

Oman Electricity Sector: Features, Challenges and Opportunities for Market Integration

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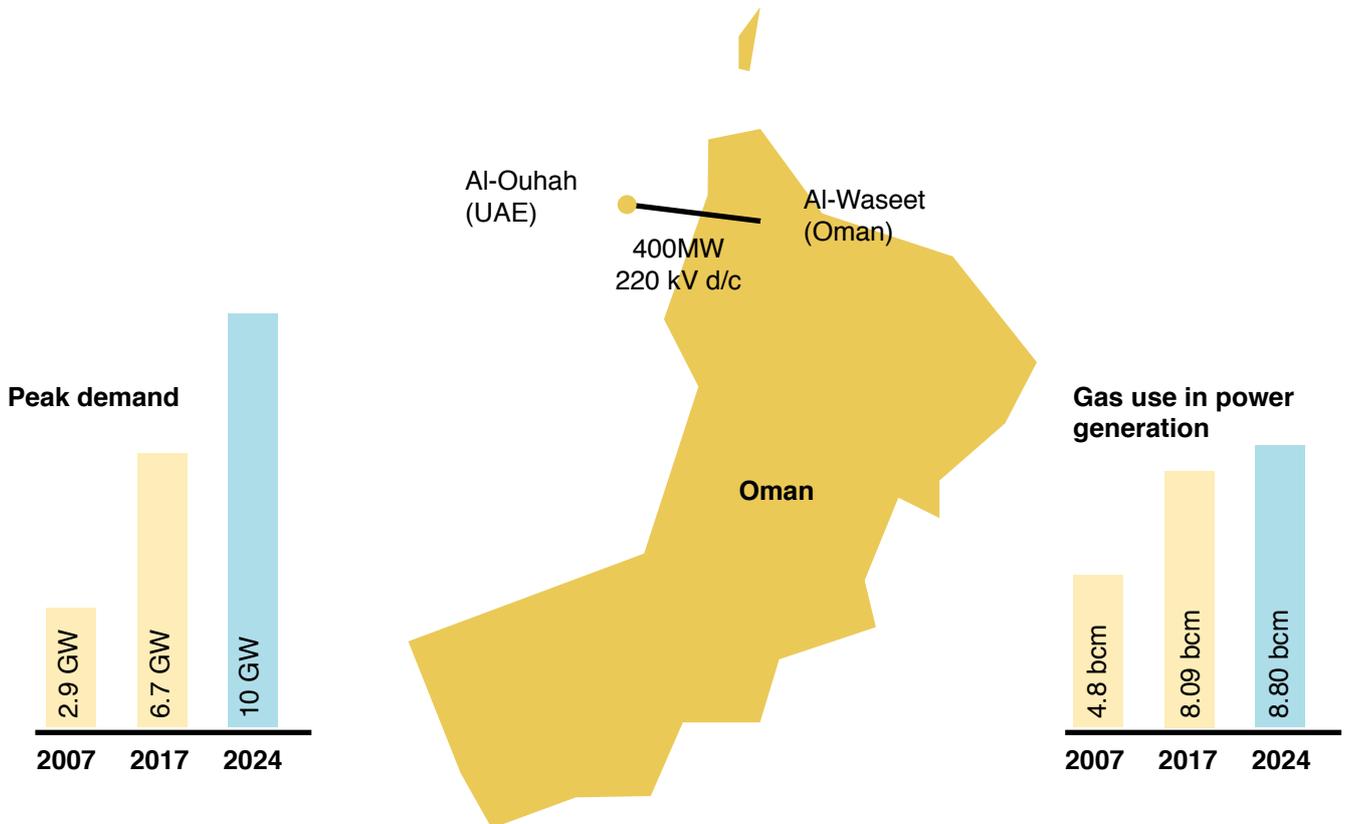
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Key Points

Oman's electricity sector liberalization process started with the introduction of a law to regulate and privatize the electricity and related water sector in 2004 (hereafter referred to as the Sector Law) and is now poised to move to the next level. The changes that are expected in the existing Sector Law and electricity market design are aimed at deepening the reform initiatives and creating a more competitive electricity industry. The key features of Oman's electricity market, challenges and opportunities for market integration are summarised below:

Since 2000, Oman's electricity sector has needed significant investments in new generation capacity to support the country's growing economy and its rising electricity needs. Accordingly, liberalization of the electricity sector, initiated in 2004, placed significant emphasis on private sector participation in electricity and water production. The success of the liberalization process is widely attributed to two major factors: clearer and comprehensive reform legislation; and effective regulatory oversight through an independent electricity regulator, the Authority for Electricity Regulation.

Figure 1. Oman's electricity demand and fuel consumption.



Source: Collated from multiple sources based on information available in the public domain. The map showing regional interconnections is for representational purposes only and does not show the exact transmission corridor between the countries.

Key Points

The private sector now owns 100% of generation capacity in Oman's main interconnected system (MIS), and efforts have started to privatize other network companies involved in transmission and distribution activities. If implemented, Oman will be the first country in the Middle East Gulf region to have privatized its electricity transmission and distribution sectors.

A financially and administratively independent, proactively engaged, electricity sector regulator with an adequate mandate has played a key role in improving the sector's performance and has also created confidence among new industry players. To further streamline the energy market, regulating the gas network may be included in the Authority for Electricity Regulation's future mandates.

Nearly one quarter of Oman's domestic natural gas production (32.3 billion standard cubic meters) is used to power electricity generation and water desalination plants. The government's National Energy Strategy 2040 seeks to ensure the country's long-term energy sustainability. The strategy envisions a substantive role for non-hydrocarbon fuels in power generation and has set a target of at least 10% of electricity output from renewables by 2025 and up to 3,000 megawatts (MW) of coal-fired power plants by 2030. Recently, the National Program for Enhancing Economic Diversification (Tanfeedh) modified the target to 11% of electricity output from renewables by 2023.

After implementing the initial reform strategies, Oman intends to implement a new arrangement for the future procurement of electricity through the spot market by 2020. Electricity consumers are also likely to have an option to choose their electricity supplier. Such new market arrangements are expected to put pressure on incumbent generators and result in enhanced competition in the wholesale electricity market.

Despite making significant progress in unbundling and reforming the electricity sector, retail tariffs in Oman are still heavily subsidized. In 2017, 57% of the overall economic cost of supply was recovered from customers through retail tariffs in the MIS. The remaining 43% of the revenue requirement came in the form of direct government subsidy. Implementing cost-reflective tariffs for industrial and government consumers and lowering the cost of power through the introduction of more competition in the wholesale electricity market are two key measures that would help reduce the stress on the government's fiscal position.

The Dhofar region is not fully integrated with the MIS grid in the north. Full integration of the Dhofar Power System (DPS) and the MIS by 2023 through a 400-kilovolt transmission line is expected to result in improved operational efficiencies and financial benefits, and the effective utilization of the renewable energy potential (wind and solar) of the southern parts of Oman. The existing regional interconnection with the United Arab Emirates (UAE) (Abu Dhabi) has limited transfer capacity and provides access to the power system of other Gulf Cooperation Council (GCC) member countries through the UAE's national grid. A direct transmission line between Oman and Saudi Arabia is likely to obviate the reliance on UAE's grid for future electricity exchanges with other countries in the Gulf.

Introduction

KAPSARC has initiated a research project to develop insights that can facilitate the creation of a well-functioning integrated electricity market comprising the member states of the Gulf Cooperation Council (GCC). This project identifies and examines the key issues affecting electricity market integration within the GCC and the wider Middle East and North Africa (MENA) region, and suggests the enablers needed to facilitate market integration. The project will examine policy, legislative, regulatory, market design, system operation and governance aspects of the electricity market for each GCC country, to identify good practice arrangements that can encourage efficient regional electricity trade. Several power systems around the world have combined to form regionally-integrated electricity markets. Their experiences will also be studied for their potential applicability to the GCC region. The research project will serve as a

tool for decision makers in the region to fill existing knowledge gaps and facilitate ongoing efforts toward regional electricity market integration.

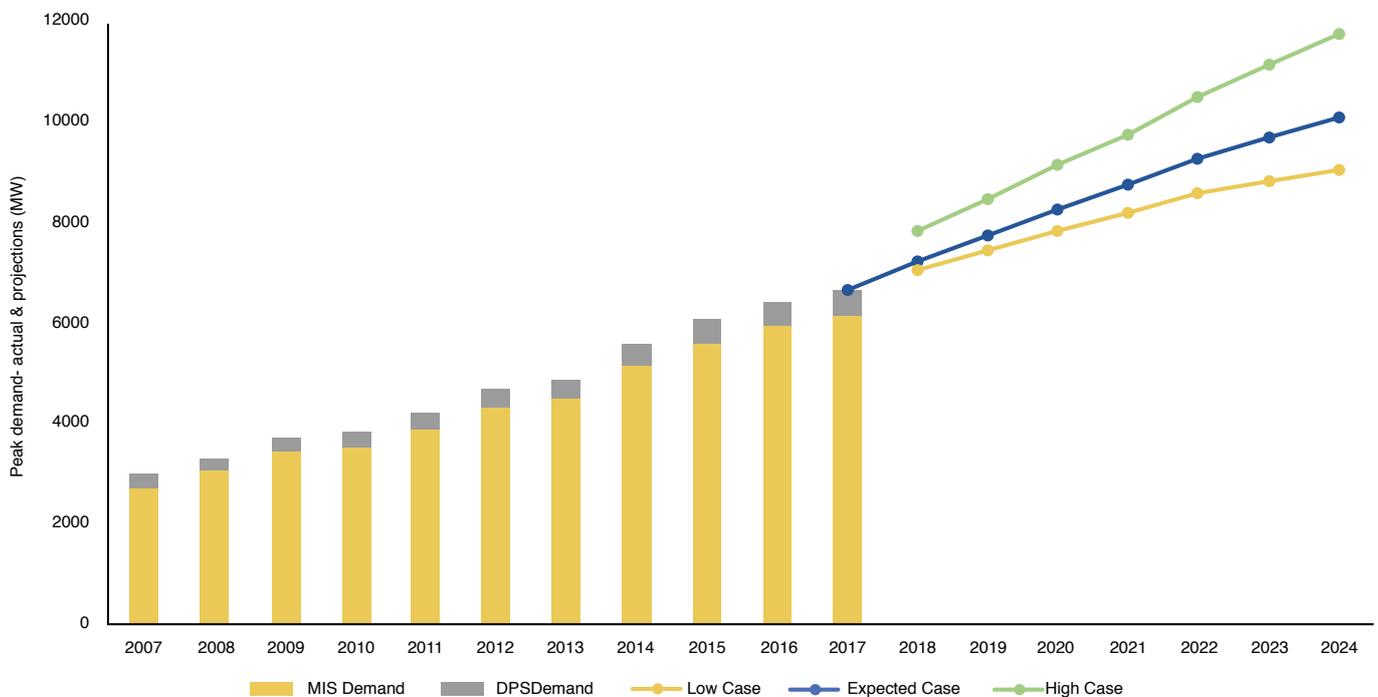
The first phase of the project addresses the electricity sector features, challenges and opportunities of several countries in the region. The analysis discusses reform initiatives, restructuring activities, key market players and associated issues. This phase provides a deep analysis of the main themes of the electricity sectors and will serve as the backbone for a subsequent comprehensive study focused on market design aspects. The study also proposes a pragmatic approach to guide the transition towards more effective regional market integration. This report focuses on Oman's electricity sector. Future reports will look at market design and market structure-related issues in the context of developing an integrated regional electricity market.

Demand and Supply Outlook

Oman's power system comprises of two major publicly-owned electricity networks: the Main Interconnected System (MIS) and the Dhofar Power System (DPS). The MIS covers most parts of the Sultanate's North region¹, serving around one million electricity customers, and comprising of some 90% of Oman's total electricity peak demand. The DPS covers the city of Salalah and the surrounding areas of the Governorate of Dhofar, serving around 100,000 customers and contributing 10% of peak demand (OPWP 2018). The Ad Duqm Power System, located on the eastern coastline of the Al Wusta region, and the Musandam Power System in the Musandam Governorate are the country's other two, small and isolated, power systems. The Ad Duqm region is served by the Rural Areas Electricity Company (RAEC). With nearly 7,858 megawatts (MW) of generation capacity and 6,668 MW of peak demand in 2017, Oman ranks fifth in generation assets and peak demand in the GCC region.

Oman has witnessed a robust compounded annual growth of 8.34% in peak electricity demand since 2007. The Sultanate's growing economy, the government's focus on non-oil sectors and its rising population (GTR 2018) have mainly contributed to this steady increase in demand. According to Oman Power and Water Procurement Company's (OPWP's) 7-Year Statement, the combined demand of the MIS, DPS and other small and isolated systems is likely to increase from 6,668 MW in 2017 to 10,072 MW in 2024 under its Expected Case scenario for demand projections from 2018 to 2024. The low and high case scenarios signal 9,044 MW and 11,754 MW in 2024 for the MIS and DPS, respectively (Figure 2). Peak demand from 2018 to 2024 is expected to increase at a lower rate of 5.74% due to the introduction in 2017 of the Cost Reflective Tariff (CRT) for large industrial, commercial and government consumers. Maximum demand for the Oman Electricity Transmission Company (OETC) transmission system is usually on

Figure 2. Historical and projected electricity peak demand in Oman.



Note: MIS – Main Interconnected System, DPS – Dhofar Power System.
Source: OPWP annual reports.

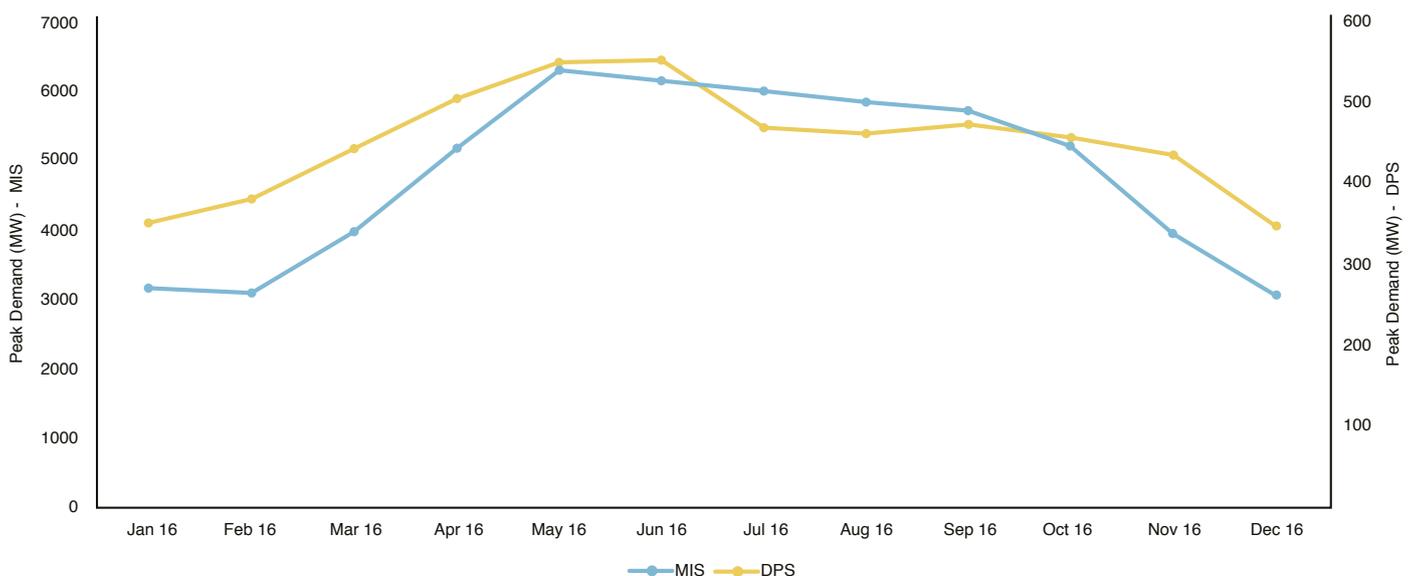
weekdays in the summer. The annual demand profile in Oman is highly seasonal, with average summer demand more than double the average demand in winter (Figure 3). Demand typically peaks from May to July, during the highest daytime temperatures and most intensive use of air conditioning units. The seasonality of demand is expected to reduce with new large industrial loads coming online. Figure 4 shows Oman’s historical and projected demand and supply.

Residential consumers represent around 74% of all retail electricity customers in Oman, accounting for 46% of the country’s total electricity supply in 2017, making households the largest power consumer category in the country. The commercial sector forms the second largest category at 21% of customers accounting for 23% of electricity supply. Fewer than 1% of industrial consumers account for around 16% of the country’s electricity supply (Figure 5). In 2017, electricity demand from industrial customers decreased by 2.6%,

while demand from government users fell by 1.3% compared to the previous year. This was due to the implementation of cost-reflective tariffs for large consumers in these two customer categories.

The assessment of electricity generation capacity requirements to meet demand is based on minimum generation security standards published by the Authority for Electricity Regulation (AER), in particular concerning the reliability and dispatchability of generation resources. The AER’s standards stipulate that the expected loss of load hours in any year must not exceed 24. Oman’s generation planning has primarily relied on ensuring self-sufficiency rather than exploring electricity trading opportunities with neighboring countries in the Gulf region. Generation capacity expansion planning by OPWP continues to be based on securing sufficient generation resources, on a short-term and long-term basis, to meet the aggregated demands.

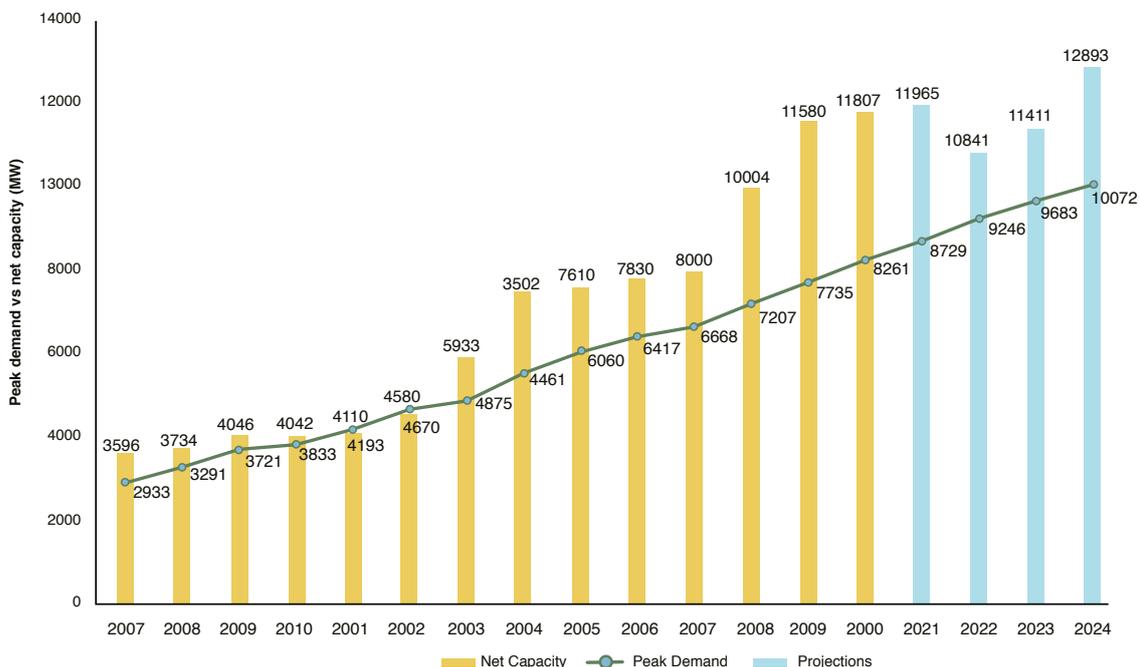
Figure 3. Seasonal variations in Oman electricity demand.



Note: MIS – Main Interconnected System, DPS – Dhofar Power System.
 Source: 2017 Annual Report for Authority for Electricity Regulations, Oman.

Demand and Supply Outlook

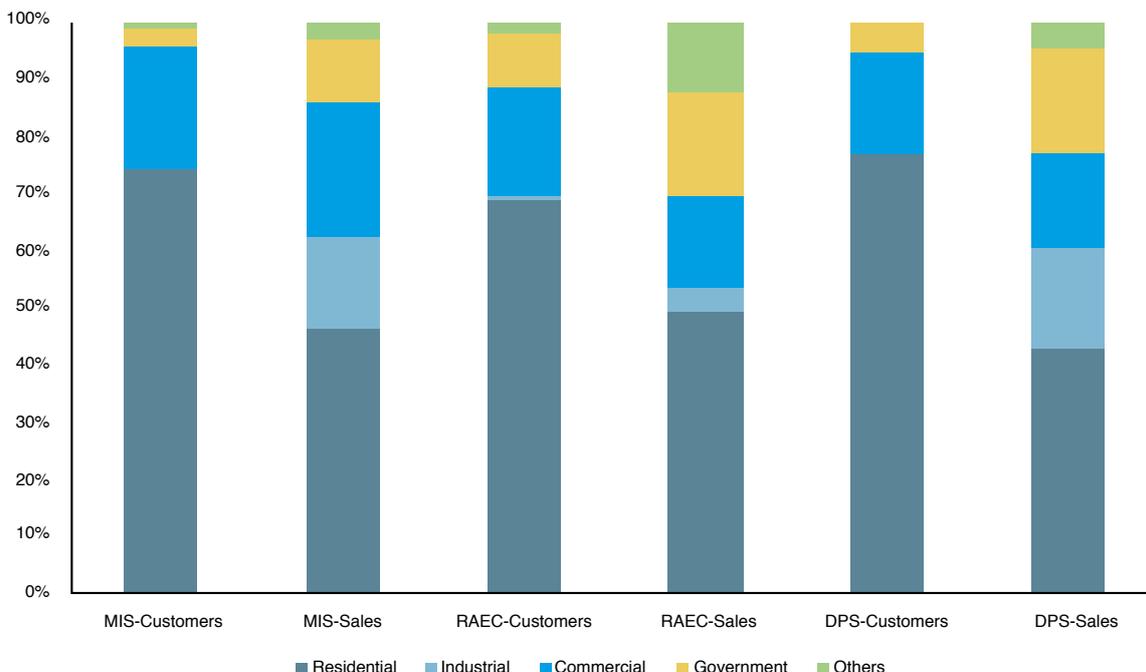
Figure 4. Peak demand in Oman vs. availability (historical and future).



Note: Projected peak demand represents “Expected Case” demand scenario. Net capacity includes (i) existing contracted capacity, (ii) planned contracted capacity with firm contracts, and (iii) other non-firm capacity for MIS, DPS, Ad Duqm and Musandam.

Sources: OPWP annual reports, OPWP 7-Year Statement (2018-2024), May 2018.

Figure 5. Oman: distribution of power customers and sales by tariff category and zones, 2017.



Note: Sales figures are in MWh.

Source: Authority for Electricity Regulation, Oman, annual report 2017.

Natural gas is the primary fuel resource for Oman's power generation and associated water desalination plants, supplied by the Ministry of Oil and Gas; rural areas mostly use diesel. Gas consumption for power and water generation has increased from 4.8 billion cubic meters (bcm) in 2007 to 8.11 bcm in 2017 (OPWP 2018), registering an average annual increase of 5.38% for the past 10 years. Nearly one quarter of Oman's domestic gas production (32.3 bcm) is used as fuel for electricity and water desalination plants, with the remainder consumed by the country's industrial and petrochemical sectors or sold for export as LNG. As Oman's domestic energy requirements associated with its growing economy have steadily risen, the government has felt the need to diversify its energy resources and relieve the pressures on the Sultanate's already constrained natural gas resources. To fulfill the government's vision of long-term energy sustainability, Oman adopted its National Energy Strategy 2040 in 2015, which sets the following targets for the electricity sector:

- Renewable energy to account for at least 10% of electricity output by 2025.
- Up to 3,000 MW of coal-fired generation capacity to be developed by 2030.
- Improvements in the thermal efficiency of gas-fired power plants to be made a priority.
- Exploring other sources for electricity generation.

The key objective of this policy is to release the domestic gas committed for electricity generation to stimulate the country's industrial and economic development. The National Energy Policy has been seen as a welcome step in securing the fuel requirements needed to support the continued development of Oman's electricity sector. The OPWP's subsequent 7-Year Statement sets out plans to realize the National Energy Policy's goals.

The OPWP has announced plans to build three new solar power installations and two new wind power projects aimed at delivering a total of around 2,500 MW of renewables-based capacity (including the 50 MW wind power project at the Wilayat of Shaleem and on the Halaniyat Islands) by 2024 (OPWP 2018). The first independent power producer (IPP) project, the 500 MW Ibri II Solar IPP in Wilayat of Ibri in Al Dhahirah Governorate, is likely to be operational by 2021. The OPWP expects that solar projects will contribute at least 30% of their peak installed capacity to the MIS peak demand. Potential locations for the new wind projects include Dhofar and Duqum.

Petroleum Development Oman (PDO), the Sultanate's state-controlled exploration and production company, is also developing the world's largest planned solar thermal facility at Miraah. This project is designed to produce 1,021 MW of thermal energy and 6,000 tonnes of steam per day for use in enhanced oil recovery at the Amal West oilfield, in southern Oman (PDC 2018).

Documents outlining plans for the first 1,200 MW of clean coal-fired power plants are undergoing various stages of approval. The commissioning of a coal-fired power plant by mid-2024 is expected to reduce the share of gas used for power generation in Oman from 100% now to 83%. Furthermore, the introduction of solar, wind, waste-to-energy, and clean coal technologies, efficiency improvements in electricity production, and improved dispatch control technologies are likely to reduce the amount of gas required for electricity generation to about 150 cubic meter per megawatt-hour (MWh), some 60% less than the amount required in 2005 (OPWP 2018). Oman's Supreme Council for Planning is currently preparing Oman Vision 2040 which will aim to build a prosperous future for the nation. It is expected that the National Energy Strategy will be progressively aligned with Vision 2040 to present a coherent developmental strategy for the future.

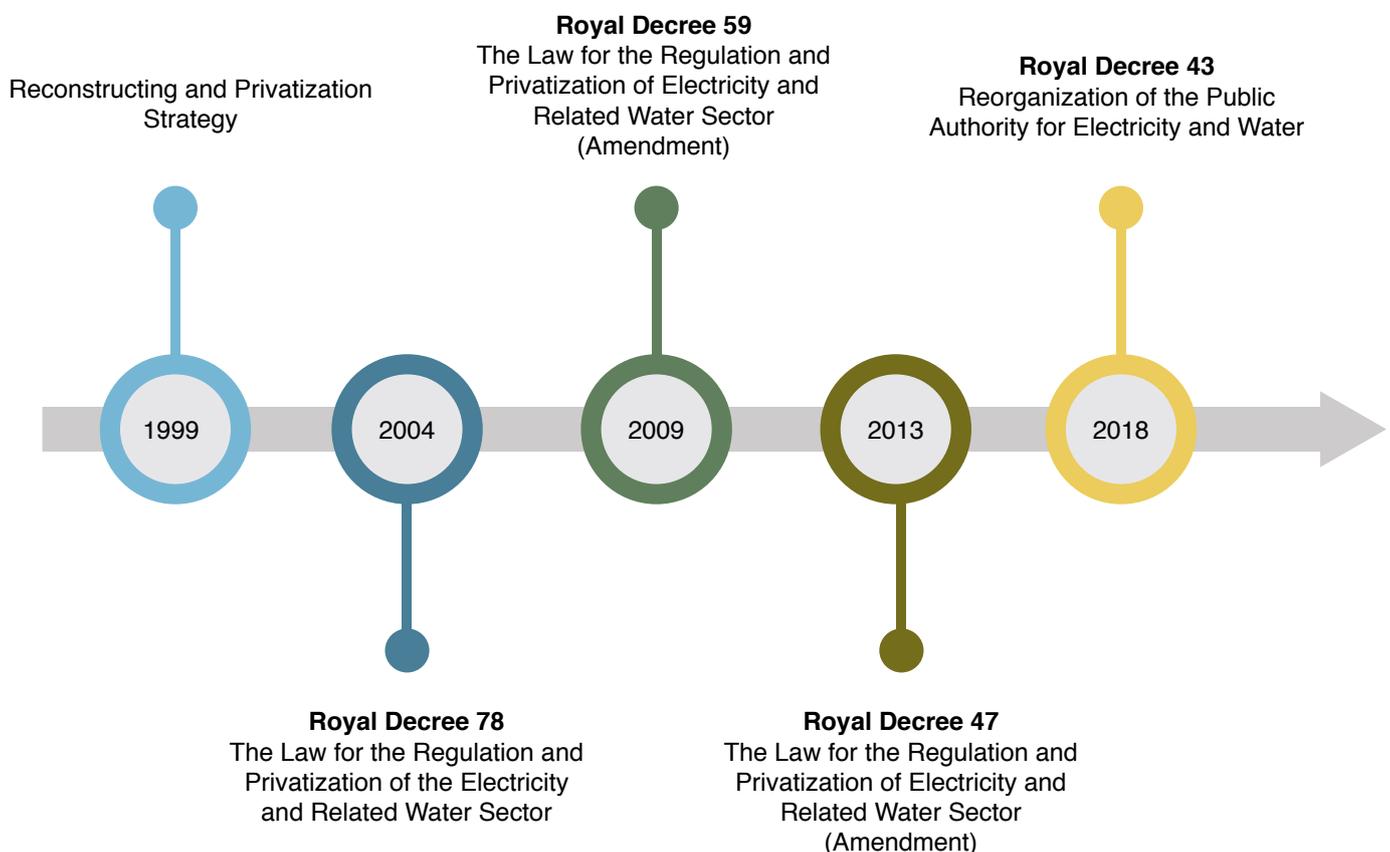
Reform Initiatives and Timelines

Oman's economy expanded significantly during the 1980s and 1990s, dominated by the country's growing petroleum and services sector. Oman therefore needed more energy, including more electricity, to support its economic growth. One of the main drivers of the Sultanate's electricity sector reform was the huge investment required by the sector due to the expected population increase and the growth of energy-intensive industries such as petrochemicals, aluminum, cement, and steel.

Some 20 years ago, given the country's growing electricity needs, Oman's government recognized the need for private sector participation in the electricity sector and unbundling of the electricity sector. In 1999, the Council of Ministers approved

a restructuring and privatization strategy for the electricity (and related water desalination) sector, both of which came under the responsibility of the Ministry of Housing, Electricity and Water (MHEW). The strategy included unbundling electricity generation, transmission, distribution and supply and facilitating private sector investment, including foreign direct investment, in generation and water desalination, as alternatives to government-financed generation plants. The government also considered establishing an independent authority to regulate the electricity and water sectors. This strategy also emphasized the need to improve the efficiency, financial transparency and security of supply of the electricity sector, to progressively reflect international standards.

Key reform milestones



Restructuring Electricity and Water Sector: Roles and Entities

The Royal Decree 78/2004 of Aug. 1, 2004, announced the development of a law for regulating and privatizing the Sultanate's electricity and related water sector. This law paved the way for the creation of various successor entities (Figure 6) responsible for activities across the supply chain, initially owned by the Government of Oman through MHEW. The successor companies include a holding company, three power generation companies, one transmission company, three distribution companies, a company servicing rural areas, and a power and water procurement company. On May 1, 2005, the Ministry of National Economy implemented its Transfer Scheme, whereby the electricity and related water assets, liabilities and staff of MHEW were transferred to the successor companies. Except for the holding company, the successor companies are now responsible for the electricity functions previously undertaken by MHEW. The electricity and related water sector in Oman are split into three separate geographic market segments: the MIS in the north of Oman; the Rural System of the Rural Areas Electricity Company (RAEC); and the Dhofar Power System (DPS). Figure 6 outlines the current structure of Oman's electricity industry. While generation, transmission and distribution functions have been unbundled in the MIS and DPS, these are still performed by RAEC as one vertically-integrated entity.

Policy, development and privatization

Under Article 63 of Royal Decree No. 78/2004, the Electricity Holding Company (EHC) was created as a joint stock company. The EHC was made responsible for (i) implementing government policies related to the privatization of the electricity and related water sector; (ii) encouraging private

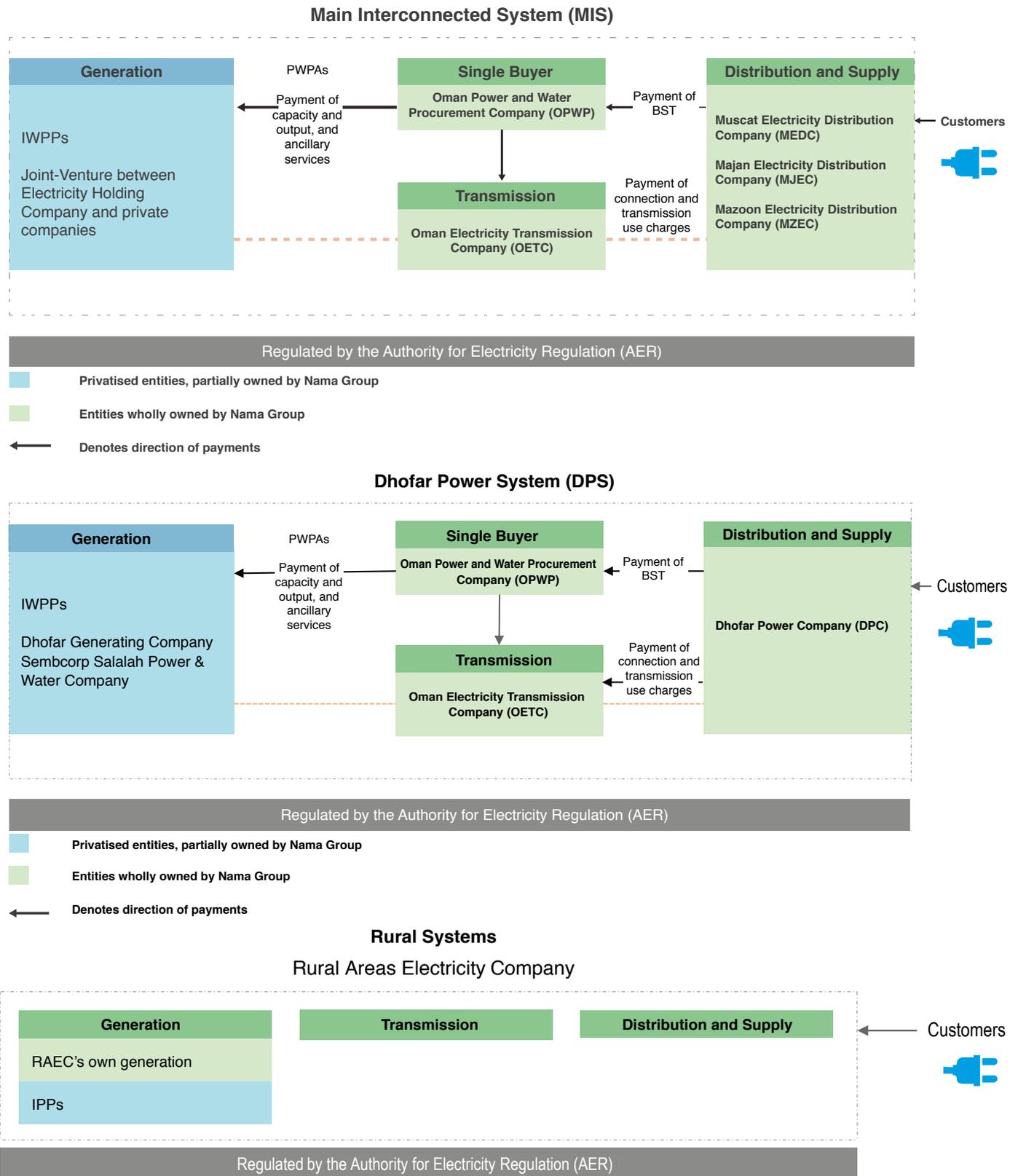
sector participation; (iii) managing government ownership of successor entities through the government's shareholding; (iv) establishing new companies or appointing existing companies to undertake production, operation, maintenance, and procurement activities; (v) performing any other functions as assigned to it in pursuant to the provisions of this law (Government of Oman 2004). The EHC and all the successor companies created as per Article 66 of the Sector Law are subject to the State Financial Audit Law for so long as these companies are wholly owned by the government.

Nama Holding (formerly the EHC), owned by the Ministry of Finance through its subsidiaries, engages in generation, transmission and distribution of electricity and related water services. It has retained 99.99% of the government's shares in eight subsidiary companies: Wadi Al Jizzi Power Company; Al Ghubrah Power and Desalination; Mazoon Electricity Company (MZEC); Muscat Electricity Distribution Company (MEDC); Majan Electricity Company (MJEC); Rural Areas Electricity Power Company; the OETC; and the OPWP. Nama also owns 99.10% of the shares of the Dhofar Power Company.

The Public Authority for Electricity & Water (PAEW) is a governmental institution and has policy and operational roles. The PAEW regulates Oman's water sector and is also a service provider, responsible for supplying the country's drinking water, except in Sohar city and the Dhofar governorate. PAEW's role in the electricity sector is limited to overseeing policy. PAEW is required to take on board the views of the AER on matters related to liberalizing and privatizing the electricity industry, including framing necessary regulations for the water sector. It communicates with the Council of Ministers through the Ministry of National

Restructuring Electricity and Water Sector: Roles and Entities

Figure 6. Oman electricity market structure.



Source: Authority for Electricity Regulation, Oman.

Economy and the Ministry of Finance. Oman's Fuel Diversification Policy envisions a substantive role for non-hydrocarbon fuels in power generation. PAEW is taking steps to promote renewable energy projects and coordinate the efforts to identify the need for establishing general policy frameworks and other support mechanisms for renewable energy in Oman. Royal Decree No. 42/2018, announced on Dec. 18, 2018, transferred all responsibilities related to electricity to the Ministry of Oil and Gas.

The single buyer

The OPWP is currently a monopolistic bulk buyer and seller of Oman's electricity and associated desalinated water. It is a wholly-owned subsidiary of Nama and is mandated with the following responsibilities:

- To secure adequate production capacity and output to meet electricity demand.
- To cooperate with other companies with respect to forward planning.
- To secure the procurement of ancillary services² in coordination with the OETC.
- To purchase, procure and manage production capacity, output and ancillary services on the basis of economic purchases.

The OPWP is required to select new production capacity through a fair and transparent competitive process and by providing a level playing field to local and foreign investors with the requisite expertise.

However, in certain cases, the OPWP can contract new capacity and/or output, of up to 150 MW, through local competition, provided the AER is of the view that no advantage would be derived from conducting an international competitive bidding

process. Further, under the law, the OPWP has the exclusive right to contract for the import and export of electricity as needed.

The OPWP determines the requirement for new capacity for electricity generation during the calendar year and the immediately succeeding seven calendar years, updated on a rolling basis. Unlike power companies in other GCC member countries, the OPWP's generation planning considers the potential for importing and exporting electricity in consultation with other entities. The OPWP, as a single buyer, also assesses the fuel requirements needed to support the continued development of the electricity sector in accordance with the government's National Energy Strategy 2040.

The OPWP buys power from a number of electricity generators through power purchase agreements (PPAs). The contractual arrangements for power delivery under these PPAs can be differentiated as firm capacity, reserve sharing, non-firm capacity, and energy-only. All of the main power plants in the MIS are contractually committed to producing specific generation capacity (measured in MW) upon demand and are dispatched by the OETC. Such firm contracts are also termed 'contracted capacity.' Besides procuring such firm capacity, the OPWP also buys power from a number of other 'non-firm' resources, where contractual arrangements do not provide a guaranteed level of capacity upon demand. Reserve sharing arrangements with other power systems through regional interconnections are treated as non-firm contracts. However, such reserve-sharing agreements provide support during emergencies for specified periods. The other non-firm arrangements include capacity exchanges and energy purchases from industries with embedded captive power generation capacity (on an in-kind basis). Industries mainly use these arrangements to meet their supply needs. The first

right to use any surplus capacity remains with the party having captive generation. However, such industrial consumers are eligible to sell power to the single buyer.

Transmission and dispatch

Electricity transmission and dispatch functions are performed by the OETC, a fully-owned subsidiary of Nama. The OETC owns and operates the MIS and the Dhofar transmission network. The main electricity transmission network operates at 132-kilovolts (kV) and above. The OETC transmission system is also interconnected with the PDO transmission network via a single-circuit 132-kV link that runs between Nizwa on the OETC system and Nahda on the PDO system (OETC 2018). This link has a nominal transfer capacity of around 60 MW and mainly serves to support reserve-sharing between the MIS and the PDO systems. A new 400-kV transmission line with a transfer capacity in excess of 1,000 MW, linking the MIS and PDO power systems, is likely to be commissioned by 2023. This line is expected to be extended to Dhofar, enabling the full integration of electricity capacity planning and operations across the country, leading to potential savings through improved operational efficiencies and other financial benefits. Further, as southern parts of Oman have significant renewable energy potential (wind and solar), this transmission expansion plan can also enable the effective realization of the country's renewable energy potential, including potential electricity export opportunities in the region.

Oman's main transmission system is interconnected with the transmission system of Abu Dhabi through a double circuit 220-kV transmission link at Mahadha. This connection can reliably transfer up to 400 MW, and up to 800 MW in emergencies. This interconnection provides Oman with access

to the power systems of all member states of the Gulf Cooperation Council Interconnection Authority (GCCIA) through the national grid of the United Arab Emirates (UAE). A proposal to construct a direct transmission line between Oman and the GCCIA interconnection in Saudi Arabia is also under consideration. This direct interconnection is likely to obviate the reliance on the UAE's grid for future electricity exchanges with other GCC member countries, thereby offering a more effective integration of Oman's transmission system with the GCC grid.

OETC is a licensed transmission system operator and undertakes dispatch activities in cooperation with the OPWP. It is required to balance demand and supply at all times of the day as part of its responsibilities for the economic dispatch of power in Oman. The OETC's load dispatch center (LDC) dispatches and controls the power output in the MIS and DPS. The LDC creates day-ahead load forecasts, incorporating forecast demand data of distribution companies and large customers connected to the transmission network, weather forecasts, and the availability of day-ahead units from all power plants. These inputs are used to find the day-ahead unit commitment and dispatch schedule using an optimization software based on unit merit order while considering reliability constraints. The LDC communicates the day-ahead plan to the market operator (OPWP) for approval. Once approved by the OPWP, the day-ahead plan is sent to power plants. The LDC may alter the dispatch schedule in real time, based on the actual load and system performance. Being the single buyer of electricity from power plants, the OPWP pays electricity producers for capacity (MW) and energy output (MWh), in accordance with the terms of long-term PPAs. Producers are also requested to provide ancillary services, as per the PPAs.

Distribution and supply

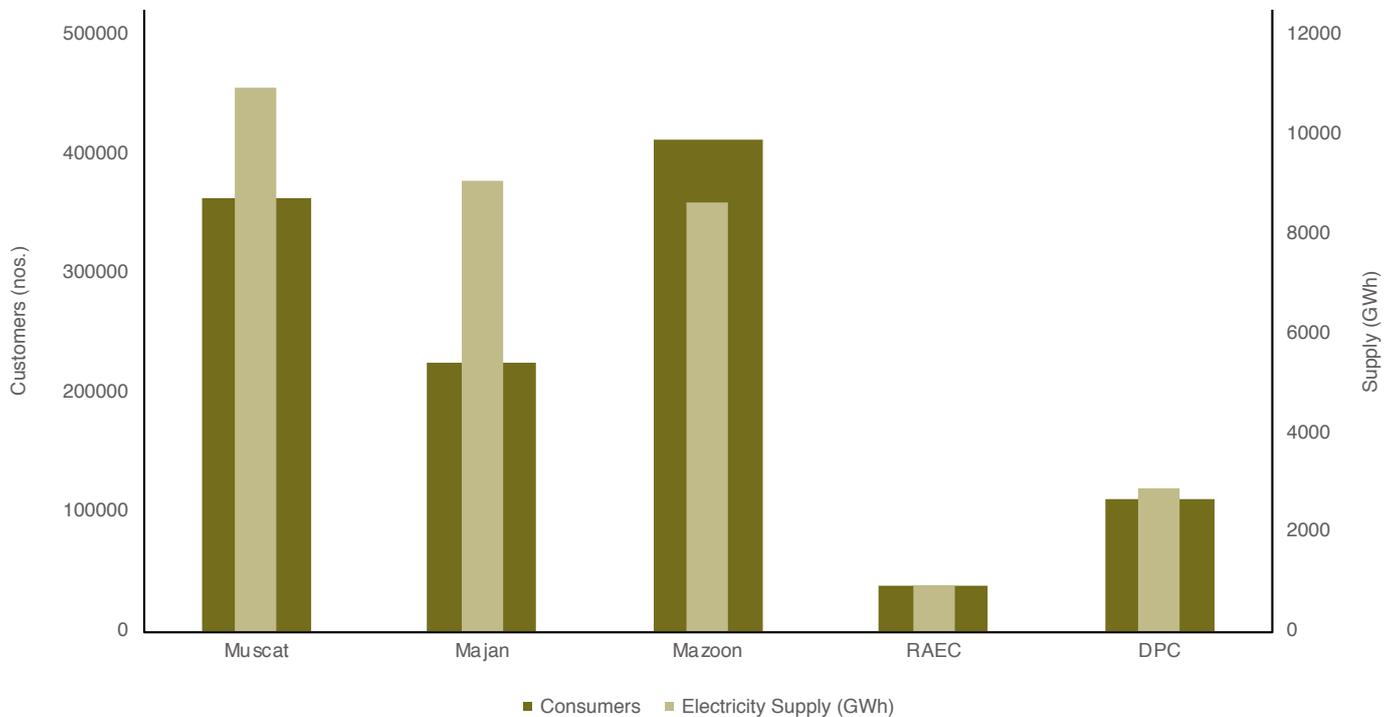
The distribution and supply functions in the MIS are carried out by three wholly-owned subsidiaries of the EHC, namely MEDC, MZEC and MJEC. The Dhofar Power Company (DPC) owns, operates and maintains the distribution network in the Dhofar region of southern Oman. The transmission part of DPC’s business was transferred to OETC in 2014 as part of its restructuring process. The DPC is now a distribution and supply business entity operating in the Dhofar region.

The RAEC is a vertically integrated entity licensed to generate electricity and desalinate water, and transmit, distribute and supply electricity to customers in its authorized area. It is responsible for the electrification of rural areas and for securing funding for electrification through a mechanism

established by Article (87) of the Sector Law. Figure 7 shows the distribution of customer accounts (i.e., the number of electricity consumers) and electricity supply. Residential customers accounted for around 46% of total consumption in 2017, compared to 55.2% in 2005. Compared to 2016, in 2017 supply to industrial customers decreased by around 2.6% and to the government by around 4.2% as an increased (cost reflective) tariff was introduced for large customers in both categories from the start of 2017. Figure 5 shows zonal electricity supply by tariff type. Residential, commercial and industrial categories together account for between 70%-86% of Oman’s total electricity consumption.

The government started liberalizing the electricity and related water sector in 2004 and now plans to sell up to 70% of its stake in the country’s four main

Figure 7. Oman, electricity customers and supply by supplier, 2017.



Source: 2017 Annual Report, Authority for Electricity Regulations, Oman

electricity distribution companies (Muscat, Majan, Mazoon and Dhofar) and to sell a 49% stake in OETC by 2020. In the first phase of the stock sale, expressions of interest are invited only for MEDC and OETC (Nama 2018). Nama's deputy chief executive has been quoted as saying that Nama aims to enhance resource utilization, attract foreign direct investment, reduce costs and share its profits more widely among citizens by part-privatizing its transmission and distribution assets (FT 2018).

Independent water and power producers: selection, ownership and PPA

The liberalization of Oman's state-owned electricity and related water industry was driven by the growing need for investment in new capacity to meet rising electricity demand, as well as the need for structural reforms and subsidy reductions. In common with many other countries, Oman also started opening its electricity generation business to the private sector. It was expected that private sector participation in electricity production would (i) reduce the burden on the state to fund the further development of the power sector, and (ii) bring in better expertise, leading to an improvement in the quality of services, better resource utilization and reductions in the per unit cost of electricity supply. The privatization of Oman's electricity sector started in 1996 when the 90 MW Manah gas-fired power station project was developed on a build-own-operate-transfer basis by the state-backed United Power Company. Manah was the first power plant in the GCC region to include some private capital and was seen as a first step in implementing Oman's policy of increasing the role of the private sector in electricity and water production. In 2002, privately-owned companies were invited to invest in Salalah Power System, now the DPS.

The 2004 Sector Law provided a new framework for regulating and privatizing the electricity and related water desalination sector, requiring the private sector to develop all power generation facilities through a fair and transparent competition process. The Sector Law also required the Electricity Holding Company to sell its shares in all or some of the companies stipulated in Article (66) of this law.

The PAEW was charged with implementing government policy to privatize the electricity and related water sector (since Dec. 18, 2018, it has only been responsible for the water sector). A number of IWPPs have been established to date, which together account for nearly all generation and desalination capacity in the sector (Figure 8). Private investors hold between 60%-65% of the shares in the IWPPs, while the government owns the remainder through the EHC.

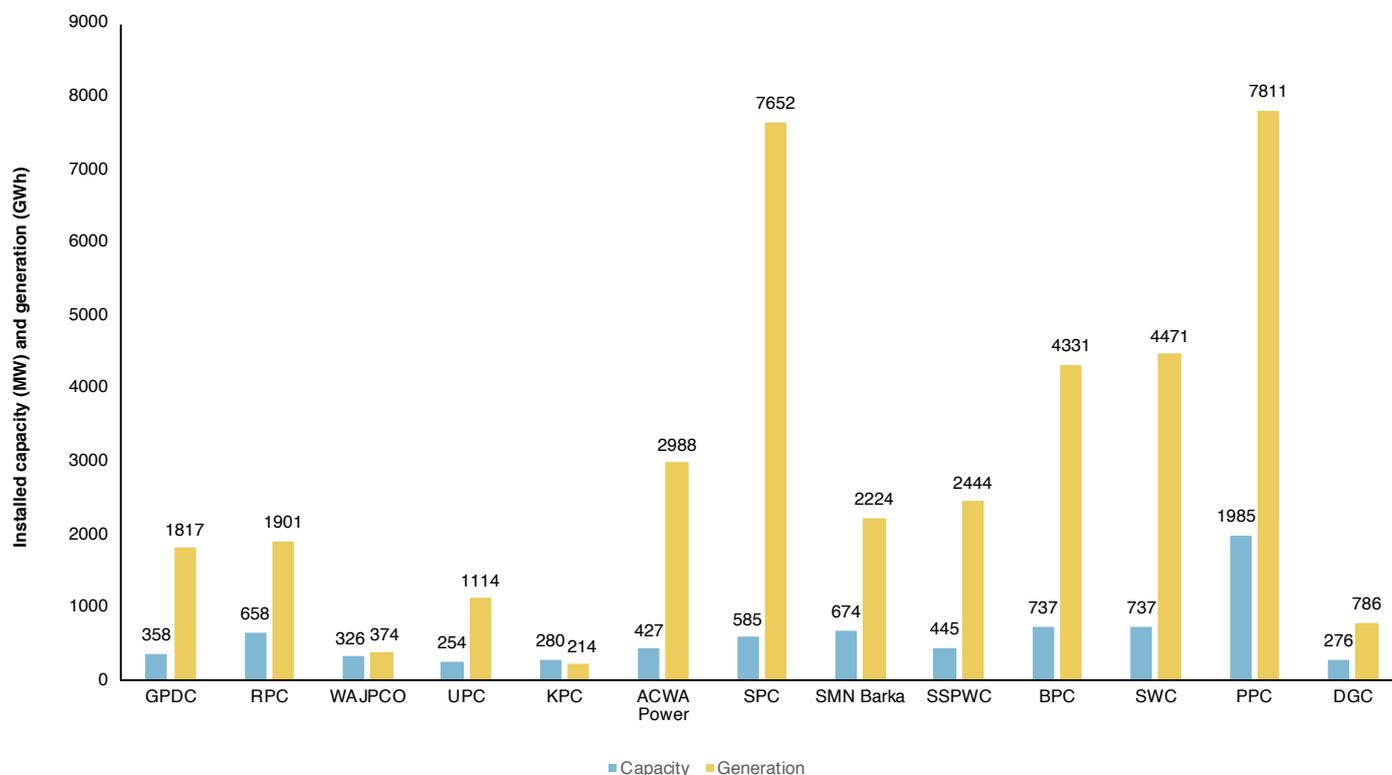
Purchase contracts normally have a duration period of 15 years for IPPs and of 20 years for IWPPs. A new procurement methodology is expected to take effect upon expiry of the current PPAs. Some of the key features are covered in the section of this paper that describes the development of the electricity spot market in Oman.

Regulation, price control and price reforms

The AER is charged with regulating all statutory monopolies established under the electricity and related water Sector Law. These include network companies such as OETC (transmission), Muscat, Majan, Mazoon and DPC (distribution and supply), RAEC, and the single buyer and seller of electricity and water, the OPWP.

The Sector Law provides the AER with a great degree of independence, a regulatory mandate and

Figure 8. Oman installed capacity and generation capacity, by company, 2017.



Note: GPDC (Al Ghubrah Power and Desalination Co.), RPC (Rusail Power Co.), WAJPCO (Wadi Al-Jizzi Power Co.), UPC (United Power Co.), KPC (Al Kamil Power Co.), ACWA Power (ACWA Power Barka), SPC (Sohar Power Co.), SMN Barka (SMN Barka Power Co.), SSPWC (SembCorp Salalah Power and Water Co.), BPC (Al Batinah Power Co.), SWC (Al Suwadi Power Co.), PPC (Phoenix Power Co.), DGC (Dhofar Generating Co.).

Source: 2017 Annual Report for Oman Power and Water Company.

organizational autonomy. In terms of its mandate, the AER is empowered to:

- Monitor the market to ensure fair competition when procuring any new (generation or desalination) capacity.
- Enforce economic purchase conditions.
- Approve the price structure from bulk to retail supply tariffs.
- Issue licenses for undertaking activities in the electricity and related water sector.

Ensure licensee compliance in securing adequate supply.

Monitor the development of the electricity and related water market, and facilitate the privatization of the electricity and related water sector.

Assess the scope for the further liberalization of the electricity and related water sector.

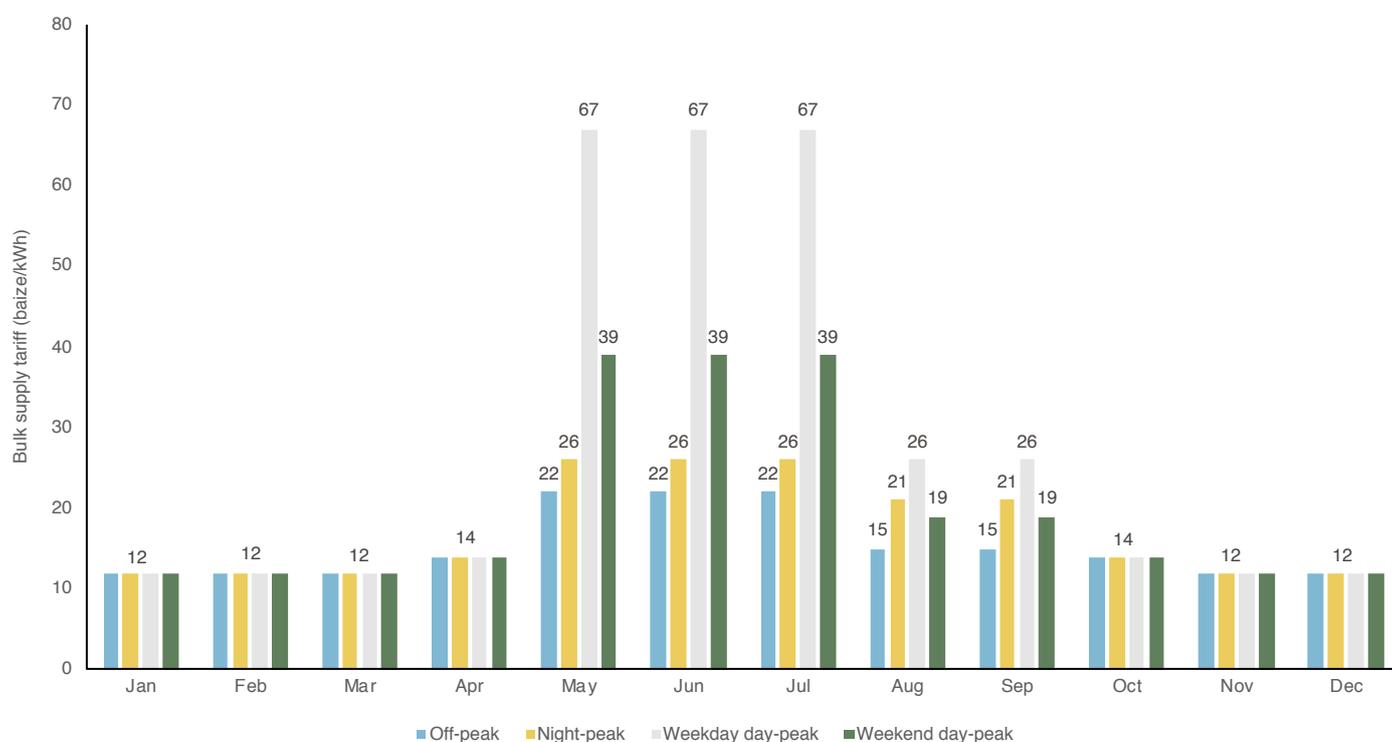
The AER also applies market share thresholds for applicants of any new capacity or to applicants wishing to expand existing capacity, to safeguard

Restructuring Electricity and Water Sector: Roles and Entities

against any market abuse. These stipulate that each generation (or generation/desalination) licensee cannot own more than 25% of the total system's capacity without the AER's consent. Price cap regulation (RPI-X) is used as a principal instrument through which the AER ensures improved efficiency, and limits costs assessed against benchmark service quality standards. It remunerates licensees through these price controls for efficient capital and operating expenditure and a reasonable return on capital. RPI-X rewards licensees for operating more efficiently than the AER's forecast and penalizes those that operate less efficiently. Licensees are subject to a three-year price control period, providing more incentives and flexibility for investing in cost reductions that can result in additional benefits.

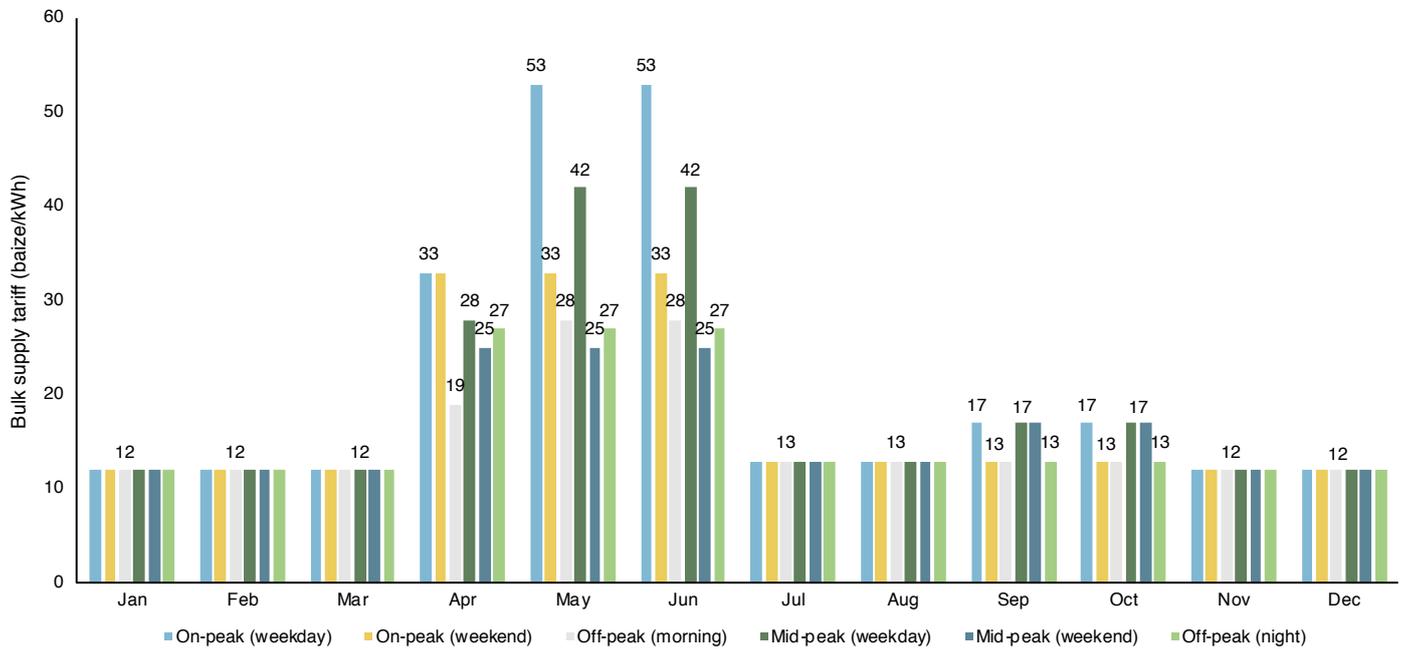
The Bulk Supply Tariff (BST) for the bulk supply of electricity and related water is determined by the OPWP, as per its license conditions and the Sector Law, and are approved by the electricity regulator. The OPWP considers the financial cost of natural gas, as supplied by the Ministry of Oil and Gas, when determining BST levels. The BST structure is based on the marginal cost of encouraging economic efficiency (Albadi 2017). Furthermore, the BST is time-differentiated and comprises of various rate bands. The MIS has four levels for this tariff: off peak, night peak, weekday day peak, and weekend day peak (Figure 9). However, the DPS uses six levels of BST: two off-peak rates for weekdays and weekends, one morning off-peak rate for all days, two mid-peak rates for weekdays and weekends, and one-night off-peak rate for all days (Figure 10). The difference in the MIS and DPS tariffs is due to different demand patterns.

Figure 9. BST rate slabs for MIS, 2017.



Source: Bulk Supply Tariff (Jan. 1, 2017-Dec. 31, 2017), Authority for Electricity Regulation.

Figure 10. BST rate slabs for DPS, 2017



Source: Bulk Supply Tariff (Jan. 1, 2017-Dec. 31, 2017), Authority for Electricity Regulation.

Despite making progress on reforming the electricity sector since 2004, retail tariffs in Oman are still subsidized by the state. To help reduce the growing subsidy burden, in 2016 the Council of Ministers approved the introduction of a new tariff structure, the Cost Reflective Tariff (CRT), designed to reflect the actual costs of providing electricity to large government, commercial and industrial customers with annual consumption of 150 MWh and above. The AER estimated that these large consumers represent 1% of all customers, consume 30% of electricity supply and receive 20% of all electricity subsidies. The introduction of the CRT was also prompted by the government’s 2015 decision to almost double the price of natural gas for power generation. Because the cost of supplying electricity is generally higher during peak hours, the CRT was further designed to reflect the time-of-use to encourage efficient consumption. Unlike the currently permitted tariff that only has one component, the CRT has been designed to have four components:

1. Hourly energy charges referenced to BST.
2. A transmission use of system (TUoS) charge applied to a customer’s contribution to system peak demand. At the current applicable rates, the TUoS is 11,500 Omani riyals (OMR)/MW.
3. A distribution use-of-system (DUoS) charge is applied to each kWh transported across a licensed distribution system to a customer’s premises. At the current applicable rates, the DUoS is 7 baize/kWh consumed for 2018.
4. A supply charge to recover the costs of administering a customer’s account. This charge is paid per electricity meter, and its value has been fixed at 50 OMR/customer for 2018.

The implementation of the CRT was a significant step in reforming retail electricity prices in Oman

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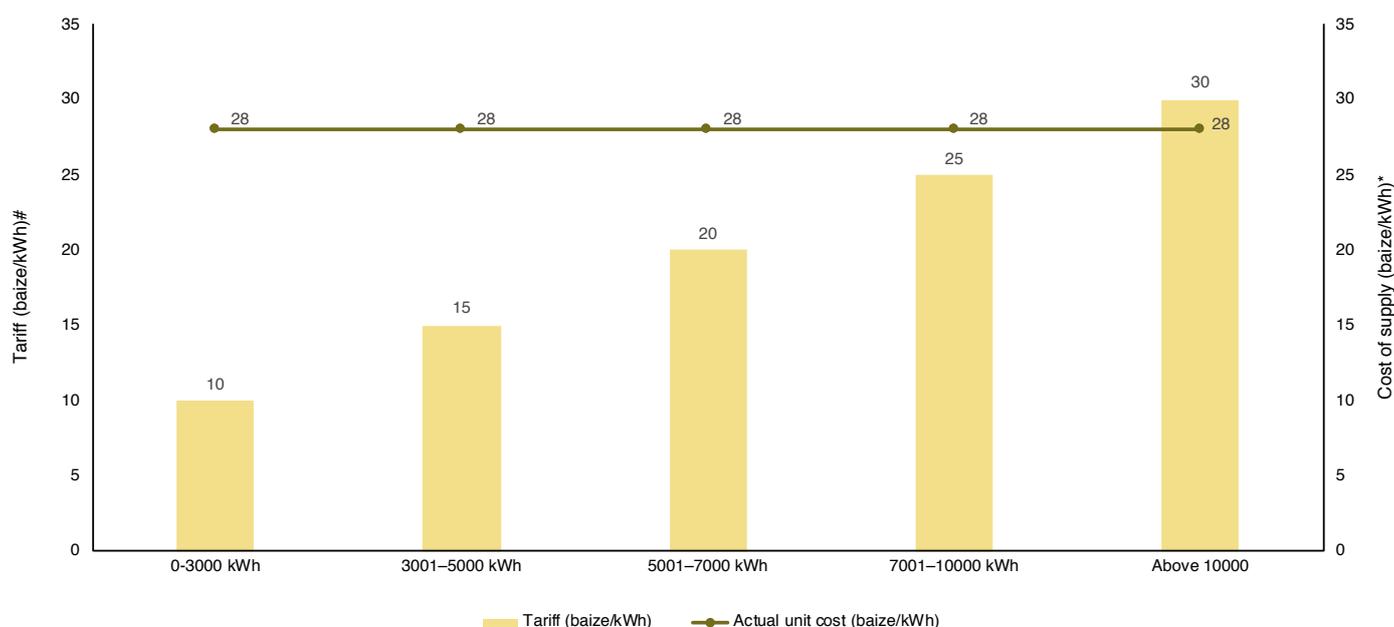
and the Middle East Gulf region. Electricity supply to industrial customers declined by 2.6% in 2017 compared to the previous year as large customers were subjected to higher tariffs. However, residential customers in Oman still continue to pay tariffs for electricity that are below the cost of supply. In the absence of the latest cost of supply numbers for residential consumers, the gap between the current residential tariff and the cost-of-supply is illustrated using cost-of-supply data from 2013 (Figure 11).

In 2017, subsidies to the three major distribution companies in the MIS accounted for nearly 43% of the overall economic cost of supply (836.5 million Omani riyal). The remaining 57% of the costs were recovered from customers through retail rates. Muscat, Majan and Mazoon accounted for 31%, 22% and 57% of the MIS subsidy in 2017, respectively. The variations in subsidy requirements were due to the differences in the

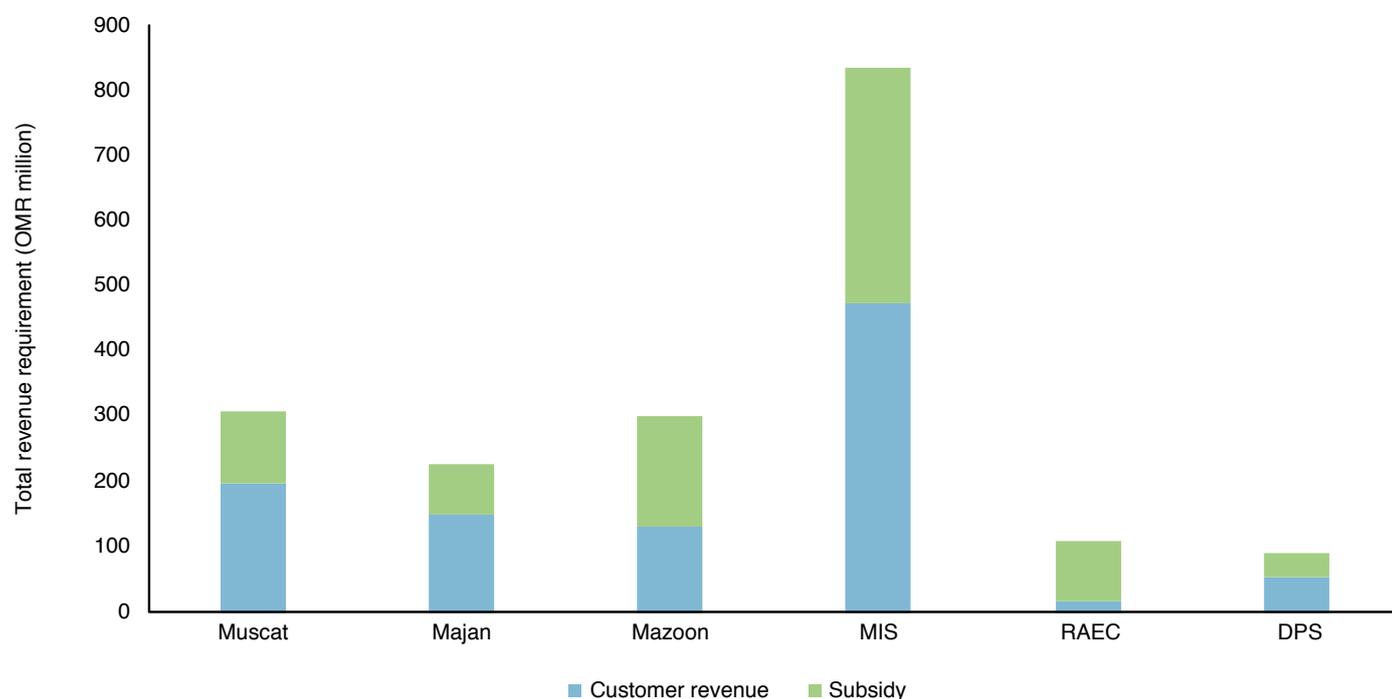
customer mix and the differing characteristics of the various distribution systems. RAEC's share of the subsidies was the highest (~84 %) of the distribution companies when compared with the economic cost of supply (Figure 12).

Enhancing energy efficiency and improving demand-side management are also integral parts of Oman's long-term strategies for the energy sector and, as such, establishing energy services companies has been an area of priority for the AER. The AER plans to roll out a program, based on energy audits of various government buildings, focused on long-term energy conservation and a reduction in government buildings' operational costs. This program will be implemented in phases and is expected to cover auditing and retrofitting of 70% of government buildings (where CRT is applicable) by 2023 (AER 2019).

Figure 11. Gap between the supply cost and the residential electricity tariff .



Source: (i) # Current residential tariff, AER, 2018; and (ii) *Average cost of supply for the year 2013, Electricity Subsidy in Oman (Taqi 2015).

Figure 12. Customer revenue and subsidy by company, 2017.


Source: 2017 Annual Report for Authority for Electricity Regulations, Oman.

Open access to transmission and distribution network

The third-party sale of electricity by I(W)PPs or industries with captive power plants directly connected to OETC's transmission network to parties other than the designated single buyer through the use of transmission or distribution networks is not currently permissible under Oman's existing electricity law. However, OPWP buys power from a number of non-firm resources (e.g., industries with embedded captive power generation capacity, intermittent renewables etc.), where contractual arrangements do not provide a guaranteed level of capacity when needed. The first right to use any surplus capacity remains with the party having captive generation. Further, as part of the government's policy of promoting more use of renewable energy sources, residential consumers are being encouraged to establish small-scale

solar photovoltaic (PV) systems and to put any surplus electricity they generate into the distribution grid at low (240/415 volts) and medium (11 kV or 33 kV) levels. The AER has developed technical and commercial connection guidelines to support the integration of small-scale solar PV with the distribution grid.

Although providing open access (OA) to the grid is an important reform measure for developing a competitive market, it was not introduced at the beginning of the electricity liberalization process in Oman as the country strove to ensure security of supply to cope with rising demand. There is now adequate generation capacity in the Sultanate and electricity demand is not expected to grow significantly in the near future. As such, OA is likely to be introduced as part of widely anticipated new reform measures aimed at further liberalizing the electricity industry and increasing competition.

New Reform Initiatives – Creating a Spot Market

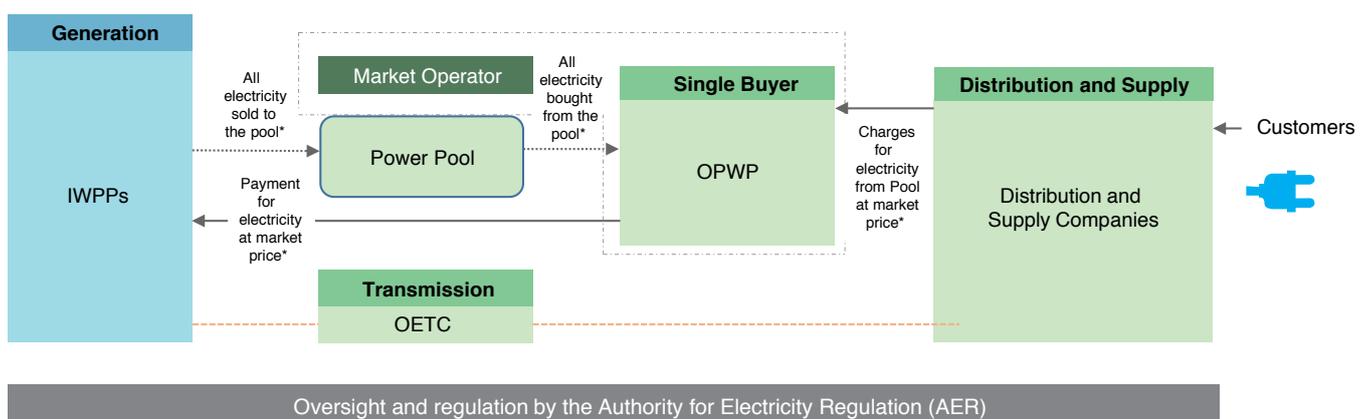
Oman set the trend for electricity market liberalization in the Middle East Gulf region. The country placed a significant focus on engaging the private sector in electricity and water production, along with improving the operational efficiencies of the successor state entities created under the Sector Law. With some of the PPAs now reaching the end of their validity period, the OPWP intends to implement new arrangements for the future power procurement through a spot market, initially only for the MIS. Under the proposed market design, the spot market will operate alongside, and in conjunction with, the existing take-or-pay contracts. All existing electricity producers will have the option to join the spot market when their current contracts expire.

The OPWP is also considering implementing a more flexible process for awarding new PPAs (and PWPAs), aimed at increasing competition, including between new and existing generating plants. This

is expected to increase competition in the power generation market and to provide a mechanism to make additional capacity available that might otherwise be inaccessible to third parties. The spot market is scheduled to begin operational trials in late 2019 and commercial operation in 2020.

On Dec. 24, 2017, the OPWP published a guide on the spot market. The document explains how market rules will be enforced through a multilateral contract (Framework Agreement), which consists of the Market Rules Document, the Market Rules Procedures (MRPs) and the Approved Methodologies. The MRPs provide administrative information on processes that are required for the operation of the wholesale spot market. The Approved Methodologies also provide information on processes required for the operation of the spot market and which require the approval of the AER. All power generators in Oman’s MIS, which are licensed to generate and supply electricity are

Figure 13. Oman’s proposed new electricity market structure.



← Denotes direction of payments

* However, existing generators with valid P(W)PPs will continue to sell electricity and be paid under the terms of their PPAs.

Source: Oman Electricity Market Guide, Version 1. Dec. 24, 2017, OPWP.

required to become a Party to the Market Rules and the arrangements therein, also known as the pool (OPWP 2017). The proposed electricity spot market will only apply to power generation and will not cover the purchase of electricity by customers or distribution companies, which will still take place via the OPWP, or the single buyer, under the Sector Law.

At this stage of the market reform, the AER does not consider the market is ready for licensed electricity producers to sell electricity to entities other than the OPWP. Likewise, no entity other than the OPWP will be permitted to directly engage in the import or export of electricity from or to other countries. Figure 13, presents an overview of Oman's proposed electricity market structure.

Summary and Insights

The liberalization of the Omani electricity sector, which started with the introduction of the Sector Law in 2004, is now poised for further development. Expected changes to the country's electricity market design are aimed at further deepening previous reform initiatives and creating a more competitive electricity industry. The key features, challenges and opportunities for market integration are:

Policy, legislative and governance

The success of the liberalization process is widely attributed to two factors: clear and comprehensive reform legislation; and effective regulatory oversight through an independent regulator. The Sector Law presented a new design for Oman's electricity and related water sector, and clearly articulated the functions and powers of the successor entities created under that law. The legislation provided a clear outline of the different parties' roles in policy design and the implementation, regulation and governance, planning, production, procurement and supply of electricity.

Oman's electricity market design followed a single buyer model, but the Sector Law provided the scope to expand the reform process. Under the subheading Liberalisation of the Electricity Market, the Sector Law detailed the avenues this expansion could take i.e., (i) disposal by the government of any economic interest in the electricity sector, (ii) permitting the sale of electricity by licensed generators to any party other than the single buyer, (iii) permitting the import or export of electricity by any party other than the single buyer and the RAEC, and (iv) creation of competition amongst licensed suppliers, including those that are not licensed distribution system operators in relation to the supply of electricity (Government of Oman 2004).

The next level of structural and institutional reform in the electricity sector is likely to be along these lines and is expected to further ease cross-border electricity trading and market integration.

Regulation

The Sector Law established the AER as an independent entity responsible for the public interest regulation of the electricity sector and some aspects of the water sector. The statutory functions and duties of the AER are designed to ensure the sector operates in accordance with the interests of customers, investors and the government (AER 2005). This requires balancing the competing interests of the market actors independently and objectively without conflicts of interest, bias or influence (OECD 2016). The financial and administrative autonomy provided under the Sector Law has helped the AER to regulate the sector independent from the government. The financial resources needed by the AER are raised through license fees, interest and other income, and are not provided by the government through any direct budgetary allocation. Furthermore, there is no government representation in the governance structure of the AER. The regulator's financial and administrative independence has played an important role in building confidence among market players.

The AER has also been given a wider mandate that includes (i) regulation of the electricity sector (and some aspects of the water sector) in an economic manner; (ii) ensuring compliance by licensees in securing adequate supply; (iii) ensuring fair and transparent competition when the single buyer is procuring new (generation or desalination) capacity and output; (iv) approving the price structure from bulk to retail supply; (v) issuing licenses to undertake activities in the electricity and related

water sector; (v) monitoring the development of the electricity and related water market, and facilitating the privatization of the electricity sector; (vi) advising on policy matters (Government of Oman 2004).

The AER's statutory obligations also include assessing the scope for the further liberalization of the electricity and related water sector and advising the government on deepening its reform initiatives. In order to meet this statutory requirement, the AER prepares and presents its vision for the electricity sector by (i) preparing the Forward Work Programme, which sets out the principal areas of work for the coming year, and (ii) assessing how to implement the four liberalization measures identified in the Sector Law (Government of Oman 2004). In regulating the electricity sector, the AER has followed RPI-X revenue cap regulation, defining the maximum allowed revenue for each year of the price control period and adjusting it by a factor X to reflect the potential cost savings of the regulated companies, due either to increased efficiency or technological improvements. Power producers recover the costs of electricity procurement through approved cost-reflective electricity and water bulk supply tariffs, subject to a revenue limit determined by the price control formula. Challenges to price controls have been addressed through innovations in the regulatory price control mechanism but the basic form of the price control has remained the same. A fair and transparent regulatory regime has helped to encourage greater private sector participation and build a competitive electricity market in Oman. A competitive wholesale electricity market with a larger presence of IPPs is likely to enable future cross-border electricity trading.

Market design

Oman's electricity market design is characterized as a capacity market model, where generators receive

capacity charges from the OPWP for their plants' contracted power capacity. The capacity charges enable the recovery of debt service and other fixed costs, including fixed operating and maintenance costs, insurance costs, taxes and capital returns. IWPPs are also paid variable output charges corresponding to the available power plant capacity. Fuel costs are based on the actual consumption of natural gas and are a pass-through (i.e., recovered from the consumers through retail tariffs), subject to the compliance with minimum efficiency norms as set by the regulator.

The OPWP as a single-buyer and guarantor of all offtake of power outputs pays the capacity charges to IWPPs irrespective of whether power is actually produced and dispatched. Although such contractual agreements have minimized power producers' investment risks through stable and predictable cash flows, exclusivity provisions in PPAs with the OPWP could hinder the development of a more competitive wholesale electricity market in Oman. A new market design is likely to be introduced soon to deal with such challenges. Preparations are currently underway for the introduction of a spot market by 2020 (initially for the MIS only). Market liquidity is likely to be helped by the increased transparency in generation scheduling, the effective utilization of off-contract generation capacity, the provision for capacity expansion in PPAs, enhancing the residual value of generators with expired P(W)PAs and providing greater flexibility to new generators in the spot market, which should facilitate cross-border electricity trading.

Under the proposed new market design, electricity purchase terms for power producers with valid PPAs will remain unchanged in the spot market. All other non-contracted power producers will be paid as per the market clearing prices discovered in the spot market. Future norms for contracted capacities

Summary and Insights

may also be relaxed, whereby only a portion of the capacity can be offered as firm contracts, with the remainder offered for sale through the spot market. Necessary license modifications for generation companies have been completed in preparation for the implementation of a spot market. A similar exercise for OPWP and OETC is underway.

Oman's electricity distribution companies currently serve all types of consumers within their areas of operation. A new business model with separate energy suppliers other than the existing distribution companies is also likely to be introduced. Such new market arrangements are expected to put increased competitive pressure on electricity producers and force the distribution companies to facilitate effective and well-functioning retail markets.

Market Integration

Oman's power system is not fully integrated. The largest part of the system, the MIS, covers the northern part of the country. The smaller DPC system serves areas in the south, which also have significant wind energy potential. The rest of the country is supplied by the RAEC, largely through its 395 MW of diesel-based generation plants. The lack of interconnections between the isolated parts of the power system has constrained operational efficiencies and other financial benefits, e.g., from the displacement of diesel-based generation by

the RAEC that could be achieved through a well-connected national grid.

In order to be able to trade electricity with other countries in the region, Oman needs to build additional infrastructure around the GCC Interconnector connecting Oman and Abu Dhabi, which currently has a limited reliable transfer capacity of 400 MW. A proposed transmission line linking Oman and Saudi Arabia is likely to obviate the reliance on UAE's grid for electricity exchanges with other GCC countries. Because Oman's electricity demand is more diverse than its neighbors' a fully interconnected system would offer the sultanate the option of selling its surplus electricity to other countries in the region.

Current projections suggest that Oman is likely to have adequate generation capacity in the future, given moderate electricity demand growth rate forecasts. As the government wants to extend electricity market reforms, Oman is likely to allow open access to its transmission network to generators and other potential beneficiaries. Such developments are likely to support the country's ongoing efforts to develop a well-functioning regional electricity market. Moreover, as peak electricity demand in Oman normally occurs in May and June, whereas peak demand in most neighboring countries is in July and August, Oman will have the opportunity to trade electricity within the GCC region.

Endnotes

¹ The northern region of Oman covers the Governorates of Muscat and Buraymi, most of the Governorates of Al Batinah North, Al Batinah South, Ad Dakhiliyah, Ash Sharqiyah North, Ash Sharqiyah South and Ad Dhahirah.

² Ancillary services refer to a variety of operational services beyond electricity production that are required to maintain grid stability and security. These services generally include black start capability (i.e., the ability to restart a grid following a blackout), frequency control (to maintain system frequency with automatic and fast responses), fast reserves (which can provide additional energy when needed), reactive power compensation and other services. Generators have traditionally provided such services as and when needed by the grid operator.

³ RPI-X regulation refers to the form of price cap regulation, where prices are adjusted for the previous year's price inflation and for expected efficiency improvements (X) during the price control period. In RPI-X regulation, the rate of inflation is measured by the retail price index (RPI), and factor X to reward the efficiency improvements.

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Notes

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About the Project

Mindful of the potential opportunities that could be harnessed by developing a common electricity market in the GCC and wider MENA region, KAPSARC has initiated a regional electricity market integration research project. It examines a range of issues relating to electricity market integration, including experiences of other power pools and their potential application for this region. The project will focus on understanding and examining the policy and legislative, market design and structure, regulatory and system operation dimensions of electricity markets, to identify good practice arrangements and to provide insights into policy and regulatory issues. The various outputs are intended to fill existing knowledge gaps and facilitate ongoing efforts toward regional electricity market integration.



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