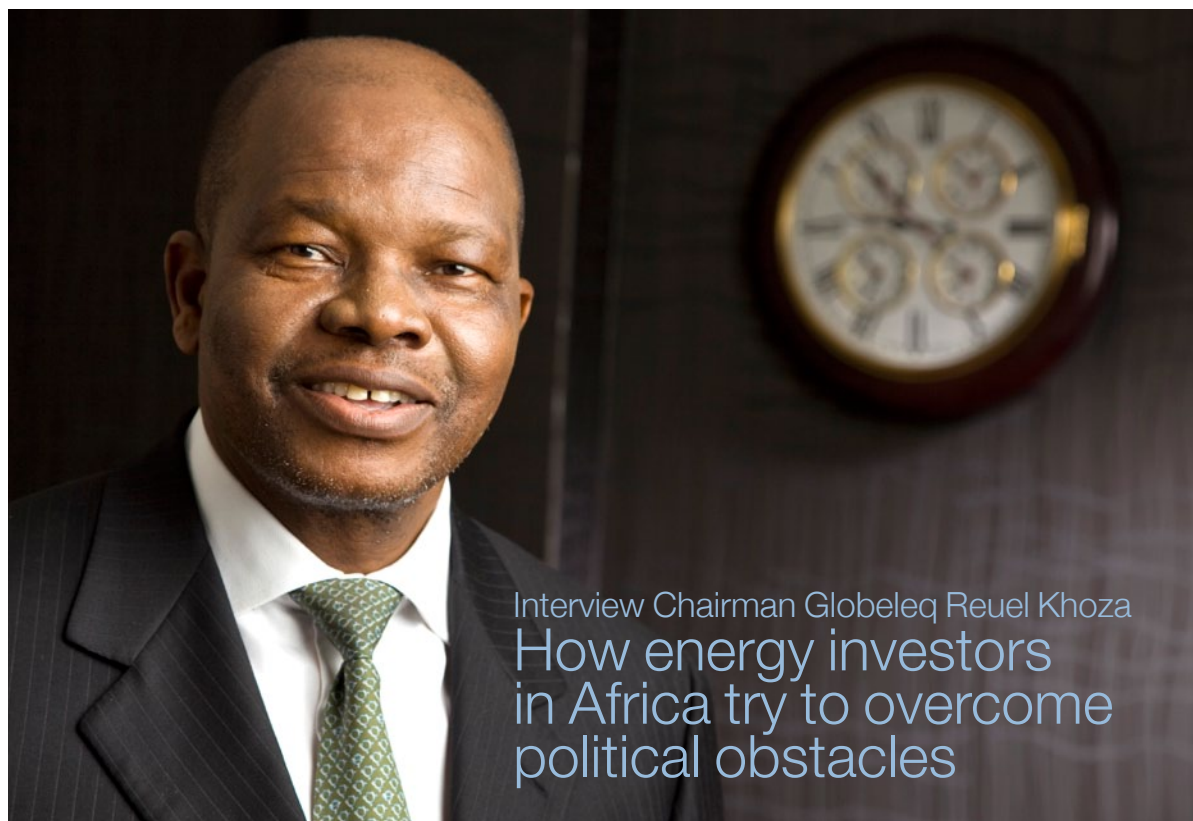


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Interview Chairman Globeleq Reuel Khoza How energy investors in Africa try to overcome political obstacles

There may be more people without access to electricity in Africa in 2030 than now, says Reuel Khoza, Chairman of independent power producer Globeleq. Lack of political will is the basic problem. Nevertheless, Khoza remains upbeat about the prospects of bringing power to the continent. "Everyone is looking for opportunities. What we need now is planning on a regional basis."

The inadequacy of electricity supply is a fact of life in nearly every sub-Saharan country. Just seven countries in sub-Saharan Africa have

electrification rates above 50%. Most of the rest of the region is around 20% and some countries at less than 10%, resulting in an overall electricity access

rate of 22.8%, according to the World Bank.

In the run up to the Africa Energy Indaba 2017 [<http://bit.ly/2kmXLpV>], to take place in Johannesburg on 21-22nd February, Dr. Reuel Khoza, a famous author, business leader and advocate of African-led, globally competitive economics, shared his views with World Energy Focus on

what it will take to bring power to sub-Saharan Africa. Twenty years ago, Dr Khoza, a former Chairman of South African utility Eskom, witnessed the rapid electrification of South Africa. Currently, he is chairman of independent power producer (IPP) Globeleq, which has been operating across Africa since 2002.

Khoza notes first of all that "There is a huge difference between the South African market and the rest of sub-Saharan Africa. When I first went to work at the South African utility Eskom, in 1986, just 27% of South Africans had access to electricity. Today over 80% of them do." He cites the strong political and financial backing from the South African government as essential success factors. He says: "When I became Chairman of Eskom in 1996, we had a government mandate and financial support for rapid electrification. We achieved a rate of connecting 1000 households per day to the grid, and maintained that rate from 1997 to 2002. Our success was due to the strong political will, and also, 'carte blanche' to operate as a business."

Efforts to bring electricity to the rest of sub-Saharan Africa, reinforced by the United Nations Sustainable Development Goal of providing universal energy access by 2030, have met with less success, however. Khoza notes that "according to the [International Energy > see page 2

Interview: Mohamed Jameel Al Ramahi, CEO Masdar: "We cannot continue to depend on fossil fuels"

Mohamed Jameel Al Ramahi, CEO of Masdar, the renewable energy company and sustainable city in Abu Dhabi, looks ahead to the next decade. "We were blessed with fossil fuels. But renewable energy will increasingly be the future."

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Agency's] World Energy Outlook 2016, we are not on track, either globally or in Africa, to meet this desirable and worthy goal. Current actions aimed at eliminating energy poverty are failing, in terms of both scale and pace. It seems likely that in 2030 we will have more people without access to electricity, as population growth outstrips the rate of electrification."

MANY RIVERS TO CROSS

Barriers to power sector growth include poor planning, lack of maintenance of existing facilities, and lack of infrastructural capacity for generation, transmission and distribution. Khoza adds: "Finance is a huge problem – there is extremely limited access to finance for large infrastructural projects."

Current actions
aimed at
eliminating
energy poverty
are failing

A case in point is the proposed hydropower scheme Grand Inga, on the Congo river in the Democratic Republic of Congo (DRC). It is estimated that Grand Inga could produce up to 40,000 MW of electricity, over twice the power generation of

Three Gorges Dam in China, and more than a third of the total electricity currently produced in Africa. Despite an initial promise to lay the first stone by October 2015, the project has been delayed due to stumbling blocks, such as a lack of funding and trust in the DRC by potential funding partners.

A further example is Cahora Bassa, a hydropower plant at the Zambezi River in Mozambique with an installed capacity of 2075 MW. A feasibility study is underway for a proposed expansion of 850 to 1300 additional MW. Khoza comments: "Under normal conditions this extension should be inexpensive as the basic infrastructure

Reuel Khoza is participating in the **Africa Energy Indaba** Conference in the opening Ministerial Plenary panel discussion on regional integration as a panel member on 21-22 February. The Africa Energy Indaba gathers international and African experts to share their insights and solutions to Africa's energy crisis, while exploring the vast energy development and investment opportunities in Africa. Key side events include the **Africa Energy Leaders' Dialogue**, where participants will explore scenarios for Africa, next steps towards regional integration and the scaling up of renewables through innovative business models. During the previous day, the World Energy Council will be hosting an **African Regional Meeting** plus a combined **Scenarios and Trilemma Workshop**. www.africaenergyindaba.com

Lasting progress cannot be achieved without regional cooperation

is in place. However, because it is in a state of disrepair, this will greatly increase the cost of the project."

Problems of governance and access to finance are closely linked. "To ensure financial viability, it's necessary to create an environment which can attract a large pool of finance. This requires the demonstration of clear political will, which is currently weak. Lack of political will results in poor planning, lack of maintenance of existing facilities and insecure or unreliable supply." Khoza is clear on what needs to happen in order to accelerate development. "First the regulatory framework must be conducive. Secondly, financial institutions should see that the sector is worthy of support. Thirdly, support should be available through blended finance – using development or donor finance to leverage private investment." He adds, "Positive examples in this respect are Cote d'Ivoire which has shown a determined attitude, and through the Renewable Energy Independent Power Producer Procurement programme South Africa has gone a long way in terms of opening up the market. Although Zambia is

extremely limited financially, there is a very positive attitude towards IPPs. Kenya has a somewhat enlightened approach, but could do more."

INDEPENDENT POWER PRODUCERS

Most African countries have poor or non-existent sovereign credit ratings, which severely limits their capacity to borrow from the global capital markets. Domestic capital is also in short supply, creating a potential opportunity for IPPs. According to a McKinsey report from 2015, over the past 20 years, private sector supply in sub-Saharan Africa has doubled every five years, with 50% of total IPP capacity added to the grid since 2009 alone. Khoza says: "The role of IPPs is increasing, as governments simply do not have the financial resources necessary for new power production. There are between 120 to 125 IPPs present in 18 countries in sub-Saharan Africa alone, and IPPs account for more than 13% of the continent's generating capacity, when South Africa is excluded this rises to 25%."

Despite these challenges, Khoza is positive about the prospects for growth, as more African countries are now experiencing peace and stability, democracy, rapid economic growth and burgeoning middle classes. "The Chinese are everywhere looking for development opportunities, Americans too, and the UK does not want to be left behind. There is a new scramble for Africa underway," he says. A 2015 McKinsey report estimates

the total cost of electrification of sub-Saharan Africa at \$835 billion by 2040. Khoza comments: "So this means about \$40.8 billion per year investment – which is 6% of continental GDP. If you consider energy supply as a leading indicator, then investment in the range of 5-7.5% of continental GDP is not unreasonable. However, this requires planning on a regional level for cooperation and pooling of resources. Regional cooperation needs to be much more robust."

He adds: "I would love for the 21st century to be the African century – I dream of that! But we must fight the tendency towards 'Afro-pessimism': lasting progress cannot be achieved without regional cooperation and a lot of hard work." ●

Dr. Reuel Khoza is an advocate of African-led, globally competitive economics and industries and is a business consultant and lecturer. He is the author of *Attuned Leadership* and *Let Africa Lead* and is the co-author of *The Power of Governance*. He is a Visiting Professor at Rhodes Investec Business School, Rhodes University, former Professor Extraordinaire of the University of Stellenbosch Business School and Chancellor of the University of Limpopo, succeeding former president Nelson Mandela. He is also Chairman of Globeleq, an IPP with projects in South Africa, Cote d'Ivoire, Tanzania, Cameroon and Kenya.



Interview
Mohamed Jameel Al Ramahi
CEO Masdar

“We cannot continue
to depend
on fossil fuels”

As Masdar, the famous sustainable City and renewable energy company from Abu Dhabi, celebrated its 10th anniversary, Mohamed Jameel Al Ramahi, CEO since February 2016, looks ahead to the next decade. “We were blessed with fossil fuels”, he says in an interview with World Energy Focus. “But renewable energy will increasingly be the future.” Masdar is counting on continued double growth, Al Ramahi says.

It was no doubt the big energy story of 2016 – the continuing rapid cost reductions of solar and wind power. This has turned renewable energy into an investment success story: renewables surpassed all other forms of power generation in terms of new capacity last year.

The potential of renewable energy is well known by now. But to have seen this opportunity ten years ago, in 2006 – that is something else entirely. That required a truly forward-looking vision. This is what Masdar embodied. “When Masdar was started ten years ago, we were the first renewable energy company in the region”, says Mohamed Jameel al Ramahi, who has been with the company since 2008. “And one of the first dedicated renewable energy companies in the world. Many people wondered what we were doing. Why we were doing it. Now all countries in the MENA region have renewable energy targets.”

According to Al Ramahi, Masdar was born out of the Abu Dhabi Future Energy Vision. This was part of the Abu Dhabi 2030 strategy. “Climate change was part of this, but the aim to diversify the economy was central. Our leadership realized that we could not continue to depend on fossil fuels. Our country was

blessed with fossil fuels. But they are not sustainable in the long run.”

We won’t be able
to rely on the sun
and the wind alone

Abu Dhabi’s Crown Prince, Sheikh Mohamed bin Zayed Al Nahyan, once said that “when the last barrel of oil is shipped from Abu Dhabi port, we should be celebrating”, recounts Al Ramahi. “Our leadership understands that what you have underground doesn’t last forever. Our strategy is based on diversification and innovation, which in turn depend on human capital and education. Renewable energy is part of the diversification drive, but it will also contribute to the energy mix that will fuel the economy.”

FIRST-MOVER ADVANTAGE

Masdar has certainly profited from its first-mover advantage in the region. It records double-digit growth every year. It has invested \$2.7 billion in renewable energy generation over the last decade and it now has a portfolio of 2.7 GW, including projects in Abu Dhabi, the wider MENA region and Europe. Some

BIOGRAPHY MOHAMED JAMEEL AL RAMAHI

Mohamed Jameel Al Ramahi was appointed Chief Executive Officer (CEO) of Masdar in February 2016. As CEO, Mohamed Al Ramahi spearheads the company’s development and strategic direction in the renewable energy and clean technology sector. Al Ramahi joined Masdar in 2008 as Head of Internal Audit and Compliance. He set up the corporate enterprise risk management function, which protects Masdar’s investments. Later, he became Director of Corporate Services & Financial affairs. He was subsequently named Chief Financial Officer, and then Chief Operating Officer. Al Ramahi serves on the board of a number of prominent companies, joint ventures and special entities, including the Dudgeon Offshore Wind Farm in the United Kingdom, the Masdar Solar Wind Cooperative, Masdar Investment Committee, and Torresol Energy.

of its most celebrated ventures include the Shams 1 concentrated solar power (CSP) plant in Abu Dhabi, the first in the region, and one that uniquely uses dry cooling; the Gemasolar CSP plant in Spain which was the first in the world to use molten salt storage; and the London Array offshore wind farm in the UK, with a capacity of 630 MW currently the largest in the world in operation.

Masdar is also a partner with Abu Dhabi National Oil Company (ADNOC), in Al Reyadah, a [see page 4](#)

carbon capture initiative. Its first project is a \$122 million carbon capture usage and storage (CCUS) facility in Abu Dhabi. The plant captures CO₂ from the manufacturing complex of Emirates Steel, before injecting it as a substitute for natural gas into ADNOC's onshore oil fields to enhance oil recovery. It is the first CCUS facility of its type in the Middle East.

Al Ramahi's aim is for Masdar to grow in line with the renewable energy market, which is experiencing double-digit growth. "We see great

ABU DHABI SUSTAINABILITY WEEK

Every year the renewable energy sector comes together for Abu Dhabi Sustainability Week, which since the inaugural World Future Energy Summit 10 years ago has grown into one of the world's largest sustainability gatherings.

Abu Dhabi Sustainability Week, which took place from 12-21 January this year, hosted by Masdar, comprises a number of co-located events, including the World Future Energy Summit, the General Assembly of the International Renewable Energy Agency, the International Water Summit, Eco-Waste, and the award ceremony of the Zayed Future Energy Prize, which honours the environmental legacy of the Founding Father of the United Arab Emirates, Sheikh Zayed bin Sultan al Nahyan.
www.abudhabisustainabilityweek.com

opportunities in our core markets – solar and wind. We are currently participating in a number of tenders in the MENA region, and we are also looking at expansion into new geographies. But we won't pursue growth for the sake of it. It is essential that we maintain our focus and control our costs."

Masdar's full-service capabilities are a key strength, notes Al Ramahi. "We develop renewable energy generation, we engineer it and operate it. We do both off-grid and grid-connected projects in both PV and CSP, onshore and offshore wind. We are technology-agnostic in the sense that all our projects at large scale must be bankable. The technology we use must be acceptable by the banking community." This does not mean that Masdar is risk averse. "We do take risks in deployment. The CSP project in Spain is the first to use molten salt, for example. The CCUS project is also in many ways unique."

HUMAN CAPITAL

A very important aspect of the Masdar initiative – which includes Masdar City, Abu Dhabi's flagship sustainable urban development that is home to the Masdar Institute of Science and Technology and more than 450 companies – is the investment it generates in human capital, says Al Ramahi.

"The UAE's cabinet has three people who came from Masdar. My predecessor, Dr Ahmad Belhoul, is

now Minister of Higher Education, for example. We are helping to graduate the next generation of leaders for our country."

It is essential that we maintain our focus and control our costs

So how does Al Ramahi see the world's energy future? "It's very simple. Renewable energy is important today and will become even more so in the future. We will see new technologies come onto the market. Storage will become important; that's an area we are closely monitoring. And we will see sustainable mobility develop strongly. But we will need all forms of modern energy. We won't be able to rely on the sun and the wind alone.

"The most important lesson that Masdar has learned over the last decade, according to Al Ramahi, is that renewable energy makes business sense. "It is competitive and makes money. It is not only the right thing to do for the climate. Today, renewable energy is commercially viable." ●

FROM THE EDITOR

This 31st issue of World Energy Focus is also the last issue produced by Energy Post Productions. We have decided to focus on our core activities, our independent websites Energy Post [www.energypost.eu] and The Energy Collective [www.theenergycollective.com].

For over 2.5 years, since July 2014, we have published the monthly digital World Energy Focus magazine. In addition, we have published three issues of the annual World Energy Focus magazine. All are available for you to download from the website www.worldenergyfocus.org.

World Energy Focus has quickly developed into a well-regarded magazine within the energy sector, and we look forward to seeing how the publication develops. It has been great to work with Stuart Neil, Kristina Acker and the team and network of the World Energy Council. We have been able to conduct a great many fascinating interviews and have enjoyed a tremendously positive response from our readers, who have grown steadily in number throughout this period.

It's always sad to say goodbye, but we will continue to work with the World Energy Council in various ways and we encourage everyone involved with the Council to connect with us on Energy Post if you have not done so yet.

We want to thank all of you for your interest and generous support, especially our sponsors (Hydro-Quebec, DNV GL and others) and magazine advertisers without whom this publication would not have been possible, and of course all our contributors, former editors Alex Forbes and Clare Taylor, and graphic designer Ron Wolak.

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ABOUT WORLD ENERGY FOCUS

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European, Japanese multinationals get behind hydrogen

Hydrogen is back. At least, it's back on the agenda. 15 years ago, author Jeremy Rifkin heralded the coming of the Hydrogen Economy - a term coined by Professor John Bockris during a talk he gave in 1970 at General Motors (GM) Technical Center, according to Wikipedia.

So far the hydrogen economy has not emerged. But recently at the World Economic Forum in Davos, 13 large companies from Europe and Japan – Air Liquide, Alstom, Anglo American, BMW, Daimler, Engie, Honda, Hyundai, Kawasaki, Shell, Linde, Total and Toyota – announced the launch of a global initiative called the Hydrogen Council.

The members “confirmed their ambition to accelerate their significant investment in the development and commercialization of the hydrogen and fuel cell sectors.” These investments currently amount to €1.4 billion/year, i.e. on average €100 million per company. The 13 companies, who together have revenues of €1.07 trillion

(€1007 billion), promise to increase this spending to “at least” €1.9 billion/year for the period 2018-2022.

The Hydrogen Council also published a report [<http://bit.ly/2kmVaME>], called How hydrogen empowers the energy transition, which argues that the energy transition needs to overcome “five major challenges”, in all of which hydrogen could make an essential contribution:

- Using more variable renewable energy in the power sector will unbalance supply and demand.
- Hydrogen helps optimize the power system for renewables. Electrolysis produces hydrogen by using (excess) power supply and enables to valorize it either in other sectors (transport, industry, residential heat) or to store it for future re-use.
- To ensure security of supply, global and local energy infrastructure will require major transformation. Hydrogen can provide a cost-effective, clean energy infrastructure, contributing to supply security both at local and country levels.
- Buffering of the energy system through fossil fuels will no longer be sufficient to ensure smooth functioning of the system. Due to its

storability and flexibility in terms of transport, hydrogen is a viable – and clean – future option for mastering the buffer challenge.

- Some energy end uses are hard to electrify via the grid or with batteries, especially in transport but also in other sectors. In many, if not all of these sectors, where technological and/or economic obstacles prevent direct electrification, hydrogen offers a viable solution.
- Renewable energy sources cannot replace all fossil feedstocks in the (petro-)chemicals industry. Combining hydrogen with captured carbon creates hydrocarbons that can complement oil and natural gas as chemical feedstock.

As to the potential of fuel cell electric vehicles (FCEVs), powered by hydrogen fuel cells, these “are starting to become commercially available, with more than a thousand vehicles already on the road in Japan and the US, and a few hundred in Europe. Several manufacturers have FCEV production lines that can produce thousands of FCEVs a year. By the early 2020s, a significant ramp-up is expected and manufacturers will have the capacity to produce tens of thousands of commercially available passenger FCEVs a year.”

According to the Hydrogen Council, China has set the goal of having 50,000 FCEVs on the road by 2025 and 1 million by 2030. Japan plans to deploy 200,000 FCEVs by 2025 and 0.8 million by 2030. ●

Car manufacturers believe in fuel cells – not in batteries

The projections of the Hydrogen Council for fuel cell EVs (FCEVs) may sound too good to be true, but they are supported by the remarkable results of a survey recently published by KPMG.

According to KPMG's 18th consecutive Global Automotive Executive Survey 2017 [<http://bit.ly/2j50Qts>], based on interviews with almost 1,000 car executives from 42 countries, no less than 78% of executives believe FCEVs “will be the golden bullet of electric mobility...”

By contrast, 62% of the executives believe the battery electric vehicle (BEV)



Toyota Mirai Fuel Cell cutaway

may well become a failure! The key issue with BEVs is “setting up a user-friendly charging infrastructure. The faith in FCEVs can be explained by the hope that they will solve the recharging and infrastructure issue BEVs face today. The refueling process can be done quickly at a traditional gas station, making recharging times of 25–45 minutes for BEVs seem unreasonable.” ●

The energy future according to ExxonMobil

In December, ExxonMobil presented its annual Outlook for Energy [<http://exxonmobil.co/1hOSCCa>], which gives the company's “global view of energy demand and supply through 2040”. This year's edition has become especially interesting in view of the appointment of Rex Tillerson, CEO of ExxonMobil, to Secretary of State in the new Trump administration. ExxonMobil, not surprisingly, expects fossil fuels to continue to dominate global energy supply out to 2040. It projects a 77% fossil share (20% coal, 32% oil, 25% gas) in 2040. This is pretty much in line with the World Energy Council's “Hard Rock” scenario, which has a 70% fossil share (18%

coal, 28% oil, 24% gas), but in 2060. However, the World Energy Council's World Energy Scenarios [[download http://bit.ly/2doTrov](http://bit.ly/2doTrov)] also include two other scenarios, which project significantly lower fossil shares.

The International Energy Agency's World Energy Outlook 2016 projects a 74% fossil fuel share in its central New Policies scenario (23% coal, 27% oil, 24% gas) by 2040. Since the WEO is based on the assumption that all countries live up to the commitments made under the Paris Agreement, this means that ExxonMobil assumes that countries will not meet their commitments. ●



Shell hydrogen vehicle in 2005.
Photo Steve Jurvetson

Renewables investment: largest drop on record

Bloomberg New Energy Finance, one of the leading research companies in renewables worldwide, has announced that worldwide \$287.5 billion was invested in renewable energy (including large hydro) last year, a drop of no less than 18% compared to 2015, the largest drop on record.

The decline was partly (about 50%) due to lower prices for solar panels, but there was also “a marked cooling in two key markets, China and Japan. Clean energy investment in China in 2016 was \$87.8bn, down 26% on the all-time high of \$119.1bn reached in 2015, while the equivalent figure for Japan was \$22.8bn, down 43%.”

Clean energy investment in the US slipped 7% to \$58.6bn. Canada was down 46% at \$2.4bn. Investment in the whole Asia-Pacific region including India and China fell 26% to \$135bn, some 47% of the world total. India was almost level with 2015, at \$9.6bn, with several giant solar photovoltaic plants going ahead.

Among developing nations, “many saw investment slip as projects that won capacity in renewable energy auctions during 2016 did not secure finance before the year-end.” Investment in South Africa fell 76% to \$914m, while that in Chile dropped 80% to \$821m, Mexico fell 59% to \$1bn and Uruguay 74% to \$429m. Brazil edged down 5% to \$6.8bn.

Europe was an exception, “up 3% at \$70.9bn, helped by offshore wind and also by the biggest onshore wind project ever financed – the 1GW, \$1.3bn Fosen complex in Norway”. But German investments were down 16% to \$15.2bn, France down 5% to \$3.6bn. The UK (soon not part of the EU anymore) led the European field for the third successive year, with investment of \$25.9bn, up 2%.

Offshore wind “was the brightest spot in the global clean energy investment picture in 2016”, with capital spending commitments hitting \$29.9bn in 2016, up 40% on the previous year, “as developers took advantage of improved economics, resulting from bigger turbines and better construction know-how.”

On a more positive note, BNEF stated that “even though overall investment in clean energy was down in 2016, the total capacity installed was not. A record 70GW of solar were added last year, up from 56GW in 2015, plus 56.5GW of wind, down from 63GW but the second-highest figure ever.” ●

The coming offshore wind boom

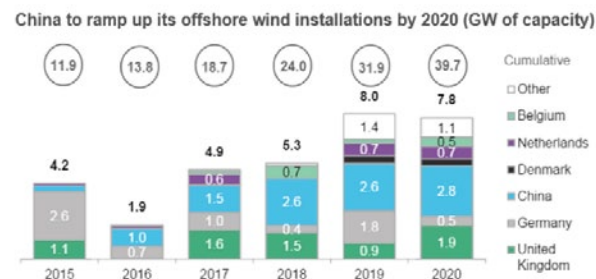
Shell's CEO Ben van Beurden recently admitted that it had been a “mistake” for Shell to get out of wind energy. In 2008 Shell left the consortium that was building the huge London Array offshore wind farm, with a capacity of 630 MW currently the largest offshore wind farm in the world. At the time, Shell concluded that offshore wind would always be too expensive to operate without subsidies.

How different things look today. Late last year Shell managed to win the tender for a 700 MW wind farm off the Dutch coast at a bid price of €54/MWh. Almost, but not quite a world record: Vattenfall won a 600 MW wind farm tender in the Baltic Sea, Kriegers Flak, last year at the record low rate of €49.90/MWh. But that farm will be built in shallower waters closer to the coast than Borssele.

Shell's move marks the first real step of a major international oil company into offshore wind. (Total of France is a big player in solar power through its subsidiary SunPower). For offshore wind this is good news: Shell will bring its huge expertise in offshore construction and operations to this sector. That can only help to bring down the price further. Shell has

promised to drive the sector forward. The low bid price is also good news for offshore wind. The 5.4 cts is a guaranteed price – that is to say, if wholesale electricity prices are below 5.4 cts, the Dutch government will pay Shell the difference. It is not certain yet how much this will be, but the government estimates that it will have to subsidize the project to the amount of €300 million. Note that connection costs, estimated at €14/MWh, will be taken care of by the government. The Netherlands is planning to build five 700 MW offshore wind farms in the North Sea in the period to 2023. Although the Dutch offshore wind plans may seem impressive, there are countries with bigger plans. This chart from Bloomberg New Energy Finance (BNEF) shows the offshore wind parks. ●

Globally offshore wind capacity looks set to triple over 2016-2020.
Source: Bloomberg New Energy Finance



How to integrate renewables into the grid

The integration of increasing amounts of variable renewable power into the electricity network is, as everyone knows, one of the big challenges of the coming years, which research groups around the world are studying. In December 2016, the prestigious institute MIT in the US, under the name of the MIT Energy Initiative (MITEI), released an in-depth report, *Utility of the Future*, which identifies “key barriers and skewed incentives that presently impede the efficient evolution of the power sector”.

Some of its core findings:

- The only way to put all resources on a level playing field and achieve efficient operation and planning in the power system is to dramatically improve prices and regulated charges (i.e., tariffs or rates) for electricity services.
- The regulation of distribution utilities must be improved to enable the development of more efficient distribution utility business models.
- Wholesale market design should be improved to better integrate distributed resources, reward greater flexibility, and create a level playing field for all technologies.
- Better utilization of existing assets and smarter energy consumption hold great potential for cost savings. At the same time, economies of scale still matter, and the distributed deployment of solar PV or energy storage is not cost-effective in all contexts and locations. ●

Interview David Kim
new Chair
World Energy Council

“Energy companies
must move beyond
the era of fossil fuels
to keep up with
disruptive changes”



After a three-year term as the World Energy Council's co-Chair, Younghoon David Kim has taken over as Chair until 2019. In this interview, he sets out his vision of the world's energy future.

What do you see as the most pressing challenges confronting the global energy sector?

There is little doubt that the energy sector will change over the coming years because of several disruptive global trends, ranging from climate change to automation and digitisation associated with the Fourth Industrial Revolution, which is also affecting other industries and transforming the global economic landscape. We are seeing a steady paradigm shift from a carbon-based economy based on combustion to one based on new sources of energy and new modes

of power generation. Fossil fuels will continue to play an important role. There are estimates that fossil fuels will still generate 75% of global power needs in 2050 because we cannot meet energy demand without them. But we also need to prepare for the future. That means not only developing clean and more efficient ways to produce and use fossil fuels, but also discover and nurture alternative energy sources. The coming decades will define the winners and losers of this energy transition. In the long term, I believe we are embarking on a significant energy revolution that could

equal and even surpass the industrial revolution in transforming the world.

Within this shifting picture, how important is natural gas as the hallowed “bridge fuel”?

I agree that natural gas serves as a “bridging” energy source to a more sustainable economy since it is the cleanest form of fossil fuel. In fact, natural gas is the only fossil fuel whose share of primary energy consumption is expected to grow. It is already the second largest energy source for power generation, accounting for 22% of generated power globally. The use of natural gas to fuel transport from trucks to ships, its role in helping make the switch from coal, and its combination with carbon capture and storage systems makes it an ideal, long-term, cheap and reliable low-carbon energy source.

What is the role of technical innovation in the energy industry? Is the sector doing enough to incentivise innovation or could more be done?

My short answer is that companies must innovate or eventually perish and that should be incentive enough for them to continuously innovate. Energy companies need to reinvent themselves. We are at the threshold of a whole new industrial era being driven by the technological advances for smart cities, connected homes or big data. We are also seeing remarkable progress in the material sciences, artificial intelligence and genetic engineering to name just a few. All of these developments, in one

way or another, will have an impact on energy production and consumption in the future. We are already seeing companies outside the energy sector, such as Tesla, Uber and even Google doing things that are impacting our industry. Even though there are many competing energy scenarios for the future, a general consensus is emerging that demands an unrelenting search for a new generation of sustainable technology to tackle climate change and other urgent global challenges. Energy companies must move beyond the era of fossil fuels to keep up with disruptive changes, while offering the hope of increased energy efficiency and reducing the carbon footprint. We are seeing utilities, for example, adapt to new energy models. Southern California Edison has set up an Advanced Technology lab that is focused on energy storage, automation and digital communications to improve the efficiency and reliability of electricity grids powered by a growing share of renewable energy sources. But beyond that, we should also consider frontier energy technologies, which may be the most exciting area of exploration. I believe there are other energy technologies out there that few can anticipate, just as few anticipated the existence of electricity four hundred years ago. These technologies range from high-altitude wind power, grid-connected tidal power machinery and power produced from nuclear waste to nanotechnology and even microbial energy research that aims to harness the cell as an energy source. We could one day see a paradigm shift from the

exploitation of dead microbes, which are basic material for fossil fuels, to using living microorganisms to generate energy. These concepts may seem far-fetched, but remember that few knew about electricity before Faraday came along. ●

Younghoon David Kim became the Chair of the World Energy Council at the close of the 2016 World Energy Congress in October 2016 and will occupy the post until September 2019. He is chairman and CEO of the Daesung Group, one of South Korea's oldest energy conglomerates.

Mr. Kim was previously Co-Chair (2013-2016) and Vice Chair for Asia Pacific and South Asia (2005-2011) for the Council. Mr. Kim was the Co-Chair of the Organising Committee for the 2013 World Energy Congress, Daegu, South Korea. In recognition of the success of the 2013 World Energy Congress in Daegu, Mr. Kim was awarded the Seo Sang-don Award in 2014, which honors the achievements of an outstanding Korean business leader.

Mr. Kim, 64, was born in Daegu, South Korea and received a Bachelor of Law degree from Seoul National University, a Master of Comparative Law degree and a Master of Business Administration degree from the University of Michigan, and a Master of Theology degree from the Harvard Divinity School. His hobbies are traditional Korean archery, swimming and hiking. He is married to Kim Jeong-yoon and they have four children.

REGIONAL EVENT

Africa Energy Indaba

Johannesburg, South Africa
21-22 February 2017

The Africa Energy Indaba is the foremost African energy event for energy professionals from across the globe. The event gathers international and African experts to share their insights and solutions to Africa's energy crisis, while exploring the vast energy development and investment opportunities in Africa.

Altogether over 600 delegates, 100 exhibitors and 80 media representatives have confirmed their attendance. Participants to date include over 60 African & Global Energy CEOs and 10 African Energy Ministers.

The Indaba has been designated the World Energy Council's African regional event and is presented by the South African National Energy Association (SANE), the Council's national committee. It is supported by the African Union Commission and the NEPAD Planning and Coordinating Agency. **Become part of Africa Energy Indaba.** Sign up to participate in this important process that is shaping the future of Africa. For more information and to register visit [Contact: Liz Hart \(event including sponsorships\)](mailto:Liz.Hart@energyindaba.co.za)
[E-mail: Liz@energyindaba.co.za](mailto:Liz@energyindaba.co.za)
[Website: www.africaenergyindaba.com](http://www.africaenergyindaba.com)

KEY SIDE EVENTS INCLUDE:

World Energy Council combined Scenarios and Trilemma Workshop, 20 February 2017

What if ...? Overall energy scenarios portray potential pathways into the future to help us better understand critical uncertainties and decision points.

The World Energy Council organises this invitation only-event exclusively for the African energy leaders' community to facilitate interactive dialogue on the key findings of the Council's 2016 two flagship reports – World Energy Scenarios and World Energy Trilemma – and on what would be the African regional implications.

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Africa Energy Leaders' Dialogue, 21 February 2017

The Indaba Energy Leaders' Dialogues are high-level events organised by the World Energy Council for the global energy leaders' community to facilitate on-going dialogue on critical issues affecting the energy world.

Participation is by invitation only to Ministers, the Council's Patron and Global Partner CEOs and selected high-level guests.

Ged Davis, Executive Chair of Scenarios will present the 'World Energy Scenarios 2016: The Grand Transition' report including its three exploratory scenarios – Modern Jazz, Unfinished Symphony and Hard Rock. In a second part, Didier Sire, Head of Programmes, will introduce to the Energy Trilemma and the implications for Africa. The Trilemma is a 21st century policy framework for evaluating the degree to which energy options are (1) secure; (2) affordable; and (3) environmentally sensitive. Both presentations will be followed by a discussion among participants.

Contact for Trilemma: Andrea Buser, buser@worldenergy.org

Contact for Scenarios: Christoph Menzel, menzel@worldenergy.org

The agenda will explore scenarios for Africa, next steps towards regional integration and the scaling up of renewables through innovative business models. The dialogue is preceded by an African Regional Meeting on 20 February. It will give African energy leaders an opportunity to discuss existing and emerging solutions to develop a greater understanding of how to manage these challenges.

Contact: Lena Dente, dente@worldenergy.org

SEE MORE COUNCIL EVENTS AT www.worldenergy.org/events/future

GLOBAL EVENT

**2017 Executive Assembly
Lisbon, Portugal**

16-19 October 2017

The World Energy Council's annual meeting, welcoming the Council's community and representatives from the global energy sector, will discuss sustainable energy systems on national, regional and global levels.

The Executive Assembly will also host the World Energy Council's major governance meetings, culminating in the full Executive Assembly Plenary, where the Council's members will agree on the strategic direction of the organisation.

MEMBER COMMITTEE EVENT

2017 Canadian Energy Industry Updates and Insights

6 February 2017

Ottawa, Canada

During the Energy Council of Canada's annual event 'Canadian Energy Industry: Updates and Insights' leaders from Canada's energy sector provide the latest information and insights on energy developments across Canada. This year they will examine the theme 'Reducing Emissions from Energy Use: Policies, New Initiatives, and What's Needed'. The conference will be held in English and followed by a networking reception. Participation cost is 100 CAD for members and 140 CAD for Non-Members. Please register via Eventbrite on <http://bit.ly/2jrt59b>.
Contact: Max Arsenault
E-mail: max.arsenault@energy.ca
Website: <http://www.energy.ca/> and <http://bit.ly/2iC3R3K>

ABOUT THE COUNCIL

The World Energy Council has been at the forefront of the energy debate for nearly a century, guiding thinking and driving action around the world to achieve sustainable and affordable energy for all. It is the UN-accredited energy body and principal impartial network, representing more than 3,000 organisations – public and private – in almost 100 countries.

Independent and inclusive, the Council's work covers all nations and the complete energy spectrum – from fossil fuels to renewable energy sources.

JOIN OUR NETWORK

Join the debate and help influence the energy agenda to promote affordable, stable and environmentally sensitive energy for all. As the world's most influential energy network, the World Energy Council offers you and your organisation the opportunity to participate in the global energy leaders' dialogue.

Find out how you can:

- join a Member Committee;
- become a Project Partner, Patron or Global Partner;
- take part in annual industry surveys, study groups and knowledge networks;

by visiting our website and contacting our team on: <http://www.worldenergy.org/wec-network>

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