

Saudi Arabia's Electricity Market and Opportunities for U.S. Exporters

This report presents an overview of Saudi Arabia's electricity market and examines the growing opportunities for U.S. exporters of solar technologies and services, transmission & distribution equipment, smart grid technologies, and energy efficiency products and services.

High incomes and population growth have driven both electricity consumption and investment in transmission infrastructure in Saudi Arabia. As Saudi Arabia expands its energy supply and integrates renewable energy, further investment will be required in grid modernization and smart grid technologies that enable electric utility management of variable energy sources. Additionally, the Saudi government has introduced an ambitious plan to increase energy efficiency in both the delivery and consumption of electricity throughout the Kingdom and to reduce its reliance on hydrocarbons for power generation.

These are some of the factors driving a growing market in Saudi Arabia for renewable energy, particularly solar, and the technologies and services necessary to modernize the electric grid, begin the implementation of a smart grid, and enable energy efficiency gains for both commercial and industrial consumers.

The Saudi Electricity Market

The electricity market in Saudi Arabia has been growing rapidly for over twenty years. In the late 1990s, the Saudi government began a process to

consolidate and regulate the market to ensure reliability and formed the Saudi Electricity Company (SEC) by Royal Decree in 1999. Today, SEC is majority owned by the Saudi government (74.3%), with a significant stake for Saudi Aramco (6.9%) and the remaining shares held by private investors (18.8%).¹ The company accounts for almost 90% of the country's power generation capacity and serves nearly 6 million customers (households, businesses and government offices) in 12,000 cities, towns, and villages.²

The electricity market is open to independent power producers (IPP), some of which supply electricity to SEC. Some large consumers also have on-site power generation. Through the SEC IPP program, there are eight conventional thermal build-own-operate projects totaling 15 GW announced or under construction. Started in 2007, this program is intended to attract greater private sector investment in the power industry to meet high growth in demand. SEC offered 20-year term offtaker power purchase agreements and provided equity, fuel, land and grid connection for these projects. SEC welcomes the participation of IPPs in solar power generation in a variety of forms, but notes that government incentives are required for solar to be competitive with fossil fuels.

1 Business Monitor International, "Saudi Arabia Power Report, Q4 2011". Accessed: December, 2011.

2 Saudi Arabia Electricity Company, Annual Report. Available at: <http://www.se.com.sa/SEC/English/Panel/Reports/EAnnualReport2010>



January 2012

Country Quick Facts

Size: 2,149,960 sq. km

Population: 26,131,703 (July 2011)

Type of government:
Monarchy

Head of state: King and Prime Minister Abdullah bin Abd al-Aziz Al Saud

Capitol: Riyadh

Religion: Muslim

Language: Arabic



Source: CIA World Factbook



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According to its 2010 Annual Report, SEC has doubled the available electricity generating capacity of Saudi Arabia over the last decade. In 2010, installed electric capacity was 51.9 GW, of which oil accounted for 57% (gas supplied nearly all the remainder).³ Installed solar capacity includes a few small pilot plants and one 2 MW photovoltaic (PV) project on the roof of the King Abdullah University of Science and Technology (KAUST).⁴

SEC has also expanded its transmission network by over 50% since 2000, including 8.1% growth in 2010, to reach a total length of 46,000 km. The distribution network stretches 383,304 km, reaching 317,932 additional customers in 2010. SEC's major investments over the last year included 33 new substations, 77 more transformers to the transmission network, and an additional 19,330 transformers for the distribution network. To boost its new grid infrastructure, SEC deployed 12,000 electric meters equipped with automated reading and variable rate systems in 2010, and plans to deploy a total of 60,000 new meters by 2013.⁵

In recent years, SEC has focused much of its longer-term investment on interconnecting the Kingdom's transmission network both internally - between the Western, Central, and Southern provinces - and internationally, with Kuwait, Qatar, and Bahrain. The latter represents the first phase of the Gulf Cooperation Council Interconnection Authority's (GCCIA) Interconnection Project. SEC provided almost half of the \$1 billion invested by GCCIA to complete phase I of the project and develop the GCC North Grid.⁶ GCCIA is now embarking on phase II, which will focus on connecting the UAE to Oman (completing the "GCC South Grid"); this will be followed by the final interconnection of the North and South grids.⁷

The Saudi government is expected to publicize a plan in early 2012 calling for the country to generate up to 10% of its electricity, or at least 5 GW, from solar resources by 2020. While most analysts agree that reaching this amount of installed capacity by 2020 is ambitious, the target represents an aggressive commitment to developing alternative sources of power generation and should help advance the Saudi solar market going forward.

3 Business Monitor International, "Saudi Arabia Power Report, Q4 2011". Accessed: December, 2011.

4 Bloomberg New Energy Finance database.

5 Ibid.

6 Ibid.

7 Gulf Cooperation Council Interconnection Project, Project Framework. Available at: http://www.gccia.com.sa/intercon_project.htm

Regulatory Landscape

The development of Saudi Arabia's electricity market is overseen by three major government entities: the Electricity and Co-Generation Regulatory Agency (ECRA), King Abdullah City for Atomic and Renewable Energy (KACARE), and the Ministry of Water and Electricity.

ECRA is the independent watchdog and standard setter for The Kingdom's electricity industry. ECRA assesses tariffs, licenses and monitors service providers, investigates complaints, establishes quality of service standards, and promotes fair competition among providers and suppliers. Meanwhile, KACARE drives the integration of clean energy sources in Saudi Arabia, and the development of energy efficiency programs and directives. The Ministry of Water and Electricity (the Ministry) is responsible for setting policy for the electricity sector and long-term energy plans. The Ministry also oversees private investment in the water and electricity sectors.

ECRA is in the midst of a comprehensive long-term plan to privatize and deregulate the electricity market, starting with structural separation of the vertically integrated monopoly electric supplier, Saudi Electricity Company (SEC). ECRA has stated its intent to separate - and introduce private competition to - SEC's generation, transmission, and distribution networks. However, today competition only exists in the form of Independent Water and Power Plants (IWPP) that compete with SEC in the generation market and are integrated with its grid.

Electricity Demand and Supply Trends

Saudi Arabia is among the world's highest per capita energy consumers, with primary energy consumption rates of four times the global average. Electricity demand has continued to outpace growth in supply, leading the SEC to limit electricity for some areas during peak demand times. Current generation capacity is approximately 52 GW. Peak power demand is expected to increase from 43 GW in the summer of 2010 to more than 120 GW by 2030, requiring massive investment in additional installed capacity or major improvements in energy efficiency measures.⁸

The rapid growth in energy consumption in the Kingdom over the last two decades, which has never dipped below 6%, has been driven largely by increased electricity demand

8 HE Dr. Khalid Al-Sulaiman, Vice President for Renewable Energy, KA-CARE, "Towards a sustainable energy mix for Saudi Arabia," Presentation to the Third Saudi Solar Energy Forum, April 3, 2011.

in both the industrial and residential sectors. Demand in Saudi Arabia will continue to rise as The Kingdom's population grows from 26.5 million in 2011 to an expected 28.6 million by 2020.⁹ The share of electricity in final energy consumption increased from 12% in 1990 to about 15% in 2009. Today, Saudi Arabia's per capita electricity consumption is more than double the world average. Increased consumer spending and construction activity will sustain global demand for oil, keeping oil prices high. As a result, Saudi Arabia is likely to generate greater revenues from exporting oil or using it for development of downstream petrochemical industries, rather than directing it to lower priced domestic electricity generation.

In order to meet the growing electricity demand that has even outpaced the country's impressive GDP growth, Saudi Arabia has turned almost entirely to gas and oil-fired energy supplies. In 2008, the Kingdom relied on its valuable oil supplies to generate over 56% of its electricity and national gas-fired sources supplied the rest. As a result, Saudi Arabia's CO₂ emissions factor for power generation remains about 1.5 times the world average. Additionally, Saudi Arabia's electric grid suffers from above average transmission losses, with 8% of generated electricity not consumed.

With an annual average of 3,000 hours of sunshine per year, Saudi Arabia has sufficient solar resources to meet a large portion of its electricity demand. Saudi Arabia has double the amount of average solar radiation of Europe at 2,550 kWh per square meter per year.¹⁰ However there are some challenges to deployment of solar technology. In Saudi Arabia, electricity demand is highest between 12-4 p.m., which photovoltaic (PV) generation can meet. There is also an early evening demand peak, which PV cannot satisfy without energy storage. The Saudi government's

plans to install new transmission infrastructure could help to connect PV systems to the existing grid. If 10-20 MW of capacity could be built adjacent to currently existing substations (which is often the model for solar power development), Saudi Arabia could provide up to 10% of its total electricity capacity through PV projects without significant effects on power quality.

Based on winter peak demand, the maximum contribution of solar energy is currently capped at 55 GW. Although it will take decades to reach this level of capacity, the constraint could be lifted over the long term with the development of affordable energy storage technologies or the possibility of solar electricity exports through the ongoing GCCIA's Interconnection Project, which will allow supply and demand to aggregate over the whole Gulf region.

Energy Efficiency Goals and Planned Investment in the Electricity Sector

The Saudi government has set a number of goals for the wider energy sector that will likely act as key drivers for investment in the country's electricity infrastructure and services; these include:

- reductions in the amount of crude and natural gas-fired electricity generation;
- establishment and development of nuclear power;
- integration of solar energy supplies for electricity;
- interconnection of the regional electric grid;
- increased reliability and efficiency of electricity transmission and distribution; and
- the achievement of significant energy efficiency gains among residential, commercial, industrial and government consumers.

Solar Power

In September 2009, Saudi Oil Minister Ali Al Naimi first set a goal of matching oil output with solar power at the inauguration of the King Abdullah University of Science and Technology (KAUST). Saudi Arabia currently has roughly 2 MW of installed solar capacity with *Bloomberg New Energy Finance* reporting an additional 38.5 MW in projects announced or under construction. Saudi Aramco is the owner or developer for all except one of these projects; King Abdullah City for Science and Technology's (KACST) is developing the remaining project. Saudi Aramco is also exploring development of polysilicon manufacturing facilities as well as silicon PV cell

9 Business Monitor International, "Saudi Arabia Power Report, Q4 2011". Accessed: December, 2011.

10 Gavin, James. "Creating a solar industry," *Middle East Economic Digest*, Vol. 55 Issue 41, p 52-53. Also, the U.S. and Saudi Arabian governments partnered on solar energy research in the 1970s, through the Solar Energy Research American-Saudi program (SOLERAS), which resulted in solar-powered generation for two Saudi villages. A second joint R&D program in the 1990s, the Saudi Atlas Project, sought to improve data on solar radiation levels at 12 locations in Saudi Arabia. This joint project between KACST's Energy Research Institute and the U.S. Department of Energy's National Renewable Energy Lab (NREL) produced data on Saudi solar radiation and provided technology transfer and training to KACST scientists and technicians to allow them to continue working toward a clear understanding of solar radiation resources in Saudi Arabia. The project ended in 2000 with collected data through January 2003 available on NREL's website.

manufacturing. The SEC reports an additional 1 MW of small (<500 kW) solar projects under construction.¹¹ Thus far, development has been driven by government-issued tenders to build defined projects.

In 2010, KACARE was established by royal mandate. KACARE serves as the center for research on civil nuclear and renewable energy technologies, coordinates national and international energy policy, and leads development of policies and programs to achieve a “sustainable future for Saudi Arabia.”¹² To achieve its objectives, KACARE has announced major government investments to promote renewable and nuclear energy deployment.

In its mandate, KACARE was charged with drafting a National Atomic and Renewable Energy Policy as well as a national strategy and implementation plan. KACARE envisions both PV and CSP technologies will play a role in solar energy development in Saudi Arabia. KACARE hired Finnish firm Poyry as an advisor to prepare a strategy for nuclear and renewable energy projects in Saudi Arabia. The Saudi Council of Ministers is reportedly considering a feed-in-tariff scheme, which the Middle East Economic Digest suggested would award three-year contracts to the lowest-priced bids, allowing the tariffs to come down in future bidding rounds.

Transmission and Distribution

Plans to integrate new energy supplies and realize efficiency gains while keeping up with surging electricity demand in Saudi Arabia will also necessitate major investments in the electric grid. In 2006, SEC developed a long-term plan for transmission investments that forecast \$8 billion in upgrades and build-outs through 2015. Additionally, last year, SEC's CEO and President Ali Al-Barrack estimated that total investments would reach \$80 billion over the next decade.

The ongoing project to connect the Gulf's regional grid will help provide improved demand and supply aggregation over a wider area for SEC. Additionally, the Saudi government recently carried out a feasibility study to build an interconnected grid that would extend The Kingdom's regional ties to Egypt and provide an additional 3,000 MW of capacity. The World Bank has expressed

11 Dr. Amer Al-Swaha, Head of IPP Program, Saudi Electricity Company, “Solar power through SEC IPP program,” Presentation to the Third Saudi Solar Energy Forum, April 3, 2011.

12 K.A.CARE, “A New Era of Sustainability.” Available at: <http://www.energy.gov.sa/default-en.htm>

interest in funding the project. Other major transmission and distribution investments by SEC include the expansion of High Voltage Direct Current (HVDC) and Flexible AC Transmission Systems.¹³

Smart Grid

SEC also plans to accelerate its investments in the smart grid, including a significant smart meter roll out across the country. One component of the Kingdom's smart grid and energy efficiency program was put into place in 2010 when electricity tariffs for industrial and large commercial customers were increased and variable tariffs were introduced to encourage conservation during peak demand hours. In order to implement the new tariff system in the private consumer sector, SEC sees smart meters as a necessary tool for its customers. With a number of pilot projects completed in Riyadh, SEC is now looking to roll out smart meters to the rest of the country. Investment in the distribution system in Saudi Arabia, including smart grid systems, is predicted to reach \$24 billion over the next decade.¹⁴

Opportunities in Solar Power, Grid Modernization, Smart Grid, and Energy Efficiency

Saudi Arabia's push to integrate renewable energy into its electricity supply and achieve a reliable and interconnected transmission network will drive expanded short and medium-term opportunities for technology suppliers and service providers in the following sectors:

- Solar power
- Power system construction and engineering
- High voltage transmission systems
- Substation equipment and construction services
- Transmission & distribution transformers, switching gear, control systems, and other equipment and services

Bloomberg New Energy Finance analysis, using Standard Chartered Bank's future oil price forecasts, already shows that “PV projects built to offset oil-fired generation will demonstrate positive returns in 2011.”¹⁵ U.S. companies

13 “Saudi Power Sector Moves to Privatisation”, MegaWhat, June 15, 2011. Available at: <http://www.megawhatme.com/en/2011/06/saudi-power-sector-moves-towards-privatisation/>

14 Jennifer Eagle, “Smart Grids ME 2010”, Construction Week Online, January 9th, 2011. Available at: <http://www.constructionweekonline.com/article-10695-smart-grids-me-2010>

15 Bloomberg New Energy Finance, “Sun sets on oil for Gulf power generation,” Research note, January 7, 2011.

will find opportunities in consulting and engineering services for design, construction and management; and supplying solar technology, machinery and equipment for power plants.

Solar project developers in Saudi Arabia will need to adjust their designs to account for atmospheric temperatures that often rise higher than the optimal level for most PV technologies. Dust storms, combined with high humidity, may require dust-resistant films or near-constant cleaning of the panels for solar to reach its full potential in Saudi Arabia. Water requirements for concentrated solar power (CSP) systems may prove difficult to meet cost-effectively in the Saudi desert climate. Saudi Arabia is also currently investing in the creation of domestic polysilicon production facilities.

In addition to large investments in solar power project development and transmission & distribution infrastructure, opportunities will develop for suppliers and service providers in the smart grid sector over the next decade. Some of the needed smart grid solutions that have been identified in Saudi Arabia include:

- System monitoring and outage management
- Substation automation
- Synchrophasor technology and wide area network management systems
- Distribution automation
- Demand response technology platforms and software services
- Smart meters

As the country's transmission and distribution infrastructure is modernized, commercial and industrial-scale consumers will also seek to capitalize on potential energy efficiency gains through investments in smart grid and smart building technologies and services. The market potential for residential and industrial energy efficiency products and services is projected to grow rapidly as a result, and a wide range of opportunities for U.S. companies in the green building and energy efficiency subsectors are expected to open up.

Upcoming Trade Events

Webinar: Solar Opportunities in Saudi Arabia

January 23, 2012 at 1 p.m. EST

[Registration and information](#)

Webinar: Saudi Arabia's Electricity Market and Opportunities for Smart Grid Exporters

January 31, 2012 at 12 p.m. EST

[Registration and information](#)

Executive-Led Clean Energy and Energy Efficiency Trade Mission to Saudi Arabia

Riyadh and Dhahran

April 14-18, 2012

<http://www.export.gov/saudiarabia/SaudiEnergy>

Application due date: March 1, 2012

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