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Solar Energy Beyond 2017 and Vision 2030

The Saudi Arabia Solar Industry Association (SASIA) is pleased to publish this country focus report in support of the Saudi Arabia Vision 2030 and National Transformation Plan (NTP). Founded in 2011, SASIA encourages cooperation between stakeholders to make Saudi Arabia a leader in solar energy development. The Kingdom has the unique opportunity to become one of the most energy advantaged countries in the world.

The 2011 Chatham House report titled “Burning Oil to Keep Cool - The Hidden Energy Crisis in Saudi Arabia” stated that “Saudi Arabia’s place in the world oil market is threatened by unrestrained domestic fuel consumption. In an economy dominated by fossil fuels and dependent on the export of oil, current patterns of energy demand are not only wasting valuable resources and causing excessive pollution, but also rendering the country vulnerable to economic and social crises.”

The report foreshadowed the inevitable economic and social challenges we see unfolding today in Saudi Arabia. As outlined in the Chatham House analysis, Saudi Arabia and the region face specific challenges including “reversing a history of low energy prices and vested interests in low prices; managing the transition to higher prices, especially for low-income groups; making energy conservation policy coherent and effective, given the vertical structure of government and lack of channels for societal feedback; and convincing the public that such measures are necessary when oil and gas reserves are so abundant.”

In November 2016, Browning Rockwell, founder of SASIA, described Saudi Arabia as “the big multiplier for the region”. Speaking to The New York Times, he said that if the Saudis can figure out how to make it work in their country, they can drive development of solar energy in other markets.

The first of these markets would be the Middle East and North Africa region, which is home to 5.5 percent of the world’s population, boasts 3.3 percent of its GDP, and accounts for 48 percent of global energy subsidies. Regional governments now have the political will to curtail domestic energy subsidies and allow real market conditions to drive solar energy development.

Saudi Arabia’s recently announced Vision 2030 and the NTP clearly outline ambitious renewable energy goals under the King Salman Renewable Energy Initiative. In line with the goals of Vision 2030, SASIA will continue to bring the local and international industries together, transforming the vast solar potential of Saudi Arabia into a commercially viable solution for the region’s growing electricity demand.

Browning Rockwell
Founder and Special Advisor
Saudi Arabia Solar Industry Association (SASIA)
In Association with the Solar GCC Alliance

Browning Rockwell has worked in the GCC/MENA region for more than a quarter century. He is the founder of the Saudi Arabia Solar Industry Association (SASIA), and Solar GCC Alliance, which publishes the MENA Solar Brief, a monthly e-newsletter covering solar energy development in the GCC/MENA region.
EMPOWERING SOLAR DEVELOPMENT AND COLLABORATION IN THE GCC REGION -

We encourage business, government, and academic institutions in affiliate nations and the international community to join us in our efforts to make the solar potential of the MENA region a reality.
Preface

Since its establishment in 2011, the Saudi Arabia Solar Industry Association (SASIA) has made remarkable contributions to the kingdom’s solar industry, facilitating communication and enabling partnerships between the government and private sector, as well as promoting the development of the country’s large-scale renewable energy program. We are confident that with the support of all our stakeholders, SASIA will accelerate its momentum towards Vision 2030 objectives, whilst continuing to provide a reliable platform for international institutions to engage with the local market.

Abdulmohsin Mohammad Al Shoaibi, Chairman, SASIA
Dr. Amin Al-Yaquob, Executive Director, SASIA
The re-emergence of Saudi Arabia’s renewable energy program in 2016 marked a new starting point for the world’s largest oil exporter. Following a sharp drop in oil prices that started in mid-2014 and a budget deficit that reached almost $100 billion in 2015, a historic decision was taken to restructure the economy.

In May 2016, the Ministry of Petroleum and Mineral Resources was renamed Ministry of Energy, Industry and Mineral Resources, and Khaled al-Falih, former minister of health and chairman of Saudi Aramco, was appointed as the new minister of energy. Other changes saw the water and electricity ministry broken up, with the water portfolio added to a new environment, water and agriculture ministry, and the management of electricity incorporated into the new energy ministry.

The government had already set the wheels in motion about a month prior to these announcements, when Deputy Crown Prince Mohammed bin Salman launched Vision 2030 on April 25, 2016. Under this long-term strategy, Saudi Arabia will install 9.5 GW of renewable energy capacity by 2023 and localise a considerable part of the value chain.

This new capacity will be introduced as part of the National Renewable Energy Program (NREP), which targets 9.5 GW of renewable energy by 2023 with an interim target of 3.45 GW by 2020 under the National Transformation Program.

Saudi Arabia estimates that the renewable energy programme will cost $30 to $50 billion by 2023, Khalid al-Falih, Minister of Energy, Industry and Mineral Resources said at the World Future Energy Summit 2017.

At the start of February 2017, the Ministry of Energy announced that the kingdom’s first NREP request for qualification (RFQ) would be issued on February 20, 2017. The Ministry also said that the request for proposals (RFP) for 700 MW of solar and wind power would be issued on April 17, 2017. The RFQ is expected to close in July 2017, with the first round of projects due to be awarded in September 2017.

<table>
<thead>
<tr>
<th>Renewable Energy Capacity</th>
<th>Target Year</th>
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<tr>
<td>0.7 GW</td>
<td>2018</td>
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<td>1.2 GW</td>
<td>2019</td>
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<td>2.1 GW</td>
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<td>2.1 GW</td>
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The preliminary schedule for the 9.5 GW tender as shared with audience at the Saudi Arabia Smart Grid Conference in December 2016

The sites selected for round one include Sakaka, in the Al Jouf province where the 300 MW of solar will be developed, and Midyan, in the Tabuk province, for the 400 MW of wind power. While the first 700 MW is going to be limited to solar PV and wind, subsequent rounds are anticipated to also include concentrated solar power and waste-to-energy.
Moreover, Japan’s Sumitomo Mitsui Banking Corporation has been appointed as financial advisor and will provide overall management of the advisory function throughout the tender process. International law firm DLA Piper will provide legal counsel while Fichtner Group will supply engineering and technical advisory services. Bravo Solutions are the e-procurement service provider.

The kingdom has already succeeded in reducing the budget deficit from SAR367 billion ($97.8bn) in 2015 to SAR297 billion ($79bn) in 2016, and expects to bring it down to zero by 2020. The improved finances will allow the government to increase spending in 2017 to about $237.3 billion from the originally projected $223.9 billion.

It is also worth noting that the delay in launching the 2013 program worked to Saudi Arabia’s advantage as PV’s levelized cost of electricity has considerably fallen since then. The latest record-low bid of $2.99 cents/kWh was received by Dubai Electricity and Water Authority in June 2016 for its 800 MW PV project. The tariff was proposed by a Masdar-led consortium, which subsequently won the tender.

Today, global installed solar PV capacity has reached 321 GW in 2016, from 2.4 GW in 2007, according to GTM Research.

The ministry is currently establishing a new unit – Renewable Energy Project Development Office (REPDO) – to be responsible for the delivery and execution of the NREP. REPDO will report to a new renewable energy steering committee, chaired by the Minister of Energy, and comprising heads of the various stakeholders involved in energy research, regulation and predevelopment in the country.

These stakeholders include the King Abdullah City for Atomic and Renewable Energy (K.A.CARE), Electricity and Cogeneration Regulatory Authority (ECRA), the Saudi Electricity Company (SEC), and Saudi Aramco.

Abstract from Vision 2030:

Among our commitments: A Renewable Energy Market

“Even though we have an impressive natural potential for solar and wind power, and our local energy consumption will increase three fold by 2030, we still lack a competitive renewable energy sector at present. To build up the sector, we have set ourselves an initial target of generating 9.5 gigawatts of renewable energy. We will also seek to localize a significant portion of the renewable energy value chain in the Saudi economy, including research and development, and manufacturing, among other stages.

From inputs such as silica and petrochemicals, to the extensive expertise of our leading Saudi companies in the production of different forms of energy, we have all the raw ingredients for success. We will put this into practice with the forthcoming launch of the King Salman Renewable Energy Initiative. We will review the legal and regulatory framework that allows the private sector to buy and invest in the renewable energy sector. To localize the industry and produce the necessary skill-sets, we will also encourage public-private partnerships. Finally, we will guarantee the competitiveness of renewable energy through the gradual liberalization of the fuels market.”
In December 2015, the cabinet approved hikes for gasoline prices, electricity, water, diesel and kerosene tariffs. After remaining unchanged for the last 15 years, the new electricity tariffs affected nearly a quarter of Saudi Electricity Company subscribers, mainly commercial and industrial users.

For commercial customers using 4,001 to 8,000 kWh, the tariff has doubled from 12 halala/kWh to 24 halala/kWh ($0.03 to $0.06/kWh), while those using more than 8,000 kWh now pay 30 halala/kWh ($0.07/kWh) (SEC, 2017).

For industrial customers, the tariff has increased from 12 halala/kWh to 18 halala/kWh ($0.03 to 0.05/kWh). Nevertheless, the most crucial step will be the removal of subsidies from residential users, which make up 50% of total subsidy cost, according to Hamed Alsaggaf, executive director of independent power projects and renewable energy at SEC.

One of the most important commitments made by Saudi Arabia in Vision 2030 was a pledge to guarantee the competitiveness of renewable energy by gradually liberalizing the fuel market and engaging the private sector. These measures will not only grant renewable technologies a level-playing field with conventional power generation, but should also help increase non-oil revenues for the government.
SASIA Solar Breakfast Briefing

SAUDI ARABIA SOLAR INDUSTRY ASSOCIATION

Helping Saudi Arabia and the MENA region realize it’s full economic and environmental potential of solar energy

The Saudi Arabia Solar Industry Association is a non governmental organization that strives to make the solar vision a reality by helping Saudi Arabia and the MENA region empower the use of solar technology to strengthen the national and regional solar industry.

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Solar GCC Alliance
Empowering solar development and collaboration in the GCC region

www.solargcc.com
Saudia Dairy and Foodstuff Company (SADAFCO) for instance has started to utilize a solar PV-diesel hybrid system that can deliver 40% of the facility’s daytime energy requirements. The project was completed in December 2016 and is expected to result in cost savings from the reduced diesel consumption.

Costing SAR2 million ($533,297), the system uses thin-film PV modules from First Solar, which can deliver more energy than conventional crystalline silicon panels in hot and dusty weather, according to the U.S. based manufacturer. The solar unit generates 226kW of power and combines it with output from existing diesel generators.

"While the solar project only affects SADAFCO’s Riyadh Regional Distribution Centre, it will provide the company with a framework and key insights on the possibilities of a wider implementation across some of its other locations," said Wout Matthijs, CEO of SADAFCO. The Jeddah-based group operates sales and distribution depots in 24 locations across the kingdom as well as Qatar, Bahrain, Jordan and Kuwait.

Other industrial firms could take a similar route in the wake of subsidy reforms. Riyadh-based Almarai for example, one of the world’s largest vertically integrated dairy companies, had to increase its spending by SAR500 million ($133.3m) in 2016 due to rising energy costs and crop-growing restrictions (Khaleej Times, 2016). All dairy companies will be affected by the new rule, which requires Saudi agriculture firms to phase out local feed cultivation owing to the scarcity of water. This leaves them with no option but to import their fodder needs.

Over the next three years, Saudi Arabia plans to reduce water and electricity subsidies by about $53.3 billion. This measure should increase the country’s non-oil revenue to $141.3 billion by 2020, more than triple the current figure (Arab News, 2016). The tariff reforms are expected to have a long-term positive impact on the kingdom’s energy usage levels, obliging businesses and industrial operations to become more aware of their energy footprint.
Meanwhile, the commercial sector could similarly achieve considerable savings through solar installations and energy efficiency measures. “Commercial users should adopt solar regardless of their business activity, because they’re paying the highest tariff for electricity. We heard that the tariffs might increase again to 56 halala, which is 14-15 US cents/kWh. If this happens, solar will be the only way,” said Eng. Sabri Asfour, chief executive of Riyadh-based FAS Energy (pictured left).

“We already took the decision to install rooftop solar systems on all our shopping malls in Saudi Arabia and their car parks. We have around 18 malls,” said Asfour, adding that the solar systems will have a total installed capacity of about 100 MW. “We have around 1,500 engineers who have experience in everything from design to construction to site management.”

FAS Energy is the renewable energy development arm of Saudi retail conglomerate Fawaz Al Hokair Group. The company intended to participate in K.A.CARE’s 2013 programme but then shifted its focus to other markets, including Algeria, Egypt, Jordan, Morocco, and Pakistan.

“We signed our first PPA in Egypt for a 50 MW PV plant in round and we have a chance in round two as well for another 50 MW,” Asfour noted. “We also participated in the bid to develop the 200 MW West Nile solar project and signed an MOU to develop 2,000 MW of PV capacity with the government of Egypt.”

In its home market, FAS Energy is now gearing up for new activity and has established an energy audit division which already received hundreds of requests from the private and public sectors. “We’re moving forward with this division, because you cannot install a solar system as a business or decide on the capacity you need without having full details of your consumption and expenses.”

While there are plenty of opportunities for industrial and commercial applications, the larger share of solar tenders is anticipated to come from the government in the form of Build-Operate-Transfer IPP projects.

“We expect utility-scale projects to come from the newly established Ministry of Energy, Industry and Mineral Resources as well as leading stakeholders such as SEC, Aramco, and K.A.CARE. Each of these entities have their own tasks which have been assigned to them by the ministry. They are working as one team, they have a vision and schedule, and they’re following it. I believe bigtime in what’s going on in Saudi Arabia,” said Asfour.
Residential Applications

Unlike many countries in the Gulf region, Saudi Arabia’s urban population is expanding horizontally and thus residential solar applications may not be as financially viable as they are in other markets.

“We were seriously considering having PV on the roofs of residential units, but in the end, we opted against this and went with having good-quality insulation because we didn’t feel the returns made it viable. A lot of it had to do with maintaining solar panels in a desert environment,” said Thierry Paret, FAIA, director at large at the American Institute of Architects (AIA) and founding president of AIA Middle East (pictured above).

“In our case, there were 300 townhouses, and that’s a lot of roofs to keep clean. It means you need to have people coming in once or twice a week and climbing onto the roofs to clean them,” noted Paret, who is also the lead architect for the engineering and project management group at King Abdullah University of Science and Technology (KAUST).

“On commercial buildings, this might be easier to deal with because they are usually smaller areas, but with large-scale projects it becomes somewhat onerous in terms of the resources required to clean the panels,” he added.

According to Asfour, high-rise residential buildings are not common in Saudi Arabia because residents generally prefer to live in villas or two-to-three-storey buildings. Therefore, he expects the lion’s share of solar projects to be utility scale, followed by commercial and industrial installations.

Amr Khamis, technical manager at Green Gulf, (pictured below), similarly noted that rooftop applications in the kingdom may not be viable because most of the power goes to air conditioning. “About 80% of the electricity bill here goes towards A/C, which will not be covered by solar rooftop systems. So it doesn’t make sense to install rooftop PV over houses as they do in Europe. We expect to see more utility-scale solar projects because the government has plenty of land in the desert,” said Khamis.

Meanwhile, some developers are concerned that Saudi Arabia may approach renewable energy in the same way as conventional power generation.

“Solar and wind energy are relatively simple installations that can be completed in short periods,” said Paschal Phelan, chairman of South Africa-based Phelan Energy Group (PEG). “Saudi utilities, however, have limited experience in such procurement and could, as many other countries have done, approach it from the perspective of traditional fossil-fuel electricity procurement.”

PEG, through its subsidiary Solar Capital, has built the largest solar farm in the southern hemisphere – the 175MW PV facility in De Aar, South Africa with an investment of $315 million. The company has also established partnerships with leading family industrial business in the kingdom.
Q&A

with Tariq Alghaziri, Senior Vice President at Riyad Bank

Tariq joined Riyad Bank in 2002. Since becoming part of the Corporate Finance Department in 2008, he has been active in financing and advising in respect of some of the kingdom’s largest industrial projects including the GCC’s first alumina refinery, and the largest petrochemical facility ever built in a single phase. His work has involved sourcing debt finance from Saudi and non-Saudi banks, negotiations with export credit agencies, and the innovative use of sukuk finance for greenfield projects. Here, he shares his outlook for solar project financing in the kingdom.

SASIA: Which financing models do you think will be used to fund solar projects in Saudi Arabia?
Tariq Alghaziri: Currently, the financing model follows recourse financing due to the limited numbers of renewable projects. However, the kingdom is well established in terms of project financing and non-recourse financing. In the future, it is expected that PPP and non-recourse financing will be the dominant financing model for solar projects. This is of course subject to development and maturity of the solar industry in the kingdom.

SASIA: Do you expect to see greater involvement from local or international banks?
Tariq Alghaziri: Local banks will support project financing as it has been experienced in the past several years. Nevertheless, and due to the limited experience of local banks, such banks will prefer to have the participation of reputable international banks that have strong experience in solar project financing. The financing might start with international banks leading the market but eventually local banks will have a bigger involvement. The legal environment, proper due diligence, and acceptable contracts including PPA are mandatory to attract the both type of banks.

SASIA: What advice would you give to developers participating in the upcoming solar tenders?
Tariq Alghaziri: Risks and mitigants are part of the required due diligence for any transaction. In order to attract financing, a well-structured transaction with outstanding sponsors in addition to an acceptable technology and contractual arrangement are expected. Project financing is a well-established market in Saudi Arabia and follows international standards. Banks will apply international guidelines to maintain the required credit risk and establish a well-organized market precedent. As a result, risk transfer and distribution of risks should be defined and satisfactory to all project participants which include developer, financiers, offtakers, contractor, sponsors, regulator, and O&M provider. It would be also advisable to approach financers to find out their views, concerns or comments as part of the developer’s assessment.
with George Antonopoulos, CEO, HAACO Industrial Division

A subsidiary of multifaceted conglomerate Haji Abdullah Alireza & Co., HAACO Industrial Division specializes in renewable energy power generation, water treatment solutions, utilities operation & maintenance, among other services. The Saudi developer and EPC contractor plans to participate in the country’s renewable energy tender programme in partnership with international firms.

**SASIA: How do you envision KSA achieving its target of 10 GW of renewable energy by 2023?**

George Antonopoulos: Saudi Arabia must accelerate the offerings of renewable energy opportunities to the private sector if it is to maintain its ambitions of achieving 10 GW by 2023. HAACO is closely following the kingdom’s developments and is keen to participate in the upcoming tenders jointly with international players.

**SASIA: From a developer’s point of view, how easy will it be to secure solar-project financing from banks in Saudi Arabia?**

George Antonopoulos: Depending on the size of the project, local financial institutions have indicated their readiness to support the government’s efforts in renewable energy.

**SASIA: Do you see a future for concentrated solar power in Saudi Arabia?**

George Antonopoulos: CSP is a complex process yet to be fully developed. Given the recent pricing achievements with PV, our preference as developers is for PV opportunities.
As the world’s largest producer of desalinated water, Saudi Arabia burns enormous quantities of oil to sustain this production, using about 300,000 barrels of crude oil equivalent a day (Balch, 2014). With a staggeringly high water consumption rate of around 300 litres per capita per day, the kingdom is now on a mission to boost sustainable water production and curb skyrocketing demand (Al-Sughair, 2016).

The Al Khafji project directly reflects these efforts. Slated for completion in August 2017, the solar PV-powered desalination facility will produce 60,000 cubic metres of water per day, enough to supply about Al Khafji’s 190,000 residents.

According to Eng. Saad Alqahtani, PV modules production plant manager at KACST, the water will be delivered through an energy offset. A 48 MW PV plant will feed the reverse osmosis desalination plant during the day, and the surplus power will be exported to grid to be consumed once again during the night.

The project is valued $130 million and is being developed by a joint venture between Spain’s Abengoa and Advanced Water Technologies (AWT), the commercial arm of KACST and a subsidiary of Taqnia.
Expansion of transmission network

Saudi Electricity Company (SEC) has been continuously expanding the transmission network to keep pace with the increasing power demand. According to Hamed Alsaggaf, executive director of independent power projects and renewable energy at SEC, peak load demand in the kingdom is growing at 7 to 9% per year, and in 2016 soared by 10.2% to 62.5 GW.

“In the last 15 years, we have trebled our demand and in the next 15 it could double again, to 122 GW,” Alsaggaf said during the WFES in January 2017. “If we continue to use fossil fuels to reach this demand, our export of oil will be at risk since the rate of oil consumption in Saudi Arabia is 4% greater than our rate of oil produce increase.”

SEC has expanded the electricity transmission network by as much as 136% between 2000 and 2016, increasing the number of substations by 88% and transformers by 191%. The transmission network currently covers nearly 99% of the kingdom, according to Eng. Laith Al-Bassam, CEO of National Grid SA, a subsidiary of SEC.

Nevertheless, SEC’s Five-Year Plan (2016-2020) will see the company add another 34,000 circular kilometres of transmission lines and 370 transformation stations.

SEC is also coordinating efforts within the Gulf Cooperation Council to link the power grids of its member states to meet peak loads in summer (Export.gov, 2016). At the same time, the company is looking at exporting excess capacity in off-peak months to other Gulf countries, as well as Egypt through a 3 GW link and eventually Europe.
New Developments

SASO adopts new IEC standards

The Saudi Standards, Quality and Metrology Organization (SASO) plays an important role in defining electric, safety standards for solar projects in the kingdom. The organisation’s Certificate of Conformity is required for all PV modules imported into Saudi Arabia.

In 2016, SASO adopted the IEC 61215 “Crystalline Silicone Terrestrial PV Modules—Design Qualification and Type Approval” and the IEC 61646 “Thin-Film Terrestrial PV Modules—Design Qualification and Type Approval. These standards include the examination of all parameters which are responsible for the ageing of PV modules and describe the qualification tests based on the artificial load of the materials (TÜV InterCert, 2012).

SASO officials have also signed technical cooperation agreements with Saudi Aramco and SEC in 2016 to collaborate on energy efficiency and consumption rationalization programs, and to exchange experiences in the development and management of engineering standards.

Dust-resistant solar glass at KACST

One of the oldest organisations in Saudi Arabia, King Abdulaziz City for Science and Technology (KACST) in Riyadh built the first CPV power plant in the world in 1979 with 350 kWh capacity and 160 dual trackers to feed three villages.

Since then, KACST experts have conducted numerous R&D projects and identified high temperature, high ultraviolet irradiation and dust accumulation on PV modules’ surface as the top three challenges to solar system efficiency in the kingdom.

“KACST has studied these issues and found effective solutions to minimize the impacts of these problems and improve PV system efficiency,” Eng. Saad Alqahtani, PV modules production plant manager at KACST said. “For instance, we are working on a new type of solar glass with dust-repellent properties by using a nano-coating technology, and so far, it has shown encouraging results.”
SASIA: How do you envision Saudi Arabia generating 10 GW of renewable energy by 2023?

Iain McCulloch: Although renewable energy diversification is imperative, solar energy will undoubtedly account for the majority of future renewable power installation. Wind power does have several advantages like cleanliness and job creation, however, high initial investment and limited site choices make wind power hard to scale up.

The flexibility, reasonably-costed, scalability, combined with the high insolation in the Kingdom make solar energy attractive in the next six years. The rapidly dropping price of solar panels (20% drop for every doubling of cumulative shipped volume) makes this option even more compelling. K.A.CARE forecast that solar power, including PV and CSP, will account for the majority of renewable energy in the future.

Solar-to-fuel conversion could also be made part of this picture, perhaps as an opportunity for the Kingdom to take business initiatives and establish itself as a leader in a sector that has not already been propelled by others. Specifically: PV-driven solar-to-fuel conversion can probably be perceived as a sensible way of mitigating intermittency issues, while bringing PV to the forefront.

SASIA: What role will KAUST play to facilitate deployment of this capacity?

Iain McCulloch: KAUST will be an innovation opportunity for both solar companies and start-ups. For existing companies, KAUST can support research in areas where the Kingdom has the opportunity to play a leadership role, both regionally or globally; for start-ups, KAUST can leverage in-house expertise for emerging research opportunities and provide the capability required for rapid growth. KAUST can support diverse types of businesses with strategic R&D strengths and expertise, and will also pursue innovative solar PV technology solutions.
SASIA: Which applications do you foresee solar energy being used for in Saudi Arabia over the coming years?

Iain McCulloch: It is conceivable that a desirable application of solar energy will be feed-in tariffs (FIT). Countries such as Germany attribute massive solar success to well-designed FIT systems. If, as is the case in Germany, support for a transition away from conventional and towards renewable energy is strong, the use of well-designed FITs is likely to be competitive to alternative regulatory support mechanisms, especially during the early phases of renewable technology development.

On the premise of FIT, the importance of technologies related to grid system will become significant. To design a good FIT system, more scientists and engineers will work on macro or microgrid technologies. Given the experience of solar in well-developed countries, the importance of FIT and grid technologies will show their significance in the following few years.

SASIA: In your opinion, how could CSP fit in with the PV expansion?

Iain McCulloch: CSP cannot compete with PV, in terms of cost. Moreover, thanks to the already mentioned steady rate of cost reduction of PV, it seems very unlikely it will ever catch up with PV. This situation is also reflected in the market, where CSP represents less than 2% of the globally installed capacity of solar electricity plants.

Despite this unfavourable situation, it may be meaningful to have a certain capacity of CSP, as it may help overcome the intermittency associated with PV (molten salts can store their energy overnight).

SASIA: Which components could initially be produced within the kingdom?

Iain McCulloch: It is easier for us to contemplate ‘which technologies can initially be invented for application within the kingdom.’ The development of technologies will be focused on the stability and sustainability of solar cells in desert environment.

Some techniques are proven to be stable and sustainable in a desert environment: silicon heterojunction technology provides high-temperature tolerance, with very high performance, and facilitates drastically bifacial module design; self-cleaning thermoplastic coatings decrease cleaning cost. Customer-based technologies give local producers potentially disruptive properties. By focusing on these niche technologies, the kingdom can extend technological strength to less harsh conditions, and eventually catch up with global solar companies.
Saudi Arabia has emphasized in Vision 2030 that it intends to localize a significant portion of the renewable energy value chain, including research and development, and manufacturing, among other stages. This will be achieved through direct investments and public-private partnerships.

More recently, Khalid Al Falih confirmed that the renewables sector was going to be based on a localisation pathway and that the ministry of energy would require all bidders to invest in the supply chain of goods and services to the kingdom.

“The localization of the industry will have to be encouraged by the government by providing incentives and partnering up with global manufacturers,” said Thierry Paret, FAIA, director at large at the American Institute of Architects (AIA), founding president of AIA Middle East, and lead architect for the engineering and project management group at KAUST.

“Siemens is setting up a wind turbine rotor blade factory in Tangier and I believe the long-term plan is for Morocco to become a supplier for North Africa. Saudi Arabia could look at something similar for the Middle East and become a leader in this field, which would also generate jobs,” suggested Paret.

Iain McCulloch, professor of Chemical Science and director of KAUST Solar Center, believes that servitization will be the key for local PV manufacturers to succeed. “As customers expect additional benefits and long lasting relationships, more manufacturers add service contracts to their product sales.

“In this case, although foreign manufacturers start earlier, local manufacturers have distinct advantages of understanding the Saudi market. By utilizing servitization, local PV manufacturers can create value for customers, which help to lock in long-term relationships,” said McCulloch.

At present, the kingdom has a limited manufacturing capacity for PV components, mainly for the first stage of the value chain. While a few companies plan to cater to the second stage in the future, there are concerns over China's cheap prices. Eng. Sabri Asfour, chief executive of Fas Energy notes that the levelized cost of electricity is the main factor in competitiveness and this cost largely depends on the technology as PV components account for 36% to 50% of project costs.

“Based on our studies, it is not attractive to build PV factories in Saudi Arabia right now because competition with China will be intense. If the [Saudi] government can reach an agreement such as the one concluded between China and Europe on PV imports, or if they impose a 20% local content requirement, that could spur local manufacturing activity.”

Saudi Arabia Solar Industry
ACWA Power

ACWA Power is a remarkable example of how Saudi capabilities can set benchmarks for the global solar industry. With a renewable energy portfolio exceeding 1 GW comprising 10 projects across four countries, the company has been a pioneer in pushing the limits of competition in wind, PV and CSP.

“Renewable energy can provide approximately 40% of electricity in Saudi Arabia and there are fiscally sound ways to achieve this,” said Paddy Padmanathan, president and CEO of ACWA Power. “Using a model that ACWA has articulated over many years, developers and offtakers can set new tariff benchmarks and shore up capital at this important juncture,” he affirmed.

One of ACWA Power’s most aggressive bids was for the 200 MW PV project in Dubai, which it secured at a tariff of 5.84 US cents/kWh – a record at the time. In January 2017, the company bid 5.91 US cents/kWh for Risha – the lowest tariff ever presented for a PV project in Jordan – and subsequently won the tender.

AEC-KACO

A four-year long collaboration between Saudi Arabia’s Advanced Electronics Company (AEC) and Germany’s KACO New Energy resulted in the launch of the country’s first PV inverter line in September 2015. The facility has a production capacity of 2,000 units or 1 GW per year and can produce inverters ranging from 20 kW to 2 MW in capacity. While AEC will own the Shams PV inverter line, KACO will provide O&M services for local customers. The companies also concluded localisation and technology transfer agreements.

Al-Afandi Group

Through its subsidiary Afandi Solar, Saudi conglomerate Afandi Group plans to open a solar panel factory in Yanbu by 2017 and has signed a property contract with the Royal Commission for Jubail and Yanbu (RCJY). Covering 55,000 square-metres, the factory will feature an integrated production line utilising American, French and Swiss technologies to build solar panels from scratch.

The facility is set to become the largest in the Middle East, with an initial production capacity of 120 MW per year, or the equivalent of 450,000 panels, before being expanded to 1 GW. RCJY itself is working with K.A.CARE to assess the feasibility of a 50 MW PV power plant at Yanbu Industrial City.
Green Gulf

Al-Khobar-based Green Gulf is currently in the process of constructing a solar PV manufacturing facility in the Red Sea port of Yanbu, western Saudi Arabia. The company began its activity after the announcement of K.A.CARE’s previous programme and specifically, the local content stipulations.

“We’re going to manufacture solar wafers and modules; we’re aiming for 750 MW of wafer and 200 MW of module capacity,” said Amr Khamis, chief technical officer at Green Gulf. Although the company slowed down construction lately due to the lack of project activity, it will speed up again once the market starts picking up.

With only polysilicon under production in Jubail, PV developers in Saudi Arabia will most likely have to import components for the initial projects. In the long-term however, the kingdom should capitalise on its assets and become a manufacturing hub. According to Khamis, land in Saudi Arabia is cheap, electricity is not expensive compared to other markets, and manpower is affordable.

“If the 10 GW really starts to get implemented, it will push everyone to look at producing locally. We also heard there will be an advantage of around 10% for local suppliers but this has yet to be officially confirmed,” said Khamis.

“Creating a module line is not difficult but solar wafers take time and require a big investment. Today, with five or six million euros you can start a module line, but for wafers you need around 50 million euros. Investors want to see a mature market before they put in large amounts of money.”

King Abdulaziz City for Science and Technology (KACST)

King Abdulaziz City for Science and Technology (KACST) in Riyadh built the first PV module assembly line in the kingdom in 2010 with a small annual capacity that has today reached 100 MW. Operated by Saudi engineers, the fully automated line is capable of producing multi and mono-crystalline modules and has supplied Al Khafji water desalination project with about 40 MW of PV modules.

According to Eng. Saad Alqahtani, PV modules production plant manager at KACST, the organisation has succeeded at localizing 40% of PV module raw materials in the kingdom and cooperated with local manufacturers who offered high quality products and competitive prices.

“Our local PV industry market should not compete with Chinese products. It is necessary to protect the local PV industry and ensure it is not affected should instability occur in the international supply chain,” Alqahtani suggested.
Saudi Electricity Company

In 2016, Saudi Electricity Company (SEC) concluded multiple agreements with European manufacturers, including Alstom Grid, EDF, Siemens and AFL Telecommunications, with the aim of localizing electrical industries. Several of these companies plan to construct factories in Saudi Arabia and have agreed to open institutes to train Saudi youth on the operation and maintenance of high-and ultra-voltage equipment.

SEC has taken a more active role in solar energy development in recent years. In 2016, it invited expressions of interest for two 50 MW solar IPP projects to be located in Al-Jouf and Rafha north of the kingdom. In addition, it is collaborating with KACST and Taqnia Energy to build the 50 MW Layla PV plant in the city of Aflaj.

SEC is involved in the generation, transmission and distribution of electricity to more than 8.3 million customers in Saudi Arabia. And with a market capitalization of SAR81.4 billion ($21.7bn) as of June 2016, the company is the largest utility in the MENA region.

Taqnia Energy

A subsidiary of the Saudi Technology Development and Investment Company, which is owned by the Public Investment Fund, Taqnia Energy was founded in 2014 to develop and invest in bankable, technology-focused energy business opportunities. The company evaluates potential investments through various criteria.

"It’s very important that they are feasible and can contribute to the kingdom’s economy," said Wail Bamhair, senior business development manager at Taqnia Energy (pictured left). "The intangible investment is a way to build local expertise, transfer know-how and potentially create new jobs."

"Through the Layla project, the first IPP solar PV project in Saudi Arabia, Taqnia Energy is going to provide a clean source of energy to Al-Aflaj area, which will help build a sustainable future for the kingdom using local competencies," Bamhair said.

Taqnia Energy is currently building a PV manufacturing facility in Taif using polycrystalline technology and plans to reach an annual production capacity of 500 MW. Although the project may involve international experts, Bamhair believes there is sufficient local expertise to complete the project.

"It’s not just about manufacturing and investing, it’s also about looking at the country’s capabilities and facilities and maximizing their use," he said.
SASIA: How is First Solar involved with the Saudi market?

Raed Bkayrat: First Solar has consistently engaged with the Saudi market for several years. We have established and maintained important relationships, based on knowledge sharing, with our partners and stakeholders there. A good example is our work with KAUST, which we partnered with to perform outdoor testing of modules.

And while the market has only just started to ramp up, we already have two pilot commercial and industrial projects in place: the first is a PV plant that powers groundwater extraction and distribution operations at an organic farm owned by the Al Watania Agriculture Company. In the second pilot, we worked with Saudi-based National Solar Systems Company to deploy a carport solar power plant for the Saudia Dairy and Foodstuff Company (SADAFCO) in Riyadh.

SASIA: How do you envision Saudi Arabia reaching its target of 10 GW of renewable energy by 2023?

Raed Bkayrat: First, Saudi Arabia should take a consultative approach on its renewable energy policy framework by leaning on capable, credible industry partners to share their expertise. This will help the country avoid the steep learning curve that other markets have faced. Second, it should engage with lenders and financiers. It will be particularly important for banks and lenders based in the country to better understand the solar energy industry, ensuring that they’re comfortable with providing competitive financing for the program.

And finally, the kingdom should consider focusing on the use of solar energy for specific energy-intensive applications. For instance, it could provide long-term solar energy targets for certain, energy-intensive industrial sectors such as cement, steel, and petrochemical manufacturing.

The kingdom’s use of diesel generation in off-grid areas, also offers opportunities to introduce hybrid – solar-diesel – applications. And the desalination sector, which is extremely energy intensive, could, quite feasibly, move towards the use of Reverse Osmosis technology which can easily be powered by solar PV technology. We have a tremendous amount of experience in all these areas and would welcome the opportunity to share our expertise with Saudi Arabia.
SASIA: Which applications do you foresee solar energy being used for in KSA?

Raed Bkayrat: The LCOE from solar PV is getting to levels where it is being competitive with subsidized oil and gas power generation. This is opening a slew of applications that span from supporting district cooling to sea water desalination to hybrid power plants and supporting oil and gas operations. This is the tip of the iceberg as we see it in Saudi and the solar market will continue to expand to levels that will even exceed anyone expectations simply driven by economics and maturity in storage technology that will eventually lead to solar PV plants being treated on bar as a conventional power plant except for the massive reduction in carbon footprint, which we urgently need.

SASIA: Saudi Arabia’s high dust levels are still cited as a major challenge to solar PV systems. How does First Solar deal with this?

Raed Bkayrat: Given the availability of high-performance technologies with better spectral response, the argument about dust is a dated one. Of course, if developers opt to build projects with conventional crystalline silicon modules they will need to deal with challenges associated with that technology operating in typical, high dust, high humidity conditions that we see in Saudi Arabia and around the Gulf region.

First Solar has over 70MW installed across the region, with a further 200MW due to be installed this year. All our data points to the fact that our technology performs above expectations in the region and that our dry-cleaning regimen is sufficient to ensure optimal plant performance.

To go into more detail, we maintain a very low average soiling loss figures on the 13MW first phase of the Mohammed bin Rashid Al Maktoum Solar Park in Dubai, which has been operational since October 2013, and has not used any water for cleaning up to this point. Dry cleaning is a must for this region and silicon module suppliers will need to deal with it being a must and develop the right coatings for the glass that will not abrade under dry cleaning routines. This is currently not the case with silicon modules and is only possible with non-coated modules.
References


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