and IM SBU Marketing and Sales, Ma'aden
- Moath Alolyt, Senior Mechanical Engineering Student
- Mohamed Abbas, Business Development Manager, Lloyd's Register

LIST OF ATTENDED AND CONFIRMED GUESTS – SAUDI ARABIA ENERGY FORUM 2019

- Mohamed Al Qahtani, Chairman, Al Qaryan Group
- Mohamed Shaaban, Sales Manager, Outotec
- Mohammad Al Dubyan, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Mohammed Khan, Research Assistant, King Fahd University of Petroleum and Minerals (KFUPM)
- Mohammad Mannan, Manager, Projects, Saudi Electricity Company (SEC)
- Mohammad Abdullah Abunayyan, Chairman, Arabian Company for Water & Power International (ACWA Power)
- Mohammed Al Faraydhi, Consultant, Saudi Electricity Company (SEC)
- Mohammed Al Habib, Downstream Account Executive, Baker Hughes, a GE company
- Mohammed Al Huzami, Safety, Health and environment Manager ,BAE Systems
- Mohammed Al Khalifah, Executive Vice President Business Division, Advanced Electronics Company
- Mohammed Al Shagawi, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Mohammed Al Thumayri, Advisor, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Mohammed Alfadley, Engineering Student
- Mohammed Altamimi, Senior Projects Manager
- Mohammed Ayaz, Director, Saudi Arabian Chevron, Inc.
- Mohammed Lakhanpal, Global Executive Talent Acquisition Leader, SABIC
- Mohammed Tassi, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Mohammed A. Al Fayadh, General Manager, Al AbdulKarim Holding (AKH)
- Mohammed A. AlShaalan, Executive Vice President, National Center for Privatization & PPP
- Mohammed Abdullah Aljunaini, Industry & Manufacturing Sector Managing Director, Saudi Arabian General Investment Authority (SAGIA)
- Mohammed Aljuhani, Electrical Engineer, Royal Commission for Jubail and Yanbu – Jubail (RCJY)
- Mohammed Alkathiri, Chief Executive Officer, SEPCO Environment
- Mohammed Alshareef, Strategy and Business Development Manager, National Gas and Industrialization Company (GASCO)
- Mohammed Alsubhi, Researcher, King Abdullah City for Atomic and Renewable Energy (KA-CARE)
- Mohammed Atif Raja, Area Manager, Energy - Middle East and Africa, DNV GL - Oil & Gas
- Mohannad Rasheed, Sr. Manager, SABIC
- Mohatresh Almutairi, Regional Manager ME, BlackRock QI Ltd (BQI)
- Motashar AlMurshed, Chief Executive Officer /Country Executive, Merrill Lynch Kingdom of Saudi Arabia
- MS Prakash, MEA Strategic Planning & Marketing Director, Emerson
- Muaeayd Aldhamin, Project Manager, KBR
- Muhammad Raheel, Senior Lead Auditor & Trainer, Intertek
- Muhammad Hafeez Abbasi, Technical Training Consultant, Saudi Electric Services Polytechnic (SESP)
- Muhammad Khurram Shahzad, Business Development Manager, TÜV Rheinland Arabia LLC
- Murhaf Al-Madani, Vice President, Global Information Technology and CIO, SABIC
- Musaad Al Abdulkarim, Chief Operating Officer, Al AbdulKarim Holding (AKH)
- Musaad M. Alfakhri, Operation Engineering Unit Riyadh Refinery Department, Saudi Aramco
- Mustafa Al-Ali, Sales Manager, Intertek
- Mustafa Ansari, Senior Economist, Arab Petroleum Investments Corporation (APICORP)
- Mutlaq Al-Morished, Chief Executive Officer, TASNEE
- Nabil Abdulaziz M. Al Fraih, Vice President, Human Capital, Ma'aden
- Nada Al Ahmari, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Nadhmi Al-Nasr, Chief Executive Officer, NEOM
- Nadim Melhem, Head of Business Development, ENGIE
- Naif Al-Masoud, Company IKTVA Representative, SAIPEM
- Najeh Al - Shammari, Sales & Marketing Director, GE Saudi Advanced Turbines (GESAT)
- Naji Skaf, President - Mid. East & Turkey, Air Products
- Nasser Bin Saeed Al-Hajri, Chairman & Chief Executive Officer, Nasser S. Al -Hajri Corporation (NSH)
- Nawaz Peerbocus, Program Director, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Nicholas Howarth, Research Fellow, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Nick O'Connell, Partner – Head of Technology – KSA, Al-Tamimi & Co.
- Nizar Al-Hariri, President, Industrial Clusters, National Industrial Clusters Developing Program (NICDP)
- Norm Gilsdorf, President, Honeywell
- Noura Al-Saud, Founding Partner, Aeon Strategy
- Noura Mansouri, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Nourah Al Hosain, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Nourah M. Alhosain, Research Analyst, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Oliver Braun, Sales Leader ME Region, Honeywell
- Olivier Durand-Lasserve, Research Fellow, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Olivier Pasquier, Economic Attaché (Energy & Industry) Embassy of France in Saudi Arabia
- Olivier Thorel, Executive Director – Chemicals, Saudi Aramco
- Olof Arnman, Senior Director, Legal, Compliance & Risk Management Middle East & North Africa, McDermott
- Omer Sheikh, Manufacturing Director, Alzamil Metal Works Factory
- Osama Abdulwahab Khawandanah, Chief Executive Officer, Saudi Power Procurement
- Othman Abdullah M. Al-Garawi, Engineering & QC Manager, Advanced Petrochemical Company
- Paul Baillie, Projects Director, KBR - AMCDE
- Perumal Arumugam, Program Officer, Sustainable Development Mechanism, UNFCC
- Peter Terium, Head of Energy Sector, NEOM
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- Radia Sedaoui, Chief, Energy Section, Sustainable Development Policies Division, UNESCWA
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- Rajib Majumder, Sales Director, Honeywell
- Rakan AlKenaibet, Director, Saudi Center for International Strategic Partnerships (SCISP)
- Rakan Alshebel, Engineer - Consulting Services Department, Saudi Aramco
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- Riccardo Giannetti, Head of Security & Information Systems Programs, Leonardo
- Richelle Sansales, Sales Manager, Startech GCC
- Riyadh Abunayyan, Chairman, Digital Energy
- Rob Arnot, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Ronnie Rahman, EMEA Cybersecurity Director, Honeywell
- Roxanne Oclarino, Technical and Marketing Supervisor Business Assurance, Intertek
- Ryan Al-Yamani, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Ryan McPherson, Regional Director, EICUK Middle East (Branch)
- Saad Al Qarni, King Abdullah Petroleum Studies and Research Center (KAPSARC)
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- Saad AlQahtani, Business Director, Thomson Reuters
- Saad Amegbil, Director, International Business Development, Lockheed Martin Global Inc.
- Saad Mohammed, Al AbdulKarim Holding (AKH)
- Saeed Al-Zahrani, Chief Executive Officer, Manarah Shada
- Safwat Hakam, Country Sales Director | KSA and BAH, Rockwell Automation
- Salah Al Abdullatif, Chief Executive Officer, Abunayyan Holding
- Saleem Bitar, Director of Business Development, Emerson
- Saleh Al Oliyan, ED, Regulatory Affairs, Saudi Electricity Company (SEC)
- Saleh Al-Obisi, Public Relations-Representative, Saudi Electricity Company (SEC)
- Saleh S. Al-Solami, Secretary General - Saudi Exports, Saudi Exports Development Authority
- Salem Basalamah, SABIC
- Salha Duraibi, Economist, Princess Nourah Bint Abdul Rahman University
- Sami Al Thowani, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Sami Al-Osaimi, Vice President, SABIC
- Sami Alharbi, General Manager Business Development, Wartsila
- Samiha Khayyat, Assistant Professor of Petroleum, Energy & Resource, King Abdulaziz University (KAU)
- Sandeep Chandran, HCP Product Development, Honeywell
- Sandeep Goel, Director, Business Development, Lummus Technology
- Saqer Al-Orabi Al-Harhi, Cybersecurity Advisor, National Cybersecurity Centre
- Sara Lechtenberg-Kasten, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Scott G. Hutchins, Energy Attaché, U.S. Embassy – Riyadh
- Shaaf Shaddad Hubailees Al Osaymi, Director, Corporate Affairs Planning, Ma'aden
- Shahad Al Rashed, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Shahid Hassan, King Abdullah Petroleum Studies and Research Center (KAPSARC)
- Shikah Alshuwaihs, Engineering Graduate, University of Southern California
- Siamak Kia, VP, IBM Research Middle East and North Africa Turkey and Russia
- Siddharth Saboo, Associate Principal, Advisory Group DMCC
- Soren Nikolajsen, Board Member & Managing Director, Alawwal bank (formerly Saudi Hollandi Bank)
- Stavros Spanos, Deputy Group Chief Executive Officer, Hyperian
- Stephen McCallion, Government Affairs & Communications Director, GE
- Sulafa Hakami, Communications Leader, Saudi Arabia & Bahrain, GE Global
- Sulaiman Alsamhan, Director, Cybersecurity Services and Solutions, Saudi Information Technology Company
- Sulaiman Al Rumaih, Managing Director, Tamimi Energy Holding
- Sulaiman Aljohani, Chief Executive Officer, Be Smart
- Sulaiman Ibrahim Al-Hubaishi, Vie President, Supply Chain, Saudi Electricity Company (SEC)
- Sulaiman M. Ababtain, President & Chief Executive Officer, Saudi Aramco Total Refining and Petrochemical Company (SATORP)
- Sulaiman Saleh Al-Dobaye, Senior Manager VIP Protocol, Saudi Basic Industries Corporation (SABIC)
- Sultan Aljohani, Chief Executive Officer, Be Smart
- Talal ALShuqayhi, Project Manager, Saudi Electricity Company (SEC)
- Tamer Abdallah, Divisional Manager – Instrumentation & Control Division, Al AbdulKarim Holding (AKH)
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- Turki Al Woseamer, Director General, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Turki Alkhamees, Lecturer, Imam Muhammad Ibn Saud Islamic University
- Turki Alrasheed, Project Development Director, SABIC
- Turki Alhokail, Chief Executive Officer & Board Member, National Center for Privatization & PPP
- Victor W. Baxter, Advisor, SABIC
- Vidya Ramnath, President, MEA, Emerson
- Wael Ali Al Ghamdi, Vice President, Technology, Dawiyat
- Wael Gad, Managing Director, Al Othman Industrial Marketing Company
- Wahib Al Juhani, Strategic Account Manager, Saudi Aramco, ABB
- Waleed Al-Saadi, Vice President, Engineering, Saudi Electricity Company (SEC)
- Walid Samara, Global Strategic Account Director, Emerson
- Walid Ali, Head of Sales – KSA, Weir
- Walid Kildani, Economic Officer, Illicit Finance/AML, Sanctions, and Vision 2030 Programs, U.S. Embassy Riyadh, Saudi Arabia
- Wassim Abdulkhaliq Saad, Chief Audit Executive-Corporate Internal Audit, Ma'aden
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- Younis Hirz, Senior Analyst
- Yousef AlGhamdi, Senior Service Director, GE Power
- Yousef Abdullah Al-Benyan, Vice Chairman & Chief Executive Officer, SABIC
- Yousef H. AlYousefi, Partner, Marco
- Yousif Al Ali, Director, Business Growth, Masdar Clean Energy
- Zaid A. Al-Jendel, Manager, ASTP, Saudi Electricity Company (SEC)
- Zakaria Al-Khamis, General Manager, Weatherford
- Ziad Al Musallam, Executive Vice President Engineering & Operation, Advanced Electronics Company
- Ziad Murshed, Vice President – Downstream Growth & Interaction, Saudi Aramco
- Ziyad Alsaigh, Deputy Minister, Ministry of Energy, Industry & Mineral Resources, Kingdom of Saudi Arabia
- Zubair Ahmed, Technical Manager, Authentix

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