OMAN POWER AND WATER PROCUREMENT CO. (SAOC)

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OPWP's 7-YEAR STATEMENT

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GLOSSARY

AER	Authority for Electricity Regulation, Oman
BTU/scf	British thermal units per standard cubic foot
CCGT	Combined-cycle gas turbine
DGC	Dhofar Generating Company
DGW	Directorate General of Water (Office of the Minister of State and Governor of Dhofar)
DPC	Dhofar Power Company (SAOC)
DPS	Dhofar Power System
GJ	Gigajoule(s)
GPDC	Al Ghubrah Power and Desalination Company (SAOC)
GCCIA	Gulf Cooperation Council Interconnection Authority
HHV	Higher Heating Value
IPP	Independent power project
IWP	Independent water project
IWPP	Independent water and power project
kWh	Kilowatt hour(s)
LOLH	Loss of load hours
m^3	Cubic metre(s)
m^3/d	Cubic metres per day
MEDC	Muscat Electricity Distribution Company (SAOC)
MIGD	Million imperial gallons per day
MIS	Main Interconnected System
MISC	Majis Industrial Services Company (SAOC)
MJEC	Majan Electricity Company (SAOC)
MOG	Ministry of Oil and Gas
MSF	Multi-stage flash (desalination technology)
MW	Megawatt(s)
MZEC	Mazoon Electricity Company (SAOC)
OCGT	Open-cycle gas turbine
OETC	Oman Electricity Transmission Company (SAOC)
OPWP	Oman Power and Water Procurement Company (SAOC)
PAEW	Public Authority for Electricity and Water
PDO	Petroleum Development Oman (LLC)
RE	Renewable Energy
PPA	Power purchase agreement
PWPA	Power and water purchase agreement
RAECO	Rural Areas Electricity Company (SAOC)
RO	Reverse osmosis (desalination technology)

Sm^3	Standard cubic metre(s)
Sm^3/d	Standard cubic metres per day
Twh	Terra Watt Hours

OVERVIEW

This Statement provides a 7-year outlook for power and desalinated water supply in the two main systems of Oman – the Main Interconnected System (MIS) and the Dhofar Power System (DPS) – and the systems of Ad Duqm and Musandam. OPWP prepares the 7-Year Statement annually in accordance with Condition 5 of its license. This is Issue 12, for the period 2018 to 2024; previous issues and additional information are available on the OPWP website at www.omanpwp.com.

A salient feature of this edition of the 7-Year Statement is OPWP's plan to implement the Fuel Diversification Policy that was adopted by the Government's Financial and Energy Resources Council in December 2017. In accordance with this policy, OPWP plans to procure 2,600 MW of renewable energy (RE) projects and the Sultanate's first Clean Coal IPP, to be operational within this seven-year period. These projects will reduce commitments of natural gas to the electricity sector, enabling gas supply to new industrial projects that will boost economic growth.

Demand for Electricity

In the MIS, peak demand is expected to grow at about 6% per year, from 6,116 MW in 2017 to 9,010 MW in 2024. This growth rate is similar to the previous forecast. It includes an estimate of the impact of cost reflective tariffs that were introduced to large consumers in January 2017. Energy consumption is expected to grow at 7% per year.

High and Low demand scenarios are also considered. The Low Case projects 4% annual growth in peak demand, to be 8,100 MW in 2024, about 900 MW below Expected Demand. The High Case projects 8% annual growth and peak demand at 10,510 MW in 2023, exceeding Expected Demand by about 1, 500 MW.

In Dhofar, peak demand is expected to grow at 6% per year, from 552 MW in 2017 to 810 MW in 2024. The Low Case considers 4% growth, reaching 740 MW by 2024, about 70 MW below Expected Demand. The High Case projects 8% per year growth to 950 MW in 2024, exceeding Expected Demand by about 140 MW.

Power Generation Requirements

In the MIS, the major developments include an ambitious development program for RE projects, a 400 kV transmission connection to the PDO System and Ad Duqm, and procurement of the Sultanate's first Clean Coal IPP. The transmission connection to PDO and Ad Duqm is expected to be available by 2023, subject to agreement of the respective stakeholders. This will further stimulate development of the Special Economic Zone of Ad Duqm and development of RE projects in Al Wusta."Project developments through 2024 in the MIS are expected to include: (1) retirement of the Ghubrah and Wadi Jizzi plants in 2018; (2) completion of Sohar III IPP (1708 MW) and Ibri IPP (1508 MW) in 2019; (3) extension of the Manah PPA under new ownership in 2020; (4) launch of a Demand Response program to contribute capacity of 30 MW in 2020 and expanding to 100 MW by 2024; (5) addition of Ibri II Solar IPP (500 MW) in 2021; (6) launch of the spot market for electricity trade in 2020; (7) at least 700 MW of capacity procured via the Power 2022 process as extensions to expiring P(W)PAs or as new capacity, whereas some plants with contracts expiring in 2022 may continue to operate, uncontracted, as participants in the spot market; (8) additional solar IPP projects will begin operation in 2022, 2023, and 2024; (9) a Waste-to-Energy IPP (about 50 MW) to begin commercial operation in 2022; and (10) the Power 2024 procurement process will provide for further P(W)PA extensions and/or new capacity in 2024.

In the DPS, the Salalah II IPP (445 MW) began commercial operation on schedule in January 2018. The first wind IPP (50 MW) is expected to begin commercial operation in 2020, to be followed by Dhofar II Wind IPP (150 MW) in 2023. Extension of the North-South 400 kV Interconnect to the DPS may also occur by 2024, subject to final regulatory approval, providing for greater grid security and improved utilization of generation resources.

In Ad Duqm, OPWP plans several projects to be completed within the forecast period, including (1) two separate wind IPPs of about 200 MW each for operation in 2023 and 2024, respectively, and (2) commercial operation of the first 600 MW block of the Duqm Clean Coal IPP as Early Power in 2024.These plans remain subject to final regulatory approval.

Musandam IPP (123 MW) began operation in May 2017. OPWP plans no further IPPs in Musandam during this period.

Fuel Requirements

OPWP projects that fuel diversification plans, including RE development and the Duqm Clean Coal IPP, will enable the gas share of fuel for power generation to fall from 100% in 2018 to 83% by 2024.

In the MIS, efficiency improvements in the generation fleet and the contributions of RE and Clean Coal IPP projects are expected to limit growth in fuel requirements to 0.5% per year on average through 2024, despite steady 7% annual growth in electricity production. Average gas utilization by the generation fleet (Sm^3 consumed per MWh produced) is projected to improve by 20% from 2018 to 2024. Much of these efficiency improvements will occur by 2020, with the introduction of new high-efficiency power plants and large RO water desalination plants that enable less energy-efficient MSF plants to shift to standby operation.

In Dhofar, gas requirements are projected to increase at 6% per year, as power demand grows at 7% per year. The projections include the impact of wind IPPs planned in 2020 and 2023, which reduce gas requirements by about 10%.

The aggregate gas requirements of the MIS and DPS are projected to increase at an average annual rate of 1.2%, from 22.2 MM Sm^3/day in 2017 to 24.1 MM Sm^3/day in 2018.

Desalinated Water Requirements

Peak water demand in the Main Interconnected System (MIS) is projected to increase at 7% per year, from 974 thousand m^3/d in 2017 to around 1,580 thousand m^3/d in 2024. In the Sharqiyah Zone, water demand is expected to increase at 6%, from 114 thousand m^3/d in 2017 to 175 thousand m^3/d in 2024.

In the MIS, developments include: (1) retirement of Ghubrah IWPP desalination units in Q3 2018; (2) addition of Qurayyat IWP (200,000 m^3/d, 44 MIGD) in Q2, 2018; (3) addition of Barka IV IWP (281,000 m^3/d, 62 MIGD) in April 2018, enabling the Barka IWPP MSF units to shift to standby mode; (4) addition of Sohar III IWP (250,000 m^3/d, 55 MIGD) in Q1, 2019; (5) addition of Ghubrah III IWP (300,000 m^3/d, 66 MIGD) in 2022; (6) addition of Wadi Dayqah IWP (up to 125,000 m^3/d, (27.5 MIGD) in 2022; (7) extension of (P)WPA of Barka IWPP, or addition of new capacity, of 101,000 m^3/d, (22 MIGD) in 2022; (8) Sohar IWPP contract expiration in 2022; (9) new desalination capacity of 150,000 m^3/d (33 MIGD) in the North Batinah region, in 2023; and (10) extension of the (P)WPA of Barka II IWPP, or addition of new capacity, of 120,000 m^3/d (26 MIGD) in 2022.

In the Sharqiyah Zone, developments include: (1) addition of 10,000 m^3/d (2.2 MIGD) temporary water supply at Aseelah in June 2018; and (2) addition of Aseelah IWP (80,000 m^3/d, 18 MIGD) in 2021. Further south in Ash Sharqiyah South Governorate, OPWP expects to procure the Massirah IWP (10,000 m^3/d, 2.2 MIGD) for operation in 2023 on Massirah Island subject to confirmation of capacity requirements and regulatory approval

In Dhofar, DGW projects water demand to grow at 9%, and peak water demand to increase from 138,000 m^3/d in 2017 to 253,000 m^3/d in 2024, including network demand as well as water requirements in the Jabal and Sahal areas where DGW aims to expand its network. Developments include (1) addition of the Salalah III IWP (114,000 m^3/d, 25 MIGD) in 2020, and (2) addition of the Dhofar Water 2023 IWP (100,000 m^3/d, 22 MIGD) in 2023.

In Musandam, OPWP has initiated procurement of Khasab IWP (16,000 m^3/d, 3.5 MIGD), for operation in 2022.

Procurement Activities

The main procurement activities for power in 2018 include: (1) Ibri II Solar IPP (RFP in Q2), (2) Power 2022, which includes the asset sale of Manah IPP (RFQ in Q3) and competition among both existing plants and new capacity bidders for new P(W)PAs (RFQ in Q1 for stage 1 and Q3 for stage 2), (3) Duqm Clean Coal IPP, if approved (RFQ in Q2), (4) Waste-to-Energy IPP, if approved (RFQ in Q4), and (5) Solar IPP 2022 (RFQ in Q4). Beyond 2018, future procurement initiatives include additional RE IPPs, and Power 2024.

The main procurement activities for water in 2018 include: (1) Khasab IWP (RFP in Q2); (2) Ghubrah III IWP (RFQ in Q1); (3) New Barka IWP (RFQ in Q2, only if Barka IWPP is not extended), (4) North Batinah IWP (RFQ in Q2); (5) Wadi Dayqah IWP (RFQ in Q3); (6) Dhofar Water 2023, if approved (RFQ in Q4), and (7) Massirah IWP (RFQ in Q4). Beyond 2018, future procurement initiatives include extension of the Barka II water purchase contract or procurement of equivalent new capacity.

SECTION 1 POWER

1.1 MAIN INTERCONNECTED SYSTEM

The Main Interconnected System (MIS) extends throughout the Governorates of Muscat and Buraymi, and most of the Governorates of Al Batinah North, Al Batinah South, Ad Dakhiliyah, Ash Sharqiyah North, Ash Sharqiyah South and Ad Dhahirah, serving around 938,100[1] electricity customers.

The MIS comprises thirteen power generation facilities, owned and operated by separate companies; the 400/220/132 kV transmission grid, owned and operated by Oman Electricity Transmission Co. (OETC); and three distribution networks, owned and operated by Muscat Electricity Distribution Co. (MEDC), Mazoon Electricity Co. (MZEC) and Majan Electricity Co. (MJEC). The three distribution network operators also act as "licensed electricity suppliers", supplying existing and new electricity customers in their respective service areas. The MIS is interconnected with the power system of Petroleum Development Oman (PDO), and with the power system of the Emirate of Abu Dhabi and other Member States of the GCC Interconnection Authority via the Abu Dhabi Interconnect.

OPWP's role is to aggregate the power and desalinated water requirements of licensed electricity suppliers and water departments, and to economically procure the required power and desalinated water in bulk from generation/production facilities connected to the MIS and water transmission systems. OPWP is required to ensure that sufficient power generation resources are available to meet licensed electricity suppliers' demands. Wherever beneficial, OPWP co-procures desalinated water to meet the needs of water departments in joint power-water facilities, and procures stand-alone desalinated water facilities upon the direction of PAEW in accordance with Article 78 of the Sector Law.

DEMAND FOR ELECTRICITY

OPWP evaluates electricity demand at the system level, including transmission and distribution system losses with consumer-level loads. This equates to the output of power generation plants at the power system delivery point(s), excluding the internal power consumption of auxiliary systems.[2] OPWP follows a similar approach with respect to estimating water demand, the output of desalinated water plants, and the consumption of auxiliary systems of combined power and water plants.

Historical Demand

In 2017 electricity demand grew at a relatively slow pace compared to the historical average, and was consistent with the OPWP forecast. Peak demand increased by about 3.3% to 6,116 MW, while average demand increased by 6.4% to 3,578 MW (corresponding to 31.3 TWh of energy). This reflects the impact of the reduced economic growth that began in 2015. The lower growth rate of

[1] AER Annual Report 2016

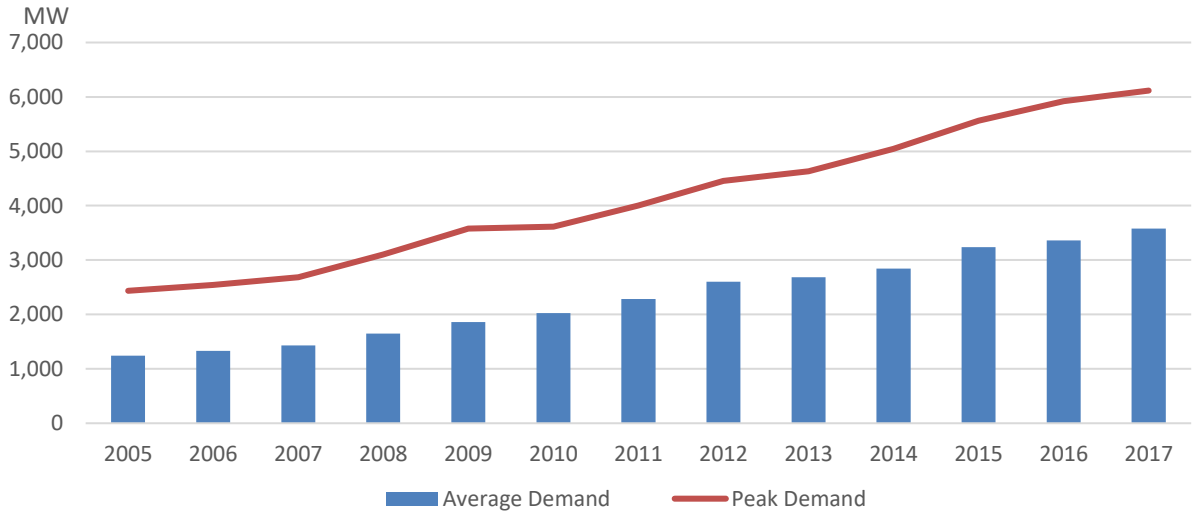
[2] This approach assures equivalence toward planning the generation supply required to meet consumer demand. However, from the perspective of power system operations, electricity demand and output are monitored at available metering points located at substations and power plants. The system "gross demand" at any point in time is the sum of the metered output at all power generators, although a portion of that generator output must be consumed by plant auxiliary systems. System peak demand is considered as net of plant auxiliaries and any exports to other power systems. The hourly consumption of plant auxiliary systems is not measured directly at some plants and in these cases must be estimated. Consequently, there may be differences in peak demand reports, depending on how auxiliary consumption at each plant is estimated.

peak demand also reflects the impact of Cost Reflective Tariffs that were introduced to large industrial, commercial and government consumers in 2017.

Over the last 7 years, peak electricity demand in the MIS grew at an average annual rate of about 7%, from 3,613 MW in 2010 to 6,116 MW in 2017. Energy consumption and average demand grew by about 8.5% annually during the same period. Single year growth rates have fluctuated widely, influenced strongly by weather and economic growth: annual peak demand growth has ranged from a low of 0.9% to a high of 15.6% over the past 12 years.

Figure 1 illustrates the growth in peak and average demand in the MIS from 2005 to 2017.

Figure 1 Historical Electricity Demand – MIS



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average Growth (%)
Historical Demand														
Average Demand (MW)	1,240	1,329	1,430	1,646	1,859	2,028	2,285	2,599	2,684	2,845	3,237	3,364	3,578	
Growth (%)		*7.2%*	*7.6%*	*15.1%*	*12.9%*	*9.1%*	*12.7%*	*13.8%*	*3.3%*	*6.0%*	*13.8%*	*3.9%*	*6.4%*	*9.3%*
Peak Demand (MW)	2,435	2,544	2,682	3,100	3,581	3,613	4,000	4,455	4,634	5,047	5,565	5,920	6,116	
Growth (%)		*4.5%*	*5.4%*	*15.6%*	*15.5%*	*0.9%*	*10.7%*	*11.4%*	*4.0%*	*8.9%*	*10.3%*	*6.4%*	*3.3%*	*8.1%*

Demand Projections

OPWP's 7-year electricity demand projections for the MIS have been developed on the basis of: (1) quantitative analyses of weather and macroeconomic demand drivers; (2) consultations with the electricity distribution companies and other relevant entities such as large industries; (3) historical growth trends; and (4) assessment of past forecasts against out-turns.

The projections cover energy, average demand, and peak demand requirements. Peak demand is most relevant for purposes of assessing capacity expansion requirements. The projections of energy demand are necessary to identify fuel requirements over the forecast period.

The projections are derived principally from scenarios of economic growth in the Sultanate. They are then aligned with analyses of distribution system demands, which are assessed on a "macro" basis by distribution company zone, and certain bulk loads that are assessed on a specific customer basis. Distribution system demand is comprised mainly of residential, service sector (including government and commercial buildings, tourism facilities), and small- to medium- scale industrial demand in all MIS regions.

The growth in demand from very large loads (generally large industries and infrastructure projects) comprises both new projects and expansion of existing industrial plants. Industrial projects are located mainly in the Sohar Industrial Port and Sohar Free Zone. Infrastructure projects include, for example, the stand-alone desalination plants and airports.

The projections are presented as a range bounded by Low Case and High Case scenarios, and a central Expected Demand forecast. These are summarized in Figure 2.

The three scenarios for electricity demand growth are linked to projections of the Sultanate's economic growth, specifically to the growth trend in Gross Domestic Product (GDP). Economic growth slowed following the fall in oil prices in 2014 and 2015. The International Monetary Fund (IMF) estimated 2017 GDP growth in Oman to be 0% in real terms,[3] although this may be amended once final 2017 data becomes fully available. The IMF expects 3-4% GDP growth in 2018, dropping gradually to 2.2% annual growth in 2020. OPWP assumes a long-term range for annual GDP growth from 2.5% to 3.5%, as determinants for the Low, Expected, and High scenarios for electricity demand.

The central, Expected Demand scenario projects 7% annual growth in energy demand (i.e, average demand). Peak demand is projected to increase at an annual average of 6% per year, from 6,116 MW in 2017 to 9,010 MW in 2024.

In January 2017, Cost-Reflective Tariffs (CRT) were introduced for large commercial, government, and industrial consumers. The CRT is time-differentiated, and reflects the cost of supply by season and time of day: higher costs during peak and summer periods, and lower costs during off-peak and winter periods.

Some large customers have shifted their demand in response to the new tariff. We have studied the impact of CRT in 2017 for grid-connected customers and estimated a reduction of about 130 MW in peak demand. We expect more CRT impacts to develop over the coming years, as consumers take time to adapt to high daytime summer prices. The Expected Demand scenario includes a CRT impact of about 500 MW by 2024. Policy development will also affect the pace and extent of consumer

[3] International Monetary Fund, October 2017.

response to CRT, such as whether tariff reform is extended to other consumer categories, and whether energy efficiency promotion or standards programs are implemented.

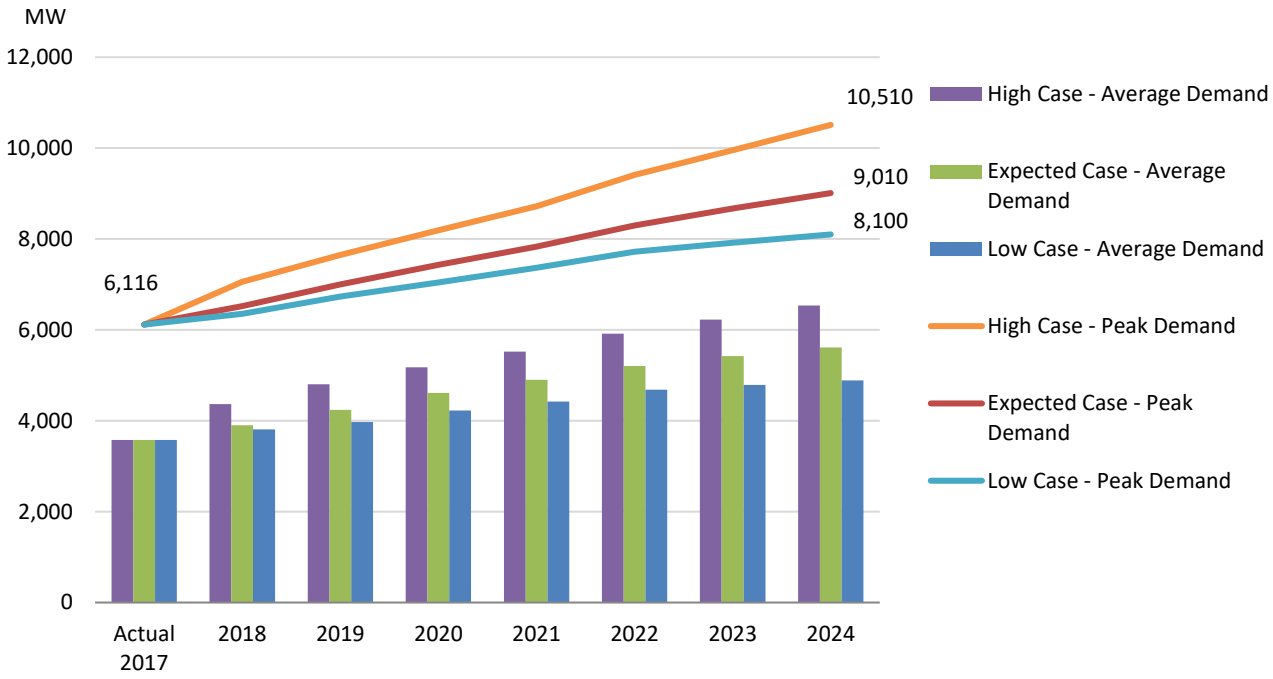
The Expected Demand projection is slightly lower than that in the previous 7-Year Statement (Issue 11), due to current expectations of economic growth and the effect of CRT. This scenario assumes GDP growth of about 3.7%, 2.9%, and 2.2% in 2018, 2019, and 2020 respectively, rising to an average of about 3% for the balance of the forecast period to 2024.

The Low Case scenario projects peak demand growth at 4% per year (on average), from 6,116 MW in 2017 to 8,100 MW in 2024. The energy growth rate is 5% per year. This follows an assumption of more modest economic growth than the Expected Demand scenario, at about 2.5% GDP growth. Also, the Low Case assumes greater CRT impacts: more than 650 MW by 2024.

The High Case scenario projects peak demand to grow at 8% annually, to 10,510 MW in 2024. The energy growth rate is 9% per year. These higher growth rates correspond to more robust GDP growth at about 3.7% on average for the forecast period. This would be similar to previous business cycle upswings, such as the 7-year period prior to 2011. The High Case assumes a lower CRT impact compared to other scenarios, about 450 MW by 2024.

The three demand projections are reference scenarios assuming normal weather conditions. Extreme weather may occur in any year, potentially increasing or decreasing peak demand up to 220 MW against the projected peak demand. These potential fluctuations are not shown in the demand forecast, as they do not affect the underlying multi-year trend. However, they are taken into account in the assessment of capacity requirements.

Figure 2 Electricity Demand Projections – MIS



	Actual 2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Expected Case Demand									
Average Demand (MW)	**3,578**	**3,899**	**4,241**	**4,614**	**4,905**	**5,203**	**5,421**	**5,614**	**7%**
Distribution Loads	3,157	3,309	3,471	3,634	3,835	4,033	4,211	4,384	5%
Directly-Connected Loads	421	590	770	980	1,070	1,170	1,210	1,230	17%
Annual Energy (TWh)	**31**	**34**	**37**	**41**	**43**	**46**	**47**	**49**	**7%**
Peak Demand (MW)	**6,116**	**6,520**	**7,000**	**7,430**	**7,830**	**8,300**	**8,670**	**9,010**	**6%**
Change from 2017-2023 Statement (MW)	*56*	*-30*	*-160*	*-150*	*-240*	*-220*	*-290*	-	-
Low Case Demand									
Average Demand (MW)	**3,578**	**3,808**	**3,973**	**4,222**	**4,420**	**4,682**	**4,790**	**4,889**	**5%**
Distribution Loads	3,157	3,268	3,363	3,392	3,540	3,652	3,760	3,839	3%
Directly-Connected Loads	421	540	610	830	880	1,030	1,030	1,050	14%
Annual Energy (TWh)	**31**	**33**	**35**	**37**	**39**	**41**	**42**	**43**	**5%**
Peak Demand (MW)	**6,116**	**6,350**	**6,730**	**7,040**	**7,370**	**7,720**	**7,920**	**8,100**	**4%**
Change from 2017-2023 Statement (MW)	*56*	*133*	*36*	*-113*	*-209*	*-235*	*-393*	-	-
High Case Demand									
Average Demand (MW)	**3,578**	**4,364**	**4,806**	**5,177**	**5,520**	**5,919**	**6,228**	**6,538**	**9%**
Distribution Loads	3,157	3,484	3,686	3,877	4,180	4,479	4,758	5,058	7%
Directly-Connected Loads	421	880	1,120	1,300	1,340	1,440	1,470	1,480	20%
Annual Energy (TWh)	**31**	**38**	**42**	**45**	**48**	**52**	**55**	**57**	**9%**
Peak Demand (MW)	**6,116**	**7,060**	**7,650**	**8,190**	**8,720**	**9,410**	**9,950**	**10,510**	**8%**
Change from 2017-2023 Statement (MW)	*56*	*-42*	*-59*	*-80*	*-104*	*-10*	*-73*	-	-

Integration with the PDO Power System and Ad Duqm

The demand projections in Figure 2 include only the native demand within the MIS. However, OPWP expects a new 400 kV transmission line to be completed by 2023, linking the MIS to the PDO power system and to the developing industrial hub at Ad Duqm. The interconnect will ultimately extend to Dhofar. This will enable full integration of capacity planning and operations, achieving significant operational efficiencies and financial benefits. This integration is not possible via the existing 132 kV link between PDO and the MIS at Nizwa.

The MIS is also connected with the power system of the Emirate of Abu Dhabi through a 220 kV link at Mahadha. The UAE interconnect provides Oman with access to the power systems of all the Member States of the GCC Interconnection Authority (GCCIA). These interconnections provide reliability benefits through the sharing of generation reserves, and potential for economic trading. Access conditions and trading agreements with UAE, GCCIA and Member States are expected to be finalized in 2018. OPWP has conducted trial capacity exchanges with UAE, and plans to develop a plan for regular trading transactions.

POWER GENERATION RESOURCES

Sources of Power

OPWP purchases power from a number of sources via power purchase agreements (PPAs), power and water purchase agreements (PWPAs) and other similar agreements. The contractual arrangements for power delivery under these agreements may be differentiated as firm capacity, reserve-sharing, non-firm capacity, and energy-only. These terms are relevant for generation planning purposes.

All of the main power plants in the MIS are contractually committed to provide a specific generation capacity (in MW) upon demand, to be dispatched by the OETC, and to maintain specific availability levels. These are firm capacity contracts, also termed ***"contracted capacity"***.

OPWP also purchases power from a number of sources where the contractual arrangements do not provide a guaranteed level of capacity upon demand. They may be termed collectively as **"non-firm resources"**. They currently include (1) reserve-sharing arrangements with other power systems via interconnection agreements and (2) capacity exchanges/energy purchases from industries with captive power generation facilities, where such industries use their embedded generators mainly for self-supply. In these cases no specific capacity is committed to OPWP. The availability of capacity for use by OPWP at any particular time may be subject to the other party's first use, although reserve-sharing agreements with neighboring power systems commit support during emergencies for specified periods of time. Collectively, non-firm resources provide reliability benefits to the MIS, in that capacity is generally available according to pre-arranged schedules or during contingency events.

The Government of Oman has recently adopted a fuel diversification policy. Whereas all the generators procured by OPWP currently use natural gas as their primary fuel, the fuel diversification policy requires that new renewable energy (RE) projects contribute 10% of generation output by 2025, and that up to 3,000 MW of coal-fired generation should be developed by 2030. A key objective of this policy is to release domestic gas committed to the power sector, to be available to stimulate industrial and economic development. OPWP has embraced this policy and is implementing a development plan to achieve the targets, as described below.

Solar and Wind projects, to be developed toward the RE target, are non-firm resources to the extent that their energy output is intermittent and non-dispatchable. However, OPWP has made estimates of their contribution to capacity on the basis of minimum expected generation output at the time of peak demand, using ground measurement data collected over a number of years. Once specific projects are under development, and later in operation, OPWP may adjust these estimates on the basis of specific locations, technology being deployed, and production out-turns.

Contracted Capacity

OPWP's present portfolio of contracted capacity for electricity generation in the MIS comprises of thirteen P(W)PAs. A summary of these contracted capacities can be found in Table 1.

A summary of the generation capacity that is expected to be provided under these P(W)PAs over the 2018-2024 period is set out in Figure 3. This shows total contracted capacity of 8,229 MW in 2018 rising to 9,806 MW by 2019 before falling back to 7,511 MW by 2022.[4] The expected decrease in contracted capacity is due to a number of contract expirations during the period as detailed amongst the following main developments:

Ghubrah IWPP: capacity of 399 MW at 45°C. All the units will be retired by 30 September 2018.

Wadi Jizzi IPP: capacity of 305 MW at 45°C. The plant is planned for retirement on 30 September 2018.

Al Kamil IPP: capacity of 291 MW at 45°C. The PPA will expire on 31 December 2021. The plant is expected to be available for further contract extension after 2021.

Barka I IWPP: capacity of 397 MW at 45°C during normal operation in CCGT mode without MSF water production. If the MSF facility is operating, then generation capacity increases to 439 MW at 45°C. The PWPA will expire on 31 December 2021. The plant is expected to be available for further contract extension after 2021.

Manah IPP: capacity of 264 MW at 45°C. The PPA expires on 30 April 2020, at which time ownership of the plant transfers to the Government. OPWP plans a competitive tender for sale of this asset in order that it may continue to operate under a new PPA.

Ibri IPP: the plant is under construction and contracted to deliver early power capacity of 997 MW from April to October 2018 and full capacity of 1,539 MW from 1st April 2019.

Sohar IV IPP: The plant is under construction and contracted to deliver full power capacity of 1,744 MW from 1st January 2019.

Sohar IWPP: capacity of 597 MW at 45°C. The PWPA will expire on 31 March 2022. The plant is expected to be available for contracting under a new P(W)PA.

Rusail IPP: capacity of 694 MW at 45°C. The PPA will expire on 31 March 2022. The plant is expected to be available for contracting under a new PPA.

As indicated above, a number of plants will reach the end of their current contract terms in 2021 and 2022. The owners of these projects will have the opportunity to offer these plants for new long-term PPAs in a competitive tender, which is expected to be issued in 2018.

[4] Some plants show marginal increases to capacity compared to the previous 7-Year Statement. This is due to revised assessments from 2017 performance tests and evaluated output at 45°C ambient temperature.

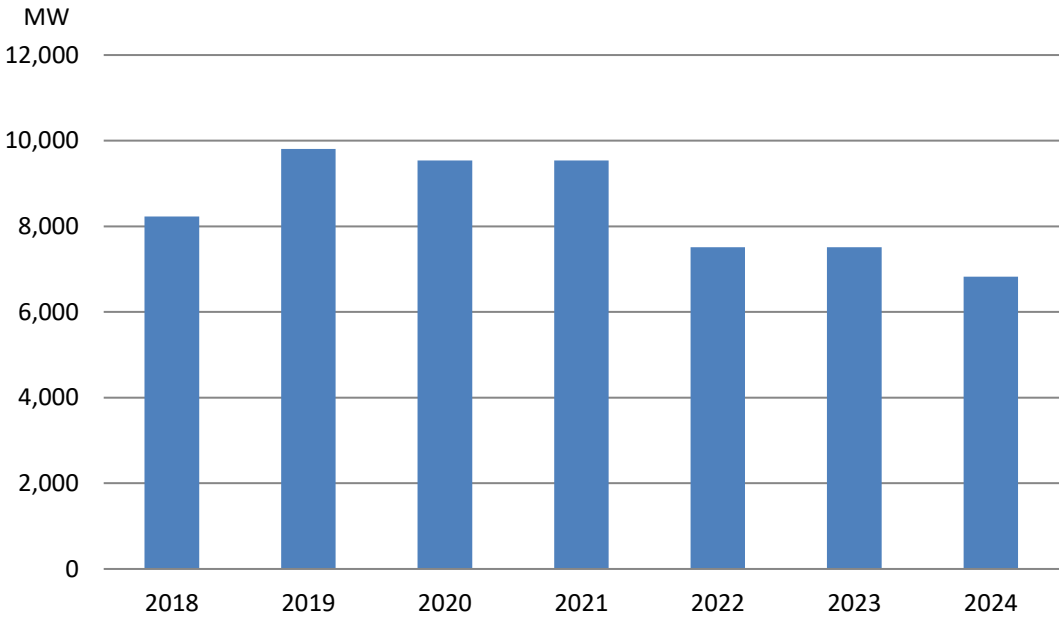
Table 1. Contracted Capacity – MIS

Project Name	Contracted Capacity[a]	Contract Type	Project Company	Project Status	Technology	Contract Expiry
Al Kamil IPP	271 MW	PPA	Al Kamil Power Co. (SAOG)	Operational	OCGT Natural gas fired Fuel oil as back-up	2021
Barka IWPP	427 MW	PWPA	ACWA Power Barka (SAOG)	Operational	CCGT Natural gas fired Fuel oil as back-up	2021
Barka II IWPP	677 MW	PWPA	SMN Barka Power Co. (SAOC)	Operational	CCGT Natural gas fired Fuel oil as back-up	2024
Barka III IPP	741 MW	PPA	Al Suwadi Power Co. (SAOC)	Operational	CCGT Natural gas fired Fuel oil as back-up	2028
Ghubrah IWPP	430 MW	PWPA	Al Ghubrah Power and Desalination Co. (SAOC)	Operational	OCGT/Steam MSF Desalination Fuel oil as secondary fuel and back-up	2018
Ibri IPP	1,509 MW	PPA	AD'Dhahirah Generation Company	Under construction	CCGT Natural gas fired Fuel oil as back-up	2034
Manah IPP	254 MW	PPA	United Power Co. (SAOG)	Operational	OCGT Natural gas fired Fuel oil as back-up	2020[b]
Rusail IPP	665 MW	PPA	Rusail Power Co. (SAOC)	Operational	OCGT Natural gas fired Fuel oil as back-up	2022
Sohar IWPP	585 MW	PWPA	Sohar Power Co. (SAOG)	Operational	CCGT Natural gas fired Fuel oil as back-up	2022
Sohar II IPP	741 MW	PPA	Al Batinah Power Co. (SAOC)	Operational	CCGT Natural gas fired fuel oil as secondary fuel and back-up	2028
Sohar IV IPP	1,710 MW	PPA	Shinas Power Company	Under construction	CCGT Natural gas fired Fuel oil as back-up	2034
Sur IPP	2,000 MW	PPA	Phoenix Power Co. (SAOC)	Operational	CCGT Natural gas fired Fuel oil as back-up	2029
Wadi Al Jizzi IPP	325 MW	PPA	Wadi Al-Jizzi Power Co. (SAOC)	Operational	OCGT	2018

[a] Contracted capacities are shown as of summer 2017, at reference condition 50oC.The contracted capacities are reported as net of plant auxiliaries except for Ghubrah IWPP, Rusail IPP, and Wadi Al Jizzi IPP which are contracted at gross capacity. Plant capacities are shown elsewhere in this report as evaluated at 45oC, which is more in line with peak demand conditions, and as net output rather than gross output.

[b] Manah IPP will be transferred from the United Power Company to the Government in April 2020, due to the project being developed under a "Build-Own-Operate-Transfer" (BOOT) model.

Figure 3. Contracted Generation Capacity – MIS



	2018	2019	2020	2021	2022	2023	2024
Contracted Capacity				Net MW [a]			
Al Kamil IPP	291	291	291	291	-	-	-
Barka IWPP[b]	397	397	397	397	-	-	-
Ghubrah IWPP	399	-	-	-	-	-	-
Wadi Al Jizzi IPP	305	-	-	-	-	-	-
Manah IPP[c]	264	264	-	-	-	-	-
Rusail IPP	694	694	694	694	-	-	-
Sohar IWPP	597	597	597	597	-	-	-
Barka II IWPP	688	688	688	688	688	688	-
Sohar II IPP	766	766	766	766	766	766	766
Barka III IPP	766	766	766	766	766	766	766
Sur IPP	2,023	2,018	2,018	2,018	2,018	2,018	2,018
Ibri IPP	997	1,539	1,538	1,537	1,535	1,535	1,535
Sohar IV IPP	-	1,744	1,742	1,741	1,738	1,738	1,738
TOTAL	**8,187**	**9,764**	**9,497**	**9,495**	**7,511**	**7,511**	**6,823**

[a] All capacities are rated on a net basis (i.e. after allowing for auxiliary consumption inside the plants) at 45°C ambient temperature. Ibri IPP and Sohar IV IPP capacities at 45°C are based on estimates which might change slightly once the plants are operating.

[b] Barka IWPP accessible contracted capacity is 439 MW. However, the plant is expected to be operated under normal conditions with no water production from the MSF facility, which reduces generation capacity to 397 MW. The MSF plant is intended to be operated only during water supply emergencies, considering its high operating cost.

[c] The contract with the current owner will expire by April 2020.

Non-Firm Resources under Contract

In addition to the contracted capacity described above, OPWP has contracts with a number of other generation sources, although these contracts are not for firm capacity commitments. They include:

- the 220 kV interconnect with the UAE (Abu Dhabi) power system at Mahadha;
- the 132 kV interconnect with the PDO power system at Nizwa; and
- the surplus generation of industries (and other parties) with captive power generation facilities.

A 220 kV interconnection between the Oman (MIS) and UAE (Abu Dhabi) power systems has been commercially operational since 2012. Oman has been a member of the GCCIA since December 2014, and has access to the other five Member State power systems via this link. Benefits of the interconnection include firm support during emergencies, and opportunities to trade electricity and coordinate both planning reserves and operating reserves.

The interconnection is a double circuit link that supports reliable transfers of up to 400 MW and can carry up to 800 MW in emergencies. The link has provided emergency reserves on a number of occasions, preventing power failures in the MIS. In 2016, AER approved OPWP's recognition of the interconnect's contribution to planning reserve requirements, based on its record of performance and the contractual obligations with the GCCIA to provide reserves support.

As a test of power trading arrangements and operational procedures, OPWP completed an energy exchange with Abu Dhabi Transco in 2016, for a net fuel savings at no cost. OPWP also initiated a power sale transaction with Abu Dhabi Transco in 2017. Although initially accepted, Abu Dhabi Transco cancelled the transaction in favor of an in-kind exchange with another party. Further trading opportunities with GCCIA neighbors are expected in coming years.

The MIS is connected with the PDO power system at Nizwa via a single 132 kV link with a nominal transfer capacity of around 60 MW. The main purpose of this interconnect is to support reserve sharing between the MIS and the PDO system. OPWP, OETC and PDO have agreed to build a new 400 KV transmission interconnect at Nahada, with secure transfer capacity in excess of 1000 MW. This will enable substantial coordination of operations and capacity planning, providing efficiency benefits to the Sultanate.

Several industries with captive power plants are connected with the MIS and have surplus power that may be purchased by OPWP. OPWP has an agreement with Sohar Aluminium Co. (LLC), whereby Sohar Aluminium exports up to 180 MW to the MIS during the summer, and imports a like amount of energy from OPWP during the winter on an annually determined schedule.[5] The schedule and operations are managed to assure that energy exports balance with energy imports. This arrangement benefits both parties: Sohar Aluminium is better able to schedule the maintenance of its generating units and gains reliability of supply, while OPWP gains an efficient generating resource during the summer and improves the system Load Factor. The agreement with Sohar Aluminium (180 MW) was renewed in 2015 for three years and is expected to be renewed again in 2018.

[5] The Sohar Aluminium plant has the capability to export up to about 300 MW under supplementary firing, by special arrangement. This capacity level has not been demonstrated on a sustainable basis but is considered as an emergency reserve in case of temporary need.

Resource Development Plan

OPWP has revised the resource development plan described in the previous 7-Year Statement, to align with the Government's new fuel diversification policy and with OPWP's current demand forecasts. This plan features rapid development of renewable energy (RE) resources, the first coal-fired IPP in the Sultanate, and implementation of OPWP's new procurement methodology for gas-fired PPAs. The resource development plan comprises new capacity contracts, renewable energy contracts, demand response, and capacity contributions from other non-firm resources.

New Capacity Contracts. OPWP anticipates four procurement initiatives for projects in the MIS that would provide guaranteed capacity during this 7-year period. Table 2 summarizes the capacity expectations from these projects. They include:

- **Manah IPP Sale / New PPA**. The Manah IPP was originally procured under a BOOT contract. The asset transfers to the Government in April 2020. Rather than own and operate the plant, the Government has authorized OPWP to conduct a sale of the plant, including a new PPA between OPWP and the eventual owner. The asset sale/procurement process is planned to begin in Q3 2018. The plant is assumed to be contracted at its current capacity.

- **Power 2022**. OPWP has begun the Power 2022 procurement initiative, a competitive tender for long-term PPAs that commence in 2022. It is a two-stage competition. The first stage is a qualification process for four existing plants,[6] in which they can commit to offer capacity at or below OPWP's benchmark price for a contract term of 4-15 years.

  Depending upon OPWP's assessment of the level of dependable capacity offered in Stage 1, OPWP may invite bidders for new capacity into the bidding process in Stage 2, when qualified participants will submit bids for new PPAs.

  The capacity requirement for Power 2022 is 700 MW.[7] OPWP will offer new PPAs for the lowest priced qualifying bids. OPWP has discretion to award PPAs for aggregate capacity in excess of the capacity requirement. However, this will be subject to regulatory review and consideration of the cost and value of surplus capacity in the MIS. Bidders that are not awarded PPAs will have the option to participate in the new Wholesale Spot Market, which is scheduled to launch in 2020. They may later participate in the next procurement for long-term PPAs, Power 2024.

- **Duqm Clean Coal IPP.** On direction from the Government, OPWP prepared a feasibility study of a coal-fired power plant in 2017. One of the main objectives of this project is to reduce commitments of natural gas to power generation, and allow domestic gas to be redirected to industrial development for the long-term economic benefit of the country. It will be the first coal-fired power plant in the Sultanate, whereas the fuel diversification policy envisions up to 3,000 MW to be developed by 2030.

[6] The four plants include the Al Kamil, Barka I, Rusail, and Sohar I IPPs. All have P(W)PAs that expire by early 2022.

[7] This capacity value compares to the expectation of 1,600 MW identified for Power 2022 in the previous 7-Year Statement. The reduction in capacity needs is due to capacity contributions expected from renewable energy projects, demand response, and impacts of the new cost-reflective tariff (CRT) on demand.

In 2018, OPWP plans to initiate the procurement process for a 1,200 MW clean coal power plant located in Duqm, subject to final regulatory approval. This plant will meet the most current international standards for environmental quality and emissions control. It is expected to reduce gas needs of the electricity sector by 4-5 million Sm^3/d, enabling MOG to supply new industrial projects.

The Duqm Clean Coal IPP is expected to provide 600 MW by 2024 and 1,200 MW at full power in 2025, assuming timely approvals. The plant will provide essential power supply to the developing Duqm industrial hub, and export surplus capacity to the MIS. In 2024, considering expected Duqm demand of about 110 MW, the contribution to MIS demand may be about 490 MW. This estimate of exports to the MIS may be revised depending on the pace of Duqm demand growth.

- **Power 2024.** OPWP plans to initiate the Power 2024 procurement in 2020, for new long-term PPAs that commence in 2024. It would follow a similar approach as that described above for Power 2022. Our current assessment for the capacity requirement is 700 MW. This is expected to change somewhat depending upon the outcome of Power 2022, demand growth, the progress of the Duqm Clean Coal IPP, and assessments of capacity contributions from other resources.

Table 2 Planned Contracts for Guaranteed Capacity

	2018	2019	2020	2021	2022	2023	2024
				Net MW [a]			
Manah IPP Sale/ New PPA	-	-	264	264	264	264	264
Power 2022	-	-	-	-	700	700	700
Power 2024	-	-					700
Duqm Clean Coal IPP (Export to MIS)[a]	-	-	-	-	-	-	490
TOTAL	**-**	**-**	**264**	**264**	**964**	**964**	**1,664**

[a] The Clean Coal IPP Early Power Capacity is 600 MW. The plant is expected to supply Duqm demand and export surplus capacity to MIS.

Renewable Energy (RE) Development. In December 2017, OPWP announced a tender for a 500 MW solar PV project to be located at Ibri. This is the first in a series of renewable energy (RE) IPP tenders that are planned to achieve the Government's target of 10% RE share of electricity generation by 2025.

OPWP's renewable energy development plan currently comprises solar, wind, and waste-to-energy (WTE) projects. OPWP plans to procure more than 2,600 MW of RE IPPs by 2025. Table 3 summarizes the plan through 2024, excluding projects in Dhofar. The majority of these projects are expected to be located in the MIS and further south around Duqm, with their main market for generation in the MIS.[8] The locations and type of RE projects will depend somewhat on approval of transmission projects and site allocations. OPWP expects to adapt the RE development plan as site acquisition and transmission development are approved and confirmed.

[8] Table 3 excludes projects planned in the Dhofar Power System, which are described in a subsequent section of this report.

Table 3 Renewable Energy Development Plan – MIS/Duqm

	2018	2019	2020	2021	2022	2023	2024
				MW			
Ibri II Solar IPP	-	-	-	500	500	500	500
Solar IPP 2022	-	-	-	-	500	500	500
Solar IPP 2023	-	-	-	-	-	500	500
Solar IPP 2024	-	-	-	-	-	-	500
Wind IPP 2023	-	-	-	-	-	200	200
Wind IPP 2024	-	-	-	-	-	-	200
Waste to Energy 1	-	-	-	-	-	50	50
Total Capacity	**-**	**-**	**-**	**500**	**1000**	**1750**	**2450**
Capacity Contribution	**-**	**-**	**-**	**150**	**300**	**500**	**650**

OPWP plans for solar, wind, and WTE development are described as follows:

- **Solar Energy.** The current procurement of 500 MW solar PV (Ibri II Solar IPP) has scheduled COD in 2021. We plan successive annual tenders of 500 MW, whereas the specific solar generation technology may differ among the tenders. The qualification process for the second tender will commence in Q4 2018, subject to confirmation of site access from the Ministry of Housing. Future solar tenders may be for larger installed capacity levels than 500 MW, depending on OPWP market assessments.

  OPWP plans that solar energy development will occur at multiple sites, and some tenders may involve multiple developer awards. OPWP has a process underway for site allocation and transmission access, with the full support of the relevant Government agencies.

  OPWP has operated two solar monitoring stations at Adam and Manah for the past 5 years, collecting data in support of project development. The stations are being moved to new locations to support project development at additional sites. The data is publicly available on the OPWP website.

  OPWP expects that solar PV projects will contribute at least 30% of their peak installed capacity to the MIS peak demand, on the basis of energy output profiles determined from Manah and Adam site data. Specific projects may contribute somewhat more or less, depending on their location and more importantly on their technology configuration. Generally, solar energy output peaks when the sun is directly overhead, and declines toward zero by sunset. The output profile may be modified by technology, configuration, solar tracking technology, and energy storage. OPWP plans to reassess the capacity contributions of specific projects as they are awarded and the technology is defined. The capacity contribution of solar PV and other RE projects is shown in Table 3.

- **Wind Energy.** The Sultanate's first utility-scale wind farm is being financed by UAE's MASDAR, to be operated by RAECO under a PPA with OPWP. The 50 MW project is under construction at Harweel in Dhofar Governorate, and is expected to begin operation in 2020. The most promising areas for onshore wind energy development are in coastal highland areas of Dhofar and Al Wusta Governorates, although certain mountainous areas of Sharquiya Governorate also have potential. In 2018, OPWP will begin installation of wind monitoring stations at three

sites. These stations will provide hourly ground-level wind data to support wind project development, similarly to OPWP's ongoing solar monitoring stations.[9]

OPWP plans to develop wind energy projects in tenders of 150-200 MW, subject to market assessment. The first OPWP tender for wind energy may be in Dhofar, subject to site access, followed by projects near Duqm and potentially Sharqiyah, with other sites to follow. Generally, utility-scale wind energy development in Al Wusta Governorate needs transmission access to the MIS demand area. The new 400 kV transmission line from Izki to PDO and Duqm is expected to be completed in 2023, subject to final approval. Hence, the wind energy development program for the MIS is linked to the transmission line development, and the first project is scheduled to reach COD in 2023. The project procurement would initiate the qualifications process in 2020.

Wind energy output is seasonal and relatively intermittent during the day. The greatest output periods for the Dhofar project are expected to be in the evening and night. OPWP currently assesses zero contribution to MIS peak demand for wind projects. This may change according to the wind profiles of specific projects.

- **Waste-to-Energy (WTE).** For several years, Be'ah has been exploring alternatives to landfill storage of municipal solid waste in Muscat and South Batinah. In 2018, OPWP is conducting a feasibility study of a WTE project, building upon previous studies by Be'ah. Subject to regulatory approval, OPWP expects to launch a qualification process in Q4 2018 to procure a WTE project with capacity of around 50 MW.

  This project would be competitively procured as an IPP, under a long-term PPA with OPWP, using municipal solid waste supplied by Be'ah. OPWP expects it to be a continuously operating plant, i.e., baseload supply, with guaranteed capacity similar to supply from the gas-fired power plants currently under contract with OPWP. In Table 3, we assess a 100% capacity contribution to the installed capacity of the WTE plant.

Demand Response. OPWP expects that Demand Response (DR) can provide a significant and cost-effective resource toward reducing capacity requirements. In this 7-Year Statement, we are setting a target to achieve a 100 MW capacity contribution from DR by 2024. OPWP conducted a preliminary proof-of-concept trial at one site in 2016, reducing demand by 25 MW during the peak period. In 2018, OPWP plans to identify DR potential in more customer segments, assess compensation options, and begin to develop verification protocols and contracting approaches. Demonstration trials would recommence in 2019. We expect to launch the DR program for commercial operation in 2020. Capacity targets are noted in Table 4.

Electricity Spot Market. Development of the electricity spot market is proceeding on schedule. AER approved the detailed market rules in 2017, with the understanding that certain technical annexes will be finalized during implementation of the IT system. OPWP has begun procurement of the Market Management System, and is staffing the Market Operator organization, which will be within OPWP. The market is scheduled to begin operational trials in 2019 and commercial operation in

[9] Site data collection augments data that is already available from satellites, providing a more accurate basis for bank-able RE projects. OPWP operates the measurement stations to reduce the risk and cost of RE project development.

2020. The electricity spot market will operate alongside the existing system of long-term PPAs and PWPAs.

OPWP expects that the spot market will increase competition in Oman's power generation market, and make available additional capacity that might otherwise not be readily accessible through the existing P(W)PA procurement channel. We have indicated its capacity contribution in Table 4 as "TBD", that is, To Be Determined. There have been preliminary indications of interest from some existing and prospective industrial plants to participant in the market as generators, but these may not be confirmed until the market begins operation. OPWP expects that some existing plants participating in the Power 2022 procurement may join the spot market if they are not awarded new P(W)PAs, considering that the capacity requirement from Power 2022 is less than the current aggregate capacity of these plants. OPWP plans to assess the capacity contribution of spot market participants coming out of the Power 2022 initiative after new P(W)PA awards have been made.

Table 4 summarizes the capacity contribution from Demand Response, Spot Market, SAC and GCCIA.

Table 4 Capacity Contribution from Other Contracts

	2018	2019	2020	2021	2022	2023	2024
				MW			
SAC[a]	180	180	180	180	180	180	180
GCC Interconnection[a]	200	200	200	200	200	200	200
Demand Response	-	-	30	40	50	70	100
Spot Market[b]					TBD	TBD	TBD
Total Capacity	**380**	**380**	**410**	**420**	**430**	**450**	**480**

[a] Contributions from non-firm resources include the assessed capacity benefit of reserve-sharing arrangements with the GCCIA over the UAE interconnect (200 MW), and the power exchange with Sohar Aluminium (180 MW). This capacity contribution was approved by the AER in 2016.

[b] Spot Market capacity contribution will be evaluated following (Power 2022) procurement process

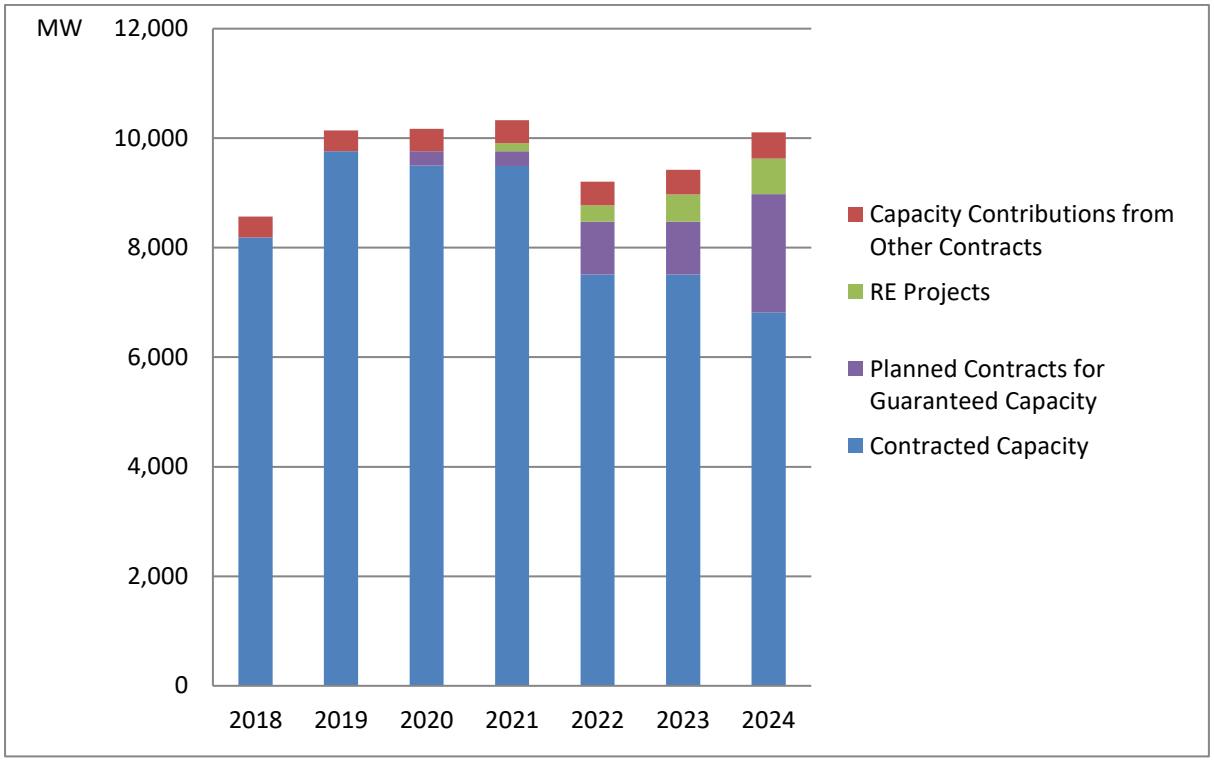
Capacity Transactions with Other Power Systems. Energy trades or firm capacity purchases from neighboring power systems are important potential contingency resources. While no firm capacity transactions are currently in place, OPWP is finalizing arrangements with GCCIA to facilitate trade agreements with GCCIA Member States. We expect to develop a trading roadmap later in 2018.

The planned 400 kV North-South transmission interconnect, once agreed, will facilitate joint resource planning and operations coordination between OPWP, OETC, PDO, and RAECo. The feasibility study for the interconnect was completed in 2017, and the interconnect has been submitted for regulatory approval. An Operations Agreement is expected to be finalized in 2018 that will establish protocols for integrated power system planning, energy trading, and dispatch operations. OPWP expects to define further developments with respect to capacity transactions with PDO in the next 7-Year Statement.

Summary

Figure 4 provides a summary of OPWP's current plans for generation capacity and resource development in the MIS for the period 2018 to 2024. The capacity indicated for each year corresponds to the quantity available as of the onset of the summer peak season in May.

Figure 4 Capacity Contributions from Generation Resources – MIS



	2018	2019	2020	2021	2022	2023	2024
				MW			
Contracted Capacity							
Total Contracted Capacity	**8,187**	**9,764**	**9,497**	**9,495**	**7,511**	**7,511**	**6,823**
Planned Contracts for Guaranteed Capacity							
Manah IPP Sale/ New PPA	-	-	264	264	264	264	264
Power 2022	-	-	-	-	700	700	700
Power 2024	-	-	-	-	-	-	700
Duqm Clean Coal IPP	-	-	-	-	-	-	490
Total Planned Contracts for Guaranteed Capacity	**-**	**-**	**264**	**264**	**964**	**964**	**2,154**
Capacity Contributions from RE Projects							
Renewable Energy	-	-	-	150	300	500	650
Capacity Contributions from Other Contracts							
Demand Response	-	-	30	40	50	70	100
Non-firm Contracts [a]	380	380	380	380	380	380	380
Total Capacity Contributions to Peak Demand	**8,567**	**10,144**	**10,171**	**10,329**	**9,205**	**9,425**	**10,107**

[a] Includes SAC and GCC Interconnection

RESOURCE ADEQUECY AND MITIGATION PLANS

Statutory and Regulatory Requirements

OPWP is required by the Sector Law and its license to ensure the adequacy of generation resources to meet future power demands. The Sector Law establishes OPWP's general responsibility to secure sufficient generation resources to meet the aggregated demands of licensed electricity suppliers. Further to this, the license issued to OPWP by the Authority for Electricity Regulation, Oman (AER) stipulates a specific generation security standard for the MIS that OPWP must comply with.

The generation security standard stipulated by the AER sets a maximum duration of power outage for the system, termed Loss-of-Load Hours ("LOLH"). OPWP must enter into agreements for enough production capacity to ensure that expected demand does not exceed available capacity for more than 24 hours in any year. This LOLH measure considers relevant uncertainties such as the reliability of generation units and the availability of non-firm generation resources. On a short-term basis, OPWP must demonstrate to the AER that sufficient supply agreements are in place to prevent an excess of 24 LOLH. On a long-term basis, OPWP must demonstrate that it has credible plans to put such agreements in place (via the procurement of new capacity or otherwise).

OPWP prepares computer simulations of power system performance to assess LOLH under a wide range of conditions that fluctuate randomly. The simulations are the basis for determining the expected level of LOLH and the adequacy of generation to meet the statutory standard. Generally, the number and type of generating units and the demand profile affect the expected LOLH level, which may also be sensitive to generation technology and other factors.

Resource Adequacy in the Expected Demand Scenario

During the 7-year planning horizon, OPWP assesses that, on average, a reserve margin of at least 6.5% over forecast peak demand is necessary to assure that expected LOLH in the MIS is 24 hours or less. The 6.5% reserve margin provides a capacity target, and OPWP evaluates resource adequacy on this basis for 2018 to 2024. The assessment can change as the power system develops. In future, as OPWP investigates the impact of new technologies, such as intermittent RE projects, the assessment of loss-of-load incidence may change. Figure 5 below compares generation resources to capacity targets (peak demand plus 6.5%) associated with each of the three demand scenarios.

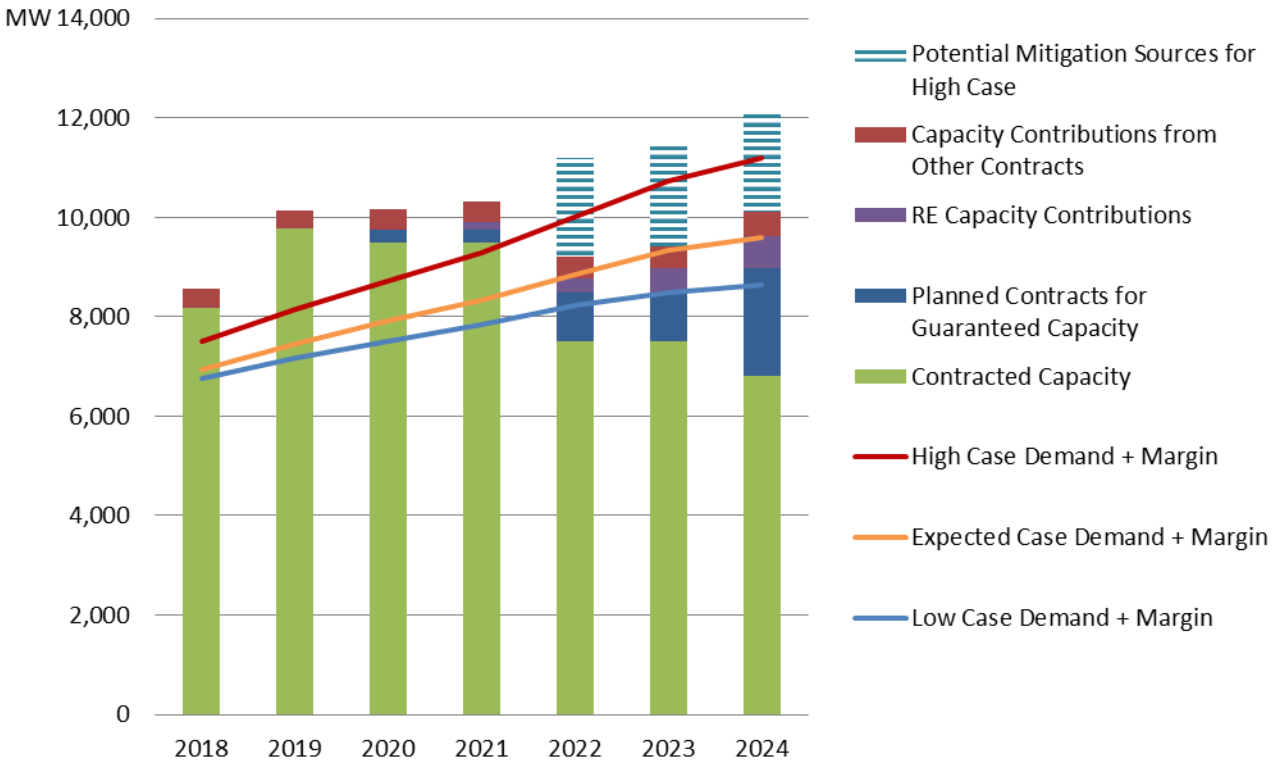
The resource development plan is developed to provide sufficient capacity to meet the generation security standard for the Expected Demand scenario, with allowances for feasible mitigations that address requirements of the Low and High Demand scenarios. Table 5A compares planned capacity with the capacity target under the Expected Demand scenario. The resource development plan provides sufficient capacity to exceed the capacity target in every year.

In the initial years of the forecast period, from 2018 to 2021, contracted capacity exceeds demand by a significant margin. This is due to new capacity additions that were committed before the extent and effects of the economic downturn on demand became evident. The new plants, Ibri and Sohar III, will be fully operational in 2019, and will immediately be fully utilized to improve the efficiency of the system, reducing gas requirements.

In 2020, ownership of the Manah IPP transfers to the Government. Although there is no need for additional capacity at that time, the asset has long-term value and OPWP plans to sell it to a new operator with a new PPA.

In 2022, four plants reach the end of their P(W)PA terms, reducing contracted capacity such that new capacity contracts are needed to meet the target. This capacity requirement is being addressed under the Power 2022 procurement process. The need for new contracted capacity is shown in Figure 4 as 700 MW. This is the amount of capacity needed from Power 2022 to meet the capacity target in each year up to the next planned capacity procurement. Power 2024 is the next procurement round, and Power 2022 must provide sufficient capacity to meet the target through 2023. Considering contracted capacity, the Manah IPP extension, capacity contributions from non-firm contracts (RE projects, DR program, and other contracts), about 700 MW is required from Power 2022 to meet the generation security standard in 2023.

Figure 5 Resource Adequacy – MIS



	2018	2019	2020	2021	2022	2023	2024
Generation Resources				MW			
Contracted Capacity	8,187	9,764	9,497	9,495	7,511	7,511	6,823
Planned Contracts for Guaranteed Capacity	-	-	264	264	964	964	2,154
RE Capacity Contributions	-	-	-	150	300	500	650
Capacity Contributions from Other Contracts	380	380	410	420	430	450	480
Total Capacity Contributions to Peak Demand	**8,567**	**10,144**	**10,171**	**10,329**	**9,205**	**9,425**	**10,107**

In 2024, Barka II will reach the end of its P(W)PA term. New capacity contracts will be required to meet capacity requirements through 2025.[10] The Power 2024 procurement process is planned to meet these long-term capacity needs. OPWP currently estimates that we will need to procure about 700 MW via Power 2024, considering contributions from RE and DR resources, the Duqm Clean Coal IPP, and the current demand forecast. This assessment is likely to change before Power 2024 launches, considering updates to demand growth expectations (particularly in Ad Duqm), the pace of project development, and other factors.

Table 5A. Resource Adequacy Under Expected Case Demand - MIS

	2018	2019	2020	2021	2022	2023	2024
				MW			
Peak Demand	6,520	7,000	7,430	7,830	8,300	8,670	9,010
Export to Duqm [a]	-	-	-	-	-	90	-
Total Peak Demand	**6,520**	**7,000**	**7,430**	**7,830**	**8,300**	**8,760**	**9,010**
Capacity Target (Demand + Margin)	**6,940**	**7,460**	**7,910**	**8,340**	**8,840**	**9,330**	**9,600**
Total Available and Planned Capacity Contracts	8,567	10,144	10,171	10,329	9,205	9,425	10,107
Additional Capacity Required	-	-	-	-	-	-	-

[a] The 400 KV Interconnect to PDO and Duqm is assumed to be completed by 2023 allowing MIS supply. In 2024, the early power of Duqm Coal IPP is expected to be utilized with a net export capacity to MIS after supplying Duqm Zone demand.

Mitigation Options for the High Case Demand Scenario

In the High Case demand scenario, the capacity requirement in 2024 is about 1,500 MW higher than in the Expected Demand scenario. Table 5B shows that additional resources would be required in 2022, 2023 and 2024 to meet the corresponding capacity target.

OPWP has a number of contingency options to address short-term capacity needs that may emerge in 2022 and 2023. They include uncontracted capacity that is available from the spot market, firm capacity purchase from GCCIA neighbors, potential expansion/acceleration of the planned DR program, and rental of diesel generators (as we have done in the past). Table 5B includes assessments of potential capacity contributions from these sources.

The previous section indicated that we assess a capacity need of 700 MW from Power 2022, whereas the four plants with expiring contracts in 2022 have aggregate current capacity of nearly 2,000 MW. We expect that plant(s) that are not awarded a new long-term P(W)PA in Power 2022 would become participants in the new spot market if it is commercially viable to do so. The High Case demand scenario presents conditions where prices would rise and the market would be profitable for uncontracted generators. OPWP anticipates that up to 1,300 MW may be available from the spot market, depending upon the level of capacity awards through Power 2022, the need for capacity and assessment of market prices, and the feasibility to extend permits or other necessary conditions for plant operation. OPWP would also evaluate the security of supply with the

[10] This assumes a Power 2026 procurement round would address supply needs in 2026.

AER if the likelihood of a supply deficit should increase. Under extreme conditions, short-term PPAs with uncontracted generators may also be considered to some extent.

The other mitigation options indicated are also quite feasible, though potentially more costly. Oman's GCCIA neighbors indicate surplus capacity on their systems during this period, which OPWP could access as capacity purchases. In this time frame, the North-South 400 kV interconnect is expected to be available (subject to final approval) allowing reserves contribution from the PDO system as well. It may be feasible to expand and accelerate the Demand Response program to achieve more capacity. Temporary diesel generation also remains a viable option.

Power 2024 provides the opportunity to contract for more capacity than the 700 MW that we have indicated, though this can only be available by 2024, and needs to be specified before RFP issue in Q4 2020.

These mitigation options confirm OPWP's ability to respond to a surge in demand beyond our Expected Demand forecast. This is important considering the Sultanate's aspirations to stimulate economic growth, and particularly to attract investment in the new industrial hub of Ad Duqm.

Table 5B. Resource Adequacy Under High Case Demand – MIS

	2018	2019	2020	2021	2022	2023	2024
High Case Scenario				MW			
Peak Demand	7,060	7,650	8,190	8,720	9,410	9,950	10,510
Export to Duqm	-	-	-	-	-	130	-
Total Peak Demand	**7,060**	**7,650**	**8,190**	**8,720**	**9,410**	**10,080**	**10,510**
Capacity Target (Demand + Margin)	**7,520**	**8,150**	**8,720**	**9,290**	**10,020**	**10,740**	**11,190**
Total Available and Planned Capacity Contracts	8,567	10,144	10,213	10,171	9,205	9,425	10,077
Additional Capacity Required	**-**	**-**	**-**	**-**	**815**	**1,315**	**1,113**
Mitigation Strategy for Deficit							
Spot Market Resources					500-1,300	500-1,300	500
New Capacity Contracts							800+[a]
Potential GCC Interconnection Purchase					400	400	400
PDO Import					TBD	TBD	TBD
Emergency Temporary Generation					300	300	300
Total Potential Mitigation Resources					800-2,000	800-2,000	800-2,000+

[a]Capacity to be procured under Power 2024 may be increased under a High Demand scenario.

Mitigation Options for the Low Case Demand Scenario

In the Low Case demand scenario, the capacity target is nearly 1,000 MW less than in the Expected Demand scenario. The capacity surplus would be high, and OPWP would consider options to improve capacity utilization and reduce the surplus. OPWP's action in 2017 provides a good example of mitigation of reduced demand. The previous 7-Year Statement indicated OPWP's plan to procure the Misfah IPP for COD in 2021. However, as the ongoing economic downturn confirmed OPWP's reduced demand forecast, the Misfah IPP procurement was suspended. OPWP's reduction to the capacity target for Power 2022 similarly demonstrates our approach to limit exposure to surplus capacity.

OPWP's principal approach to mitigation of surplus capacity would be to defer planned procurements, as we have done in 2017. OPWP would continue to honor existing contracts in a situation of capacity surplus. In the current resource development plan, the main mitigation opportunities would include deferral or capacity reduction of Power 2024, and temporary suspension of the Demand Response program. Participants in both the DR program and Power 2024 would have access to the spot market during deferral/suspension periods.

Table 5C. Resource Adequacy Under Low Case Demand – MIS

	2018	2019	2020	2021	2022	2023	2024
Low Case Scenario				**MW**			
Peak Demand	6,350	6,730	7,040	7,370	7,720	7,920	8,100
Export to Duqm	-	-	-	-	-	60	-
Total Peak Demand	**6,350**	**6,730**	**7,040**	**7,370**	**7,720**	**7,980**	**8,100**
Capacity Target (Demand + Margin)	**6,760**	**7,170**	**7,500**	**7,850**	**8,220**	**8,500**	**8,630**
Total Available and Planned Capacity Contracts	8,567	10,144	10,171	10,329	9,205	9,425	10,147
Additional Capacity Required	-	-	-	-	-	-	-
Surplus over Capacity Target	1,807	2,974	2,671	2,479	985	925	1,517
Mitigation Strategy for Surplus							
Reduce or Defer Power 2024 Capacity Procurement	-	-	-	-	-	-	-700
Defer Demand Response	-	-	- 30	40	-50	- 70	-100
Total Potential Mitigation Sources	**-**	**-**	**- 30**	**-40**	**- 50**	**-70**	**-800**

COMBINING POWER GENERATION AND WATER DESALINATION

In developing its plans for procuring power generation resources, OPWP is required to consider the opportunity for combining power generation with water desalination so as to benefit from economies of co-location and co-procurement. The most recent examples of combined development of power and desalination capacity are the Salalah IWPP in Dhofar (COD in 2011) and the Barka II IWPP (COD in 2009) in the MIS. In both cases, bidders proposed to use RO rather than MSF technology for water desalination, although the procurement specifications did not specify the technology to be used. OPWP expects that future plants will also be proposed to use RO technology due to its economic advantage.

OPWP does not anticipate a need both for power and water desalination capacity in a common location during the forthcoming 7-year period.

1.2 DHOFAR POWER SYSTEM

The Dhofar Power System (DPS) covers the city of Salalah and surrounding areas in the Governorate of Dhofar, serving around 101,000[11] electricity customers.

The DPS comprises two generation facilities, the 132 kV transmission grid that is owned and operated by Oman Electricity Transmission Company (OETC), and the distribution network which is owned and operated by Dhofar Power Company (DPC).

The DPS is interconnected with the Petroleum Development Oman (PDO) power system via a 132 kV link between Thumrait and Harweel, with transfer capacity up to 150 MW. This interconnection provides important reliability benefits through the sharing of generation reserves. A proposed expansion of interconnection capacity is currently under consideration as part of the 400 kV North-South Interconnect project.

The Directorate General of Water (DGW) is the principal entity responsible for potable water supply and distribution in the Governorate of Dhofar, apart from small, private networks. A single water desalination plant is the principal source of water supply to the DGW transmission system, although DGW also has significant groundwater resources available.

OPWP's role in the DPS is similar to its role in the MIS, which is to procure economically the power and desalinated water required by DPC and DGW, respectively, in bulk from generation/production facilities connected to the DPS. OPWP is required to ensure that sufficient power generation resources are available to meet DPC electricity demand. OPWP is also required to procure bulk water supply at the request of water departments including DGW, and, wherever beneficial, to co-procure desalinated water with power generation in joint facilities.

DEMAND FOR ELECTRICITY

Historical Demand

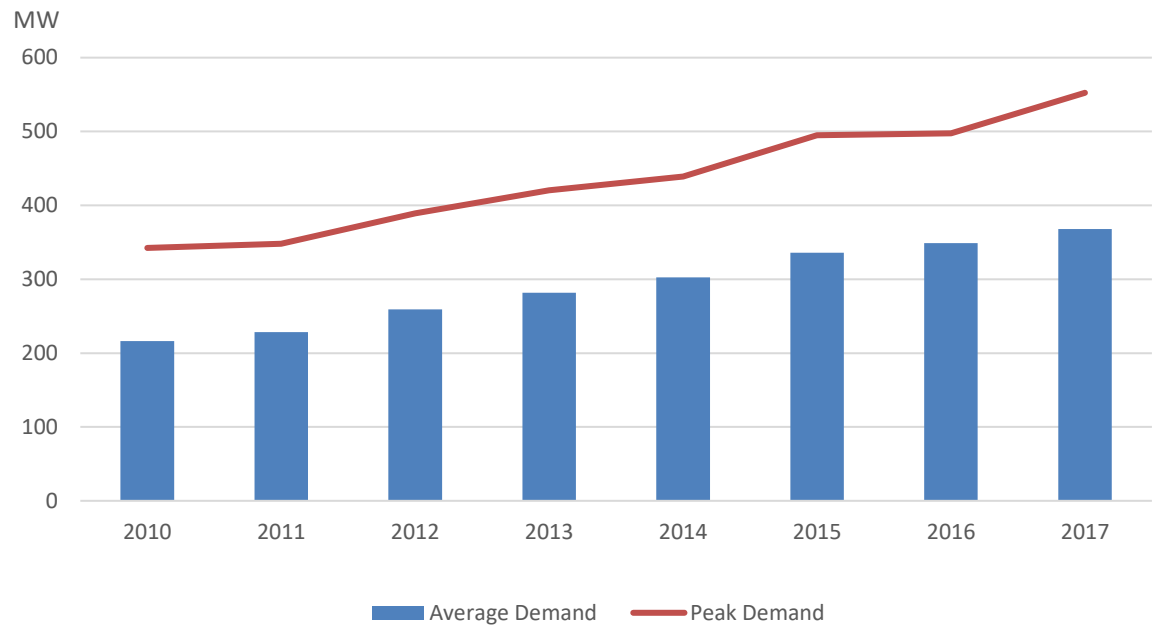
Electricity demand growth in 2017 was higher than the Expected Case forecast presented in the last 7-Year Statement, Issue 11. Average demand increased by 5.5% to 368 MW (corresponding to 3.22 TWh). Peak demand was 552 MW,[12] an increase of 11.2% over the 2016 peak demand.

Figure 6 shows that the average growth rate in annual average demand over the past seven years has been 7.9%, while single-year growth has reached as high as 13%. In addition, peak demand in the DPS has grown at an annual average of 7.2% over the same period. This rapid development rate has been common among all principal consumer sectors.

[11] AER Annual Report 2016

[12] DPC reported the net peak demand for the Dhofar Power System as 552 MW at 14:42 PM on 1st of June, 2017.

Figure 6 Historical Electricity Demand – DPS



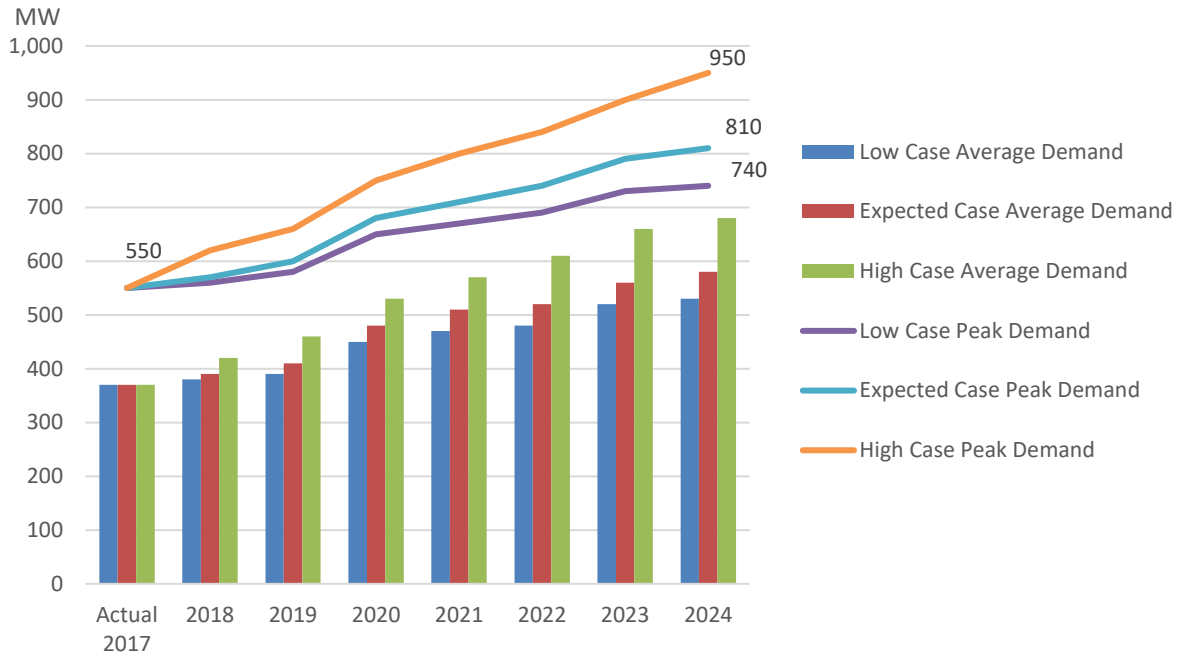
	2010	2011	2012	2013	2014	2015	2016	2017	Average Growth (%)
Historical Demand									
Average Demand (MW)	**216**	**228**	**259**	**282**	**303**	**336**	**349**	**368**	
Growth (%)		*6%*	*13%*	*9%*	*7%*	*11%*	*4%*	*5%*	7.9%
Peak Demand (MW)	**342**	**348**	**389**	**420**	**439**	**495**	**497**	**552**	
Growth (%)		*2%*	*12%*	*8%*	*4%*	*13%*	*0.5%*	*11.1%*	7.2%

Demand Projections

OPWP's 7-year electricity demand projections for the DPS have been developed in a similar manner as for the MIS. The projected demand represents the "net system demand", in that they are inclusive of assumed transmission and distribution system losses but exclude the internal auxiliary consumption of power and desalination plants. They follow a similar methodology as the MIS demand forecasts, including macroeconomic growth influences and separate analyses of underlying demand and certain bulk loads, comprising mainly industrial demands, which are assessed on a customer-specific basis.

The projections are presented as a range including Low Case, High Case and central Expected Demand scenarios. All scenarios are based on an assumption of normal weather. The Low Case and High Case scenarios assume contrasting growth levels, with the same underlying assumptions for economic growth as used for the MIS projections. The projections are summarized in Figure 7.

Figure 7 Electricity Demand Projections – DPS



	Actual 2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Expected Demand									
Average Demand (MW)	370	390	410	480	510	520	560	580	7%
Underlying Demand	280	290	310	320	340	360	370	390	5%
Bulk Loads	90	100	100	160	170	170	190	190	11%
Annual Energy (TWh)	**3.2**	**3.4**	**3.6**	**4.2**	**4.4**	**4.6**	**4.9**	**5.1**	**7%**
Peak Demand (MW)	**550**	**570**	**600**	**680**	**710**	**740**	**790**	**810**	**6%**
Change from 2017-2023 Statement (MW)	*45*	*34*	*32*	*53*	*46*	*16*	*25*	-	
Low Case Demand									
Average Demand (MW)	370	380	390	450	470	480	520	530	5%
Underlying Demand	280	290	300	310	320	330	340	350	3%
Bulk Loads	90	90	90	140	150	150	180	180	10%
Annual Energy (TWh)	**3.2**	**3.3**	**3.5**	**4.0**	**4.1**	**4.2**	**4.6**	**4.6**	**5%**
Peak Demand (MW)	**550**	**560**	**580**	**650**	**670**	**690**	**730**	**740**	**4%**
Change from 2017-2023 Statement (MW)	*56*	*42*	*38*	*61*	*55*	*29*	*42*	-	
High Case Demand									
Average Demand (MW)	370	420	460	530	570	610	660	680	9%
Underlying Demand	280	310	330	340	370	390	420	440	7%
Bulk Loads	90	120	140	190	210	210	240	240	15%
Annual Energy (TWh)	**3.2**	**3.7**	**4.1**	**4.7**	**5.0**	**5.3**	**5.7**	**6.0**	**9%**
Peak Demand (MW)	**550**	**620**	**660**	**750**	**800**	**840**	**900**	**950**	**8%**
Change from 2017-2023 Statement (MW)	*23*	*46*	*41*	*22*	*-5*	*-23*	*-24*	-	

Under the Expected Demand scenario, peak demand increases at about 6% per year, from 550 MW in 2017 to 810 MW in 2024. Energy consumption is projected to grow from 3.2 TWh (corresponding to 368 MW average demand) in 2017 to 5.1 TWh (578 MW average demand) in 2024, with an average increase of 7% per year. This projection is similar to the previous 7-Year Statement (Issue 11).

The High Case scenario has peak demand growth of 8% per year and energy growth of 9% per year. The Low Case scenario projects annual energy and peak demand growth of around 5% and 4% per year respectively. They are not symmetrical around the Expected Demand scenario, as there is currently more uncertainty with respect to the potential for higher growth.

CRT impacts are embedded in the DPS demand projections as they are for the MIS. OPWP has assessed CRT impacts in 2024 at 20 MW in the Expected Demand scenario, and at 25 MW and 15 MW in the Low Case and High Case scenarios, respectively.

POWER GENERATION RESOURCES

Sources of Power

The DPS has two gas-fired power plants in operation, and a wind energy plant that is under construction. There is a reserve sharing arrangement with PDO via the 132 kV transmission connection.

Contracted Capacity and Non-Firm Energy

OPWP's generation portfolio in the DPS includes the two plants that provide guaranteed capacity and a PPA with the wind farm to provide non-firm energy. They are described in Table 6 and as follows:

- **Salalah IWPP:** capacity of 445 MW. The Salalah IWPP is a CCGT plant comprising five gas turbines and two steam turbines. It is located in the Marbat/Taqah region, and began operation in 2012.**Salalah II IPP:** capacity of 718 MW. Located in Raysut, the facility comprises eight OCGT units with a total capacity of 276 MW and six CCGT units (two blocks of 2 GTs and 1 ST each) with a total capacity of 445 MW.
- **Dhofar I Wind IPP:** installed capacity of 50 MW. The project is under construction near Harweel, for completion in 2020. OPWP has a PPA with the operator, RAECO.

Table 6 Contracted Capacity – DPS

Project Name	Contracted Capacity	Contract Type	Project company	Project status	Technology	Contract Expiry
Salalah IWPP	445 MW[a] 68,000 m³/d	PWPA	Sembcorp Salalah Power & Water Co. (SAOC)	Operational	CCGT Natural gas fired (Fuel oil as back-up)	2027
Salalah II IPP	718 MW[a]	PPA	Dhofar Generation Co. (SAOC)	Operational	OCGT CCGT Natural gas fired (Fuel oil as secondary fuel and back-up)	2033
Dhofar I wind IPP	50 MW	PPA	RAECo	Under Construction	Wind Turbine	2033

[a] Capacities are rated on a net basis (i.e. after allowing for auxiliary consumption inside the plants) at 35°C ambient temperatures output.

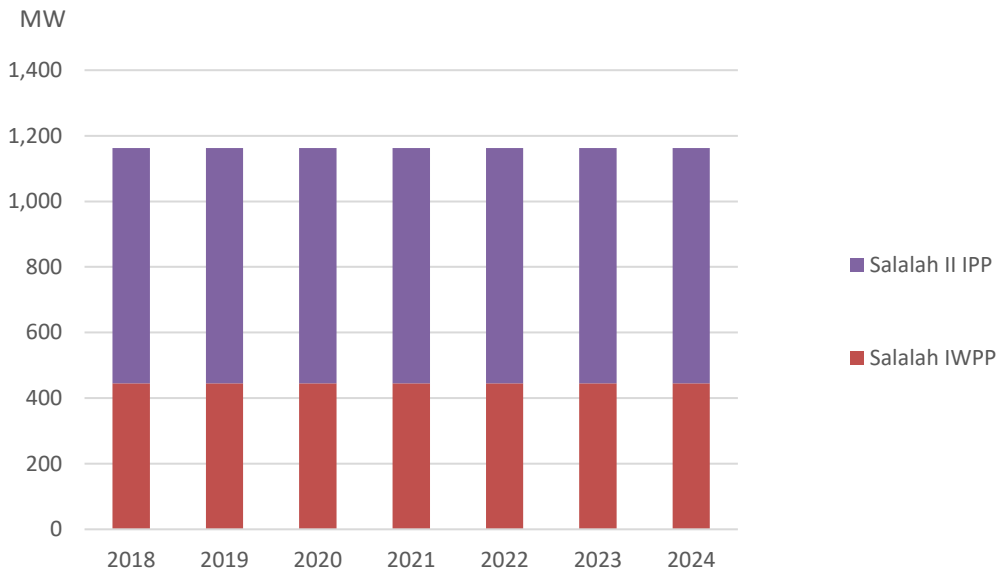
Resource Development Plan

OPWP has no plans to procure new gas-fired generation capacity for the DPS, but plans additional RE development. The Dhofar region has excellent potential for wind energy development. OPWP plans to develop a second wind energy farm for COD in 2022, with capacity of 150 MW. The timing or capacity of the project are subject to a study of grid security impacts. When the North-South Interconnect project is completed to Dhofar, OPWP expects to develop more wind energy projects in the DPS.

Summary

Figure 8 provides a summary of power generation resources for the DPS.

Figure 8 Capacity Contributions from Generation Resources – DPS



	2018	2019	2020	2021	2022	2023	2024
Contracted Capacity				Net MW [a]			
Salalah IWPP	445	445	445	445	445	445	445
Salalah II IPP	718	718	718	718	718	718	718
Total Contracted Capacity	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**
Capacity Contributions from Non-firm Contracts				MW			
Renewable Energy							
Dhofar I Wind IPP [b]	-	-	50	50	50	50	50
Dhofar II Wind IPP	-	-	-	-	-	150	150
Total Capacity	**-**	**-**	**50**	**50**	**50**	**200**	**200**
Capacity Contribution from Renewable Energy	-	-	-	-	-	-	-
Total Capacity Contribution to Peak Demand	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**

[a] All capacities are rated on a net basis (i.e. after allowing for auxiliary consumption inside the plants) at 35°C ambient temperature.

[b] Date of commissioning and contracted capacity is subject to change.

[b] Provisional import capability

RESOURCE ADEQUACY AND MITIGATION PLANS

Statutory and Regulatory Requirements

Similarly to its role in the MIS, OPWP is required by the Sector Law and its license to ensure the adequacy of generation resources in the DPS to meet future power demands. The Sector Law establishes OPWP's general responsibility to secure sufficient generation resources to meet demand and the OPWP license establishes the generation security standard as 24 LOLH.

OPWP has concluded that, on the basis of simulation studies of the DPS, a reserve margin of about 12% over peak demand is necessary to achieve the 24 LOLH standard, considering the size of the system, characteristics of generation resources, and limited access to security reserves. This establishes the capacity target for each of the three demand scenarios over the 7-year planning horizon, shown in Figure 9.

When the North-South Interconnect is connected to the DPS, planning and operations of the DPS, PDO System, and MIS will be fully integrated. OPWP expects that the reserve margin requirement for the DPS would be reduced at that time, aligning with that of the MIS.

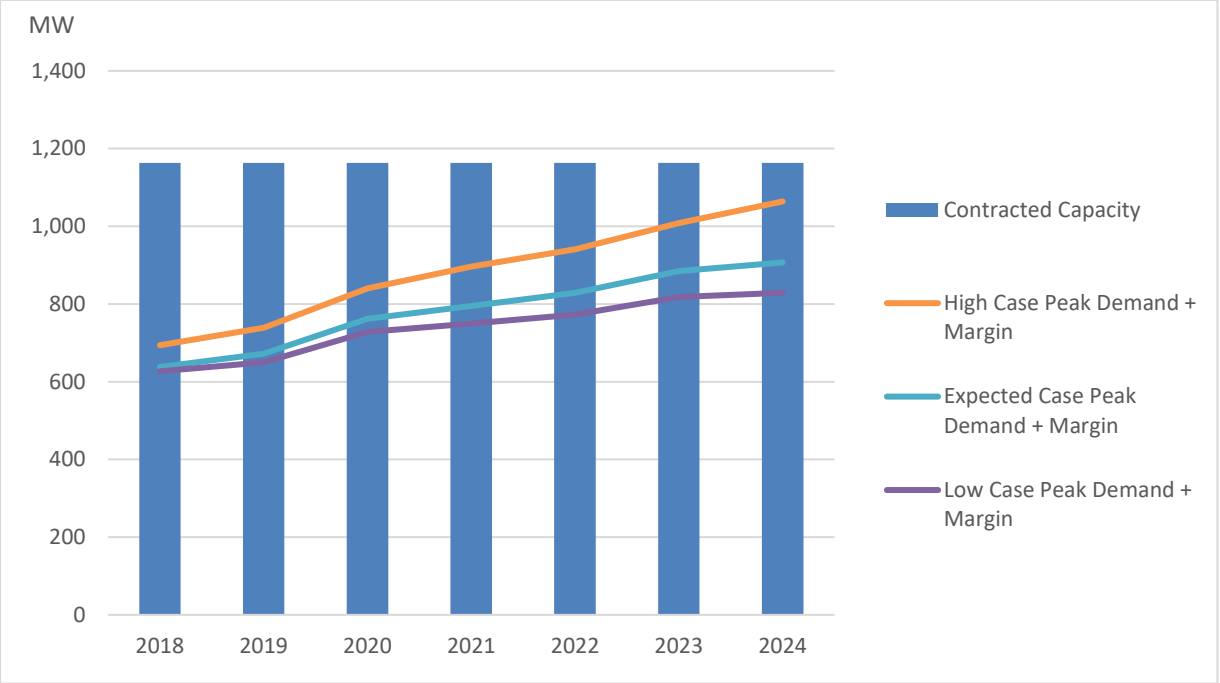
Resource Adequacy and Mitigation Plans

OPWP projects contracted capacity to be sufficient to meet the capacity targets associated with all three demand scenarios throughout the seven-year forecast period. Figure 9 and the accompanying table indicate substantial capacity surpluses, which reduce gradually due to demand growth. By 2024, the capacity surplus reduces to about 100 MW in the High Case demand scenario.

The capacity surpluses have arisen as electricity demand growth slackened sharply, just after OPWP procured the Salalah II IPP project. Industrial growth in the Salalah Free Zone has slowed, and generally the pace of economic growth and electricity demand growth is less than it was from 2012 to 2015, when demand growth averaged more than 9% per year.

Although there are costs associated with surplus capacity, the Salalah II IPP project will enable substantial gas savings due to its high efficiency. The new CCGT plant displaces generation from the older gas turbine plant, and is projected to achieve a net reduction in gas consumption in the DPS in 2018, despite 6% growth in generation output. To manage the capacity surplus, OPWP is working with PDO toward exporting energy to the southern grid of the PDO system. The existing 132 kV interconnect can support transfers of up to 150 MW, displacing generation from older and less efficient gas turbines on the PDO system.

Figure 9 Resource Adequacy – DPS



	2018	2019	2020	2021	2022	2023	2024
Generation Resources				Net MW [a]			
Total Contracted Capacity	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**	**1,163**
Expected Case Demand							
Peak Demand	570	600	680	710	740	790	810
Peak Demand + Margin	640	670	760	800	830	880	910
Deficit (Additional Capacity Required) Above Contracted Capacity	-	-	-	-	-	-	-
High Case Demand							
Peak Demand	620	660	750	800	840	900	950
Peak Demand + Margin	690	740	840	900	940	1010	1060
Deficit (Additional Capacity Required) Above Contracted Capacity	-	-	-	-	-	-	-
Low Case Demand							
Peak Demand	560	580	650	670	690	730	740
Peak Demand + Margin	630	650	730	750	770	820	830
Deficit (Additional Capacity Required) Above Contracted Capacity	-	-	-	-	-	-	-

COMBINING POWER GENERATION AND WATER DESALINATION

As in the MIS, OPWP is required to consider the opportunity for combining power generation with water desalination in the DPS, so as to benefit from economies of co-location and co-procurement.

As needs for additional water desalination and power generation capacity are confirmed, OPWP will continue to assess the potential for economic benefits that may result from co-location and co-procurement.

1.3 AD DUQM POWER SYSTEM

Ad Duqm is located on the eastern coastline of the Al Wusta region, approximately halfway between the Main Interconnected System (MIS) and the Dhofar Power System (DPS). The latest population data from the National Center for Statistics & Information reports that the total population is 9,449[13] and is expected to grow rapidly due to the development of a new economic and industrial center.

The Ad Duqm region is currently served by a relatively small integrated generation and distribution system, owned and operated by the Rural Areas Electricity Company (RAECO). RAECO owns and operates a 67 MW diesel-fuel fired power plant for supply to this grid area. RAECO is the sole licensed electricity supplier within the service area covered by the system, supplying existing and new electricity customers.

DEMAND FOR ELECTRICITY

Historical Demand

Historically, all requirements to meet electricity demands in Ad Duqm have been within the jurisdiction of RAECO. Considering the relatively small energy requirements of these areas, they have been met most economically by utilizing diesel-fired generators, located close to the areas of consumption.

Demand in this region has been largely dominated by residential and small commercial consumers. This, however, is expected to charge rapidly due to the recent and continuing development of large commercial, tourism, and industrial projects.

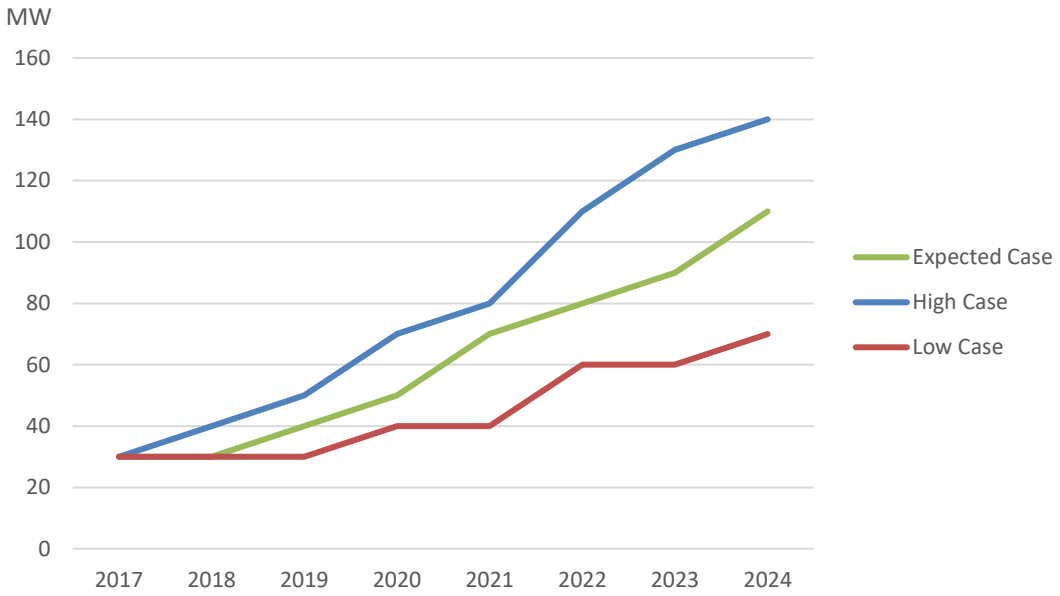
Demand Projections

The development of the Special Economic Zone Authority of Duqm (SEZAD) will contribute substantial economic and population growth. The demand for electricity in Ad-Duqm is expected to grow significantly as SEZAD realizes its ambitious development plans to transform Ad Duqm into a world class investment and leisure endpoint. The actual pace of growth is highly uncertain and depends on many factors relating to global markets, investment levels, and government incentives.

For the purposes of electricity demand projections, OPWP reports demand projections as provided by RAECO. These demand projections reflect domestic, and small industrial/commercial development. The electricity demand of projects belonging to the Oman Oil Company within Duqm SEZ are not included in this forecast, as a captive power plant is planned to meet this requirement.

[13] National Center for Statistics & Information (2016) *2016 Statistical Year Book.* Issue 44

Figure 10 Electricity Demand Projections – Ad Duqm



	2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
					MW[a]				
Expected Case	**30**	**30**	**40**	**50**	**70**	**80**	**90**	**110**	**20%**
Change from 2017-2023 Statement	*-11*	*-29*	*-30*	*-38*	*-22*	*-18*	*-15*	*-*	
High Case	**30**	**40**	**50**	**70**	**80**	**110**	**130**	**140**	**25%**
Change from 2017-2023 Statement	*-11*	*-19*	*-55*	*-88*	*-82*	*-58*	*-45*	*-*	
Low Case	**30**	**30**	**30**	**40**	**40**	**60**	**60**	**70**	**13%**
Change from 2017-2023 Statement	*4*	*-4*	*-7*	*1*	*-2*	*15*	*12*	*19*	

[a]All Numbers are rounded to the nearest 10

Under the Expected Demand scenario, peak demand is expected to grow at an average rate of 20% per year, from 30 MW in 2017 to 110 MW in 2024. The Expected Demand scenario is developed by RAECO and accounts for normal historical demand and population growth within the area and the interlinked area. In addition, this scenario includes demand related to committed and ongoing industrial and infrastructure projects within the Ad Duqm area.

The High Case scenario assumes a higher growth rate in committed and prospective projects. The High Case scenario anticipates an average growth rate of 25% in peak demand, increasing from 30 MW in 2017 to 140 MW in 2024.

These projections do not include uncommitted projects in the industrial area, i.e., the potentially large influx of industrial demand associated with SEZAD development plans. It is currently anticipated that the refinery and petrochemical complex being developed by Oman Oil Co. and others will include captive power generation to serve their own requirements. SEZAD plans large-scale industrial projects, diverse economic development and associated residential and commercial requirements over the next 30 years. The demand growth rate within the zone is expected to

accelerate rapidly as key industries become established. OPWP will attend closely to the development pace and implications for electricity demand.

POWER GENERATION RESOURCES

Sources of Power

The RAECO system serving Ad Duqm and its surrounding areas is currently supplied by Ad Duqm power station, a 67 MW diesel-fired power plant which is also owned and operated by RAECO.

Resource Development Plan

The existing 67 MW diesel-fired power plant owned and operated by RAECO is sufficient to meet growing demands through the year 2020 in the Expected Demand scenario. Figure 11 compares the demand trend with supply, including OPWP's resource development plan. As an isolated power system, RAECO can reliably supply nearly 60 MW of peak demand from its existing plant, allowing a margin equivalent to the loss of its largest generation unit (7.5 MW). If demand in Ad Duqm begins to trend along the High Case scenario, then additional resources may be needed to meet peak demand as early as 2020.

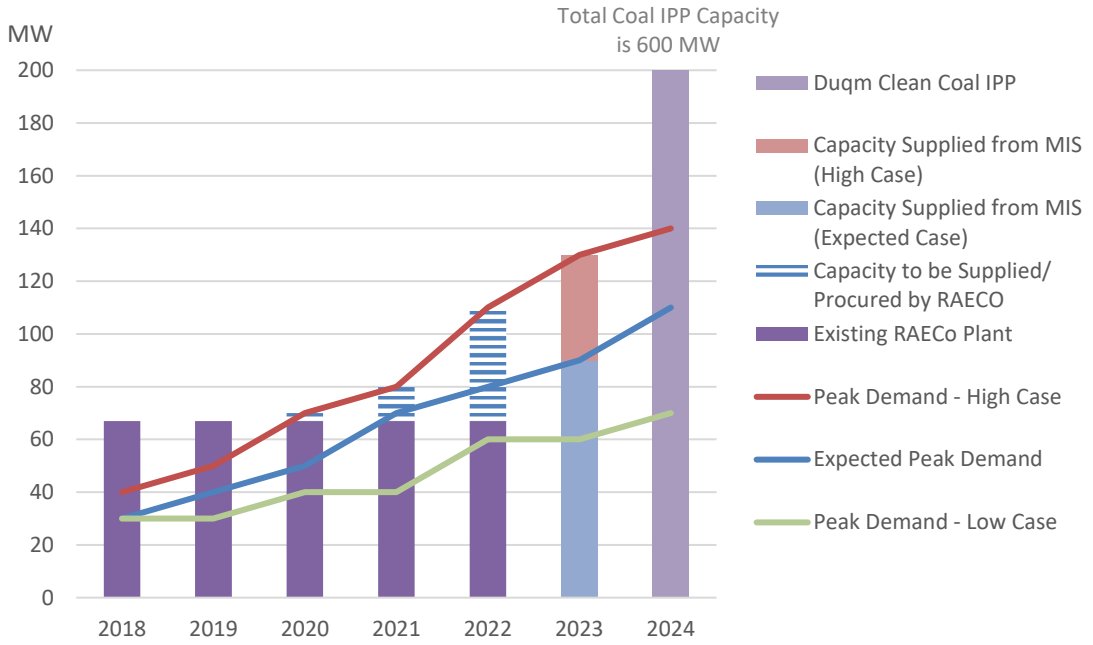
In accordance with the Government's Fuel Diversification Policy, OPWP plans to develop wind energy plants and a 1,200 MW Clean Coal IPP at Ad Duqm during this 7-year forecast period. The Duqm Clean Coal IPP has been submitted to the AER for approval, following which OPWP would begin the procurement process in 2018. The project is planned to provide 600 MW in 2024, and to reach its full capacity of 1,200 MW in 2025.

The construction schedule will require completion of the 400 kV North-South Interconnect from MIS to Duqm by 2023. The transmission line will enable development of wind energy projects at Duqm. The wind projects are planned to have installed capacity of 400 MW by 2024. They would provide economic energy to the generation portfolio, but their generation output will be intermittent and is not currently assessed to provide a reliable capacity contribution to peak demand. Together, the Duqm Clean Coal IPP and the wind energy projects are expected to export the majority of their generation output to the MIS, while securing the growth of local demand at Ad Duqm.

The transmission link to the MIS provided by the North-South Interconnect in 2023 will allow electricity supply to Ad Duqm from the MIS in that year, at much lower cost than RAECO's existing diesel generation plant. However, this leaves a supply gap from 2021 to 2022 under the Expected Demand scenario (see Figure 11). RAECO is considering options to meet the supply gap during this period, such as temporary generation, purchase from the captive power plant being developed for the Oman Oil refinery, or expansion of the existing RAECO diesel power plant.

Figure 11 demonstrates that RAECO's incremental supply requirement during the interim period from 2021 to 2022 is relatively low: up to 20 MW for the Expected Demand scenario and 50 MW for the High Case demand scenario. These needs are well within the range of supply from rental generators. However, cost considerations are important, particularly options that would reduce the high operating cost of diesel generation for baseload supply.

Figure 11 Resource Development Plan – Ad Duqm



	2018	2019	2020	2021	2022	2023	2024
Peak Demand				MW			
Expected Case	30	40	50	70	80	90	110
High Case	40	50	70	80	110	130	140
Low Case	30	30	40	40	60	60	70
Contracted Capacity							
Existing RAECO Plant	67	67	67	67	67	67	67
Prospective Capacity							
Wind IPP 2023[a]	-	-	-	-	-	200	200
Wind IPP 2024[a]	-	-	-	-	-	-	200
Duqm Clean Coal IPP	-	-	-	-	-	-	600
Capacity Supplied from MIS							
Expected Case	-	-	-	-	-	90	-
High Case	-	-	-	-	-	130	-
Low Case	-	-	-	-	-	60	-
Additional Capacity Required							
Expected Case	-	-	-	3	13	-	-
High Case	-	-	3	13	43	-	-
Low Case	-	-	-	-	-	-	-

[a] The project is also presented in MIS section

1.4 MUSANDAM POWER SYSTEM

The Musandam Governorate is located in the northern-most region of the Sultanate of Oman, and extends into the Strait of Hormuz. The Musandam Governorate is an exclave of Oman, separated from the rest of the country by the United Arab Emirates. The latest population data from the National Center for Statistics & Information reports that the total population is estimated at around 43,959[14], which is expected to grow steadily over the coming years.

DEMAND FOR ELECTRICITY

Demand Projections

The Musandam Governorate expects future developments aimed to boost touristic, economic, and commercial activities. The Expected Demand scenario as shown below was developed by RAECO.

OPWP prepared Low Case and High Case scenarios on the basis of alternate assumptions of annual growth rates for underlying demand, materialization of identified bulk consumers, and expectations for the coincidence of bulk consumers' peak demand with the peak demand on the Musandam power system. Observation of out-turns against these forecasts, and further details of specific projects, are expected to allow refinement of the forecast methodology in future OPWP Statements. The three demand scenarios are shown in Figure 12 below.

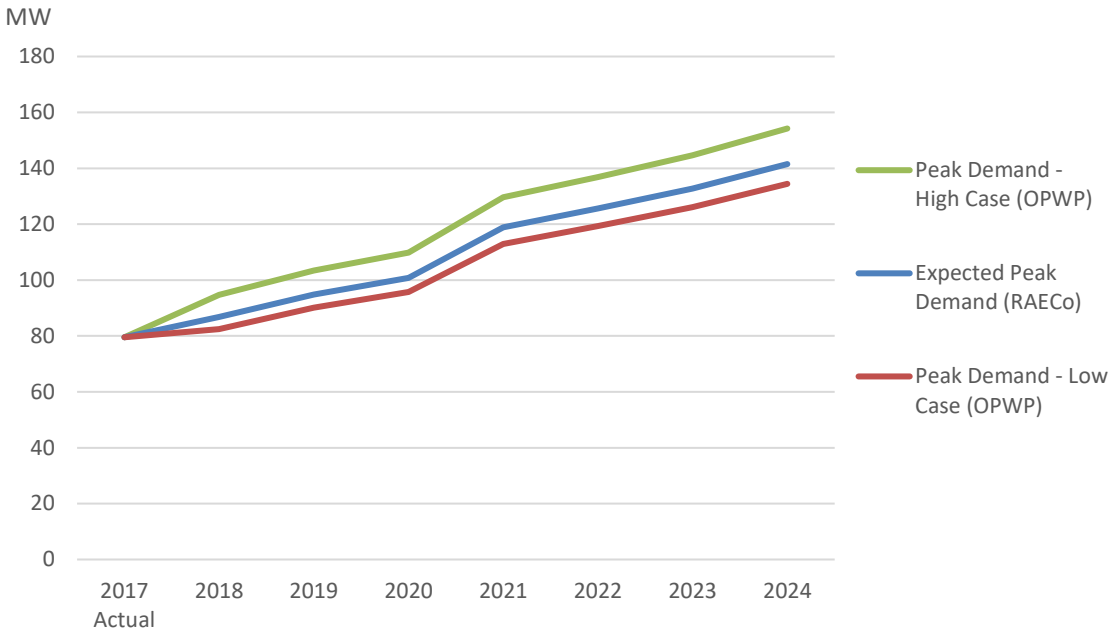
Under the RAECO Expected Demand forecast, peak demand is expected to grow from 80 MW in 2017 to 142 MW in 2024, an average increase of 9% per year.

The Low Case scenario assumes a growth rate of 8% for peak demand, increasing only to 134 MW in 2024.

The High Case scenario assumes a quicker materialization of bulk consumers, as well as increased tourism and fishery activities. Peak demand is projected to grow by an average of 10% per year to reach 154 MW in 2024.

[14] National Centre of Statistics & Information (2017) *2017 Statistical Year Book*. Issue 45

Figure 12 Electricity Demand Projections – Musandam Power System



	2017 Actual	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Peak Demand					**MW**				
RAECo Expected Case	**80**	**87**	**95**	**101**	**119**	**126**	**133**	**142**	**9%**
Change from 2017-2023 Statement	*-4*	*-9*	*-8*	*-9*	*2*	*2*	*1*	*-*	
OPWP Low Case	**80**	**82**	**90**	**96**	**113**	**119**	**126**	**134**	**8%**
Change from 2017-2023 Statement	*-2*	*-5*	*-7*	*-10*	*-13*	*-17*	*-21*	*-*	
OPWP High Case	**80**	**95**	**103**	**110**	**130**	**137**	**145**	**154**	**10%**
Change from 2017-2023 Statement	*-27*	*-30*	*-34*	*-34*	*-35*	*-36*	*-37*	*-*	

POWER GENERATION RESOURCES

Sources of Power

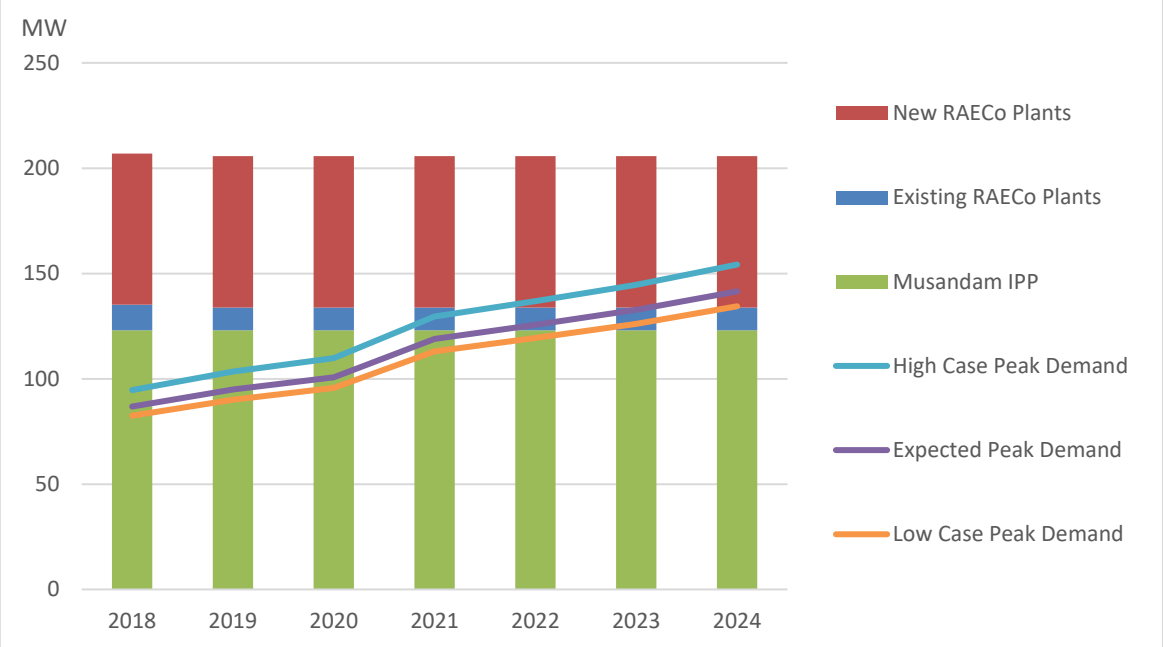
RAECO owns and operates power stations distributed near to load centers in the Musandam Governorate. They are all diesel-fired generators, with combined installed capacity of about 11 MW. RAECO is installing another 72 MW of diesel-fired generation units for completion in 2018.

Musandam IPP commenced operation in 2017 operated by a consortium led by Oman Oil Company under a PPA with OPWP. The IPP is providing net firm capacity of 123 MW using reciprocating engines fueled primarily by natural gas.

Resource Development Plan

Figure 13 illustrates Musandam's supply/demand balance. The Musandam IPP and RAECO plants provide sufficient capacity to secure all three demand scenarios through 2024. No further resources are required during this time period. Musandam IPP can meet all supply needs through 2020 in all scenarios, after which the RAECO diesel generators may be required to some extent during peak demand periods.

Figure 13 Future Power Generation Expansion Plans - Musandam Governorate



	2018	2019	2020	2021	2022	2023	2024
Peak Demand				**MW**			
Expected	87	95	101	119	126	133	142
High Case	95	103	110	130	137	145	154
Low Case	82	90	96	113	119	126	134
Existing Capacity							
RAECo Plants (Current)	12	11	11	11	11	11	11
Musandam IPP [a]	123	123	123	123	123	123	123
Total Contract Capacity	**135**	**134**	**134**	**134**	**134**	**134**	**134**
New Capacity							
RAECo Plants (New)	72	72	72	72	72	72	72
Total Existing + New Capacity	**207**	**206**	**206**	**206**	**206**	**206**	**206**

[a]The MW figures are at 45 deg. C

SECTION 2 FUEL REQUIRMENTS

OVERVIEW

FUEL DIVERSIFICATION POLICY

Since OPWP's beginnings in 2005, all power plants have been procured to utilize natural gas as their primary fuel and diesel fuel as their backup fuel. The power sector has grown rapidly, in step with the infrastructure development that has underpinned the tremendous economic growth of the Sultanate. Generation output from OPWP-contracted plants in 2018 will be three times that of 2005. The fuel requirements for power generation have likewise increased, and the power sector currently requires more than 25% of the Sultanate's natural gas production.

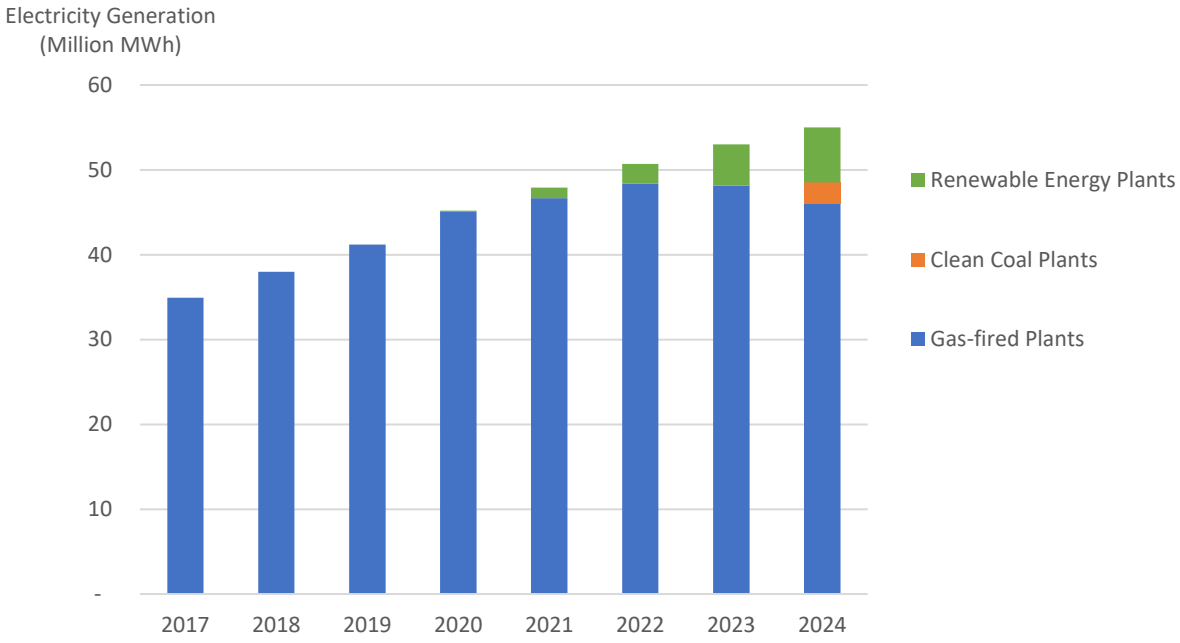
Looking to the future, the Government has now taken a decisive step to limit the growth in gas consumption by the electricity sector in order to make more gas available to fuel industrial and related economic development. In January 2018, the Government's Financial and Energy Resources Council approved a Fuel Diversification Policy, which sets the following targets for the electricity sector:

- Renewable energy will generate at least 10% of electrical energy by 2025
- Coal will be utilized to fuel up to 3,000 MW of generation capacity by 2030
- Gas efficiency will continue to be a priority of the electricity sector
- Study of alternate sources for electricity generation from local gas, such as imported gas

This policy is a welcome step toward securing the fuel requirements needed to support continued development of the electricity sector. This 7-Year Statement sets out the plans to realize these policy targets, with immediate effect. OPWP plans to develop 2,600 MW of installed capacity of renewable energy (RE) projects by 2024, aiming to exceed the 10% generation share target. Procurement documents for the first 1,200 MW clean coal plant have been submitted to the AER for approval, to be tendered in 2018. OPWP's continuing progress with gas efficiency improvements is described below. OPWP also expects to complete a study of gas imports in 2018.

The impact of these initiatives will become evident within the forthcoming 7-year period, as the new RE projects are developed and the first 600 MW block of the Duqm Clean Coal plant is commissioned in mid-2024. Figure 14 shows our projection of energy generation shares by fuel type among OPWP-contracted generators. By 2024, the gas share in the generation mix will have reduced to 83%. The gas share will reduce further in 2025 with completion of the Duqm Clean Coal project. The AER has recently announced Sahim, an initiative to facilitate development of solar PV projects in homes and in private and public facilities. Future issues of the 7 Year Statement will include impacts of such projects as estimates become available from the AER.

Figure 14 Fuel Shares in Electricity Generation

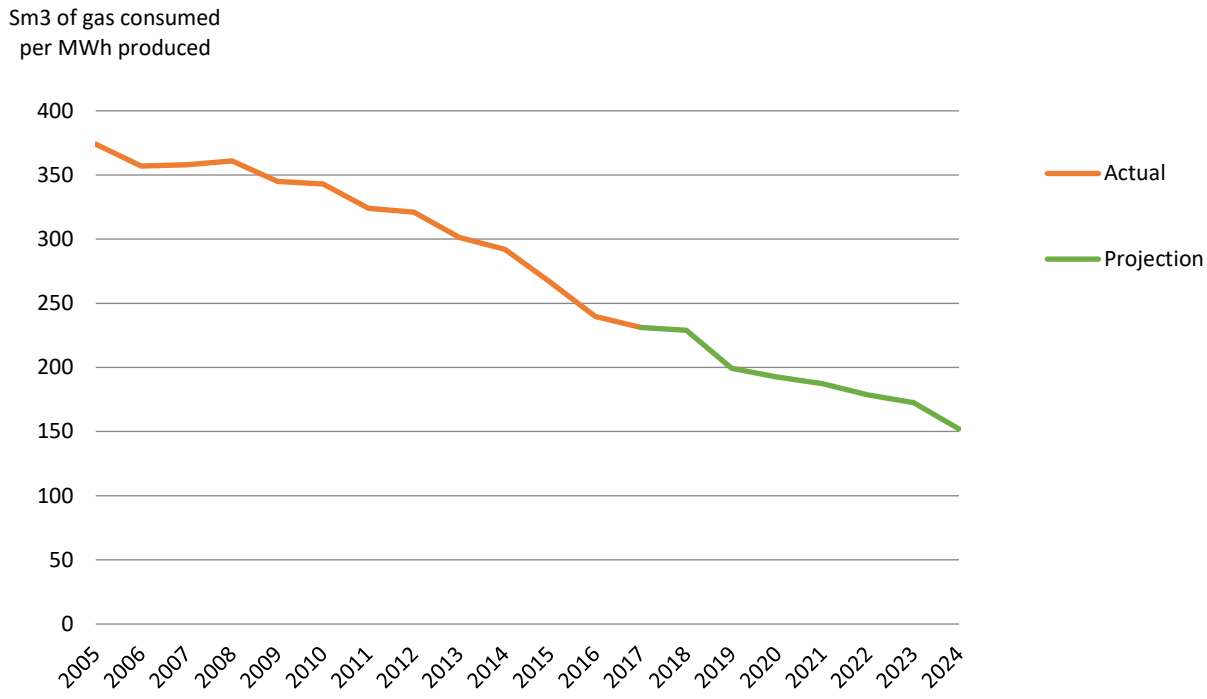


EFFICIENCY IMPROVEMENT

Since 2005, through the introduction of progressively more efficient generation plants, OPWP has achieved a 38% reduction in the gas required per unit of electricity production, from 374 Sm^3/MWh in 2005 to 231 Sm^3/MWh in 2017. OPWP's procurement of new state-of-the-art CCGT plants in 2019, and new water desalination plants that shift water production from energy intensive MSF technology to efficient RO technology, will enable further improvements in gas utilization in the coming years, as shown in Figure 15. By 2020, we expect a further 17% improvement in gas utilization.

After 2020, with the introduction of solar, wind, waste-to-energy, and clean coal plants, as well as improved dispatch control technology, OPWP expects that the gas requirements for electricity generation will have fallen to about 150 Sm^3/MWh, or 60% less than that required in 2005.

Figure 15 Gas Required per Unit of Electricity Generation – MIS



2.2 MAIN INTERCONNECTED SYSTEM

2017 Fuel Consumption

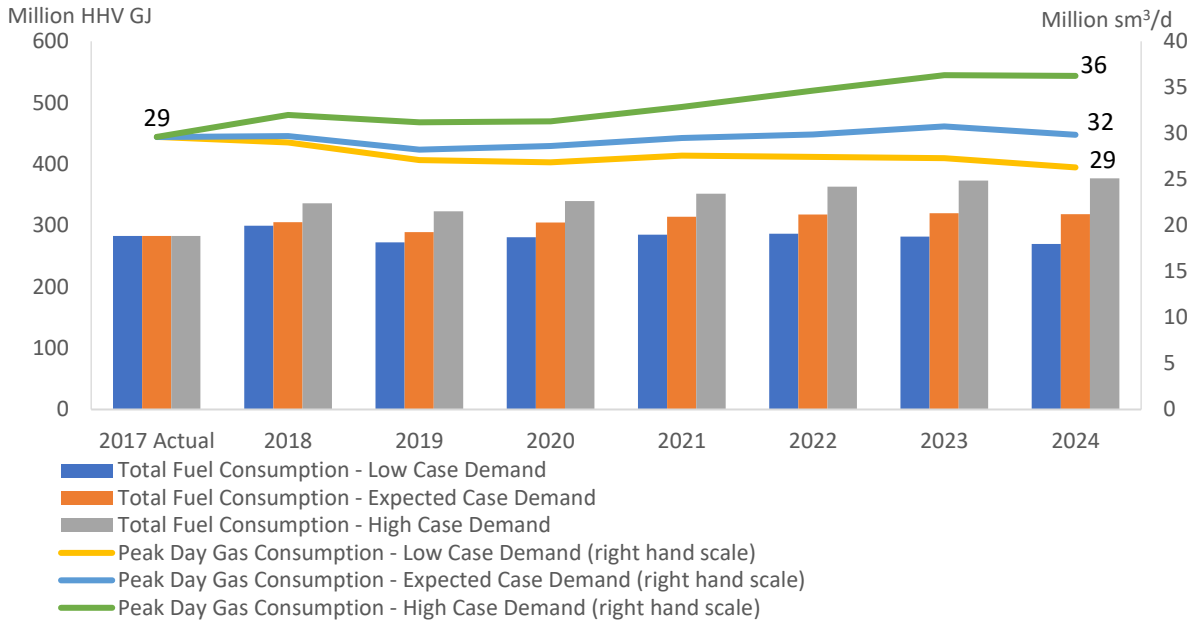
Total gas consumption at the main power and desalination plants in 2017 was about 7.25 billion Sm^3, equivalent to 19.8 million Sm^3/d, about 2% more than in 2016. The peak daily natural gas consumption in 2017 was 29.6 million Sm^3, around 3% higher than in 2016. These modest increases compare to the 6% increase in generation output in 2017, demonstrating a significant improvement in gas utilization. Completion of transmission grid upgrades has enabled better access to the most efficient generation plants.

Projected Fuel Requirements

OPWP's plans to implement the new Fuel Diversification Policy are projected to have a dramatic impact on the requirements for natural gas over the next seven years. In the previous 7-Year Statement, we projected that MIS gas consumption would grow at an average annual rate of 3%. With the introduction of RE and clean coal projects, as well as efficiency improvements, we now project an annual growth rate of only 0.5% in the MIS from 2017 to 2024.

The projections of fuel requirements in the MIS are shown in Figure 16 for each of the three demand scenarios. Under the Low Case demand scenario, fuel consumption would decrease at an average of 2% per year. In the High Case demand scenario, fuel consumption would increase at an average rate of 3% per year. In each of the three scenarios, the rate of growth in fuel consumption is well below that of electricity demand.

Figure 16 Projected Fuel Requirements – MIS



	2017 Actual	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Expected Demand									
Gas Consumption (million Sm³/d)									
Annual Average	19.8	21.4	20.3	21.3	22.1	22.3	22.4	20.5	0%
Peak Day	29.6	29.7	28.2	28.6	29.5	29.9	30.8	29.8	0%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**283**	**305**	**289**	**305**	**314**	**318**	**320**	**318**	**2%**
Gas	*283*	*305*	*289*	*305*	*314*	*318*	*320*	*293*	*0%*
Coal	-	-	-	-	-	-	-	*25*	-
Low Case Demand									
Gas Consumption (million Sm³/d)									
Annual Average	19.8	21.0	19.1	19.6	20.0	20.1	19.8	17.1	-2%
Peak Day	29.6	29.0	27.1	26.9	27.6	27.4	27.3	26.3	-2%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**283**	**299**	**273**	**281**	**285**	**287**	**282**	**270**	**-1%**
Gas	*283*	*299*	*273*	*281*	*285*	*287*	*282*	*245*	*-2%*
Coal	-	-	-	-	-	-	-	*25*	-
High Case Demand									
Gas Consumption (million Sm³/d)									
Annual Average	19.8	23.6	22.7	23.8	24.7	25.5	26.2	24.6	3%
Peak Day	29.6	32.0	31.2	31.3	32.9	34.6	36.3	36.2	3%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**283**	**336**	**323**	**340**	**352**	**363**	**373**	**377**	**4%**
Gas	283	336	323	340	352	363	373	351	*3%*
Coal	-	-	-	-	-	-	-	25	-

[a] Based on natural gas HHV of 1,050 BTU/scf

2.3 DHOFAR POWER SYSTEM

2017 Fuel Consumption

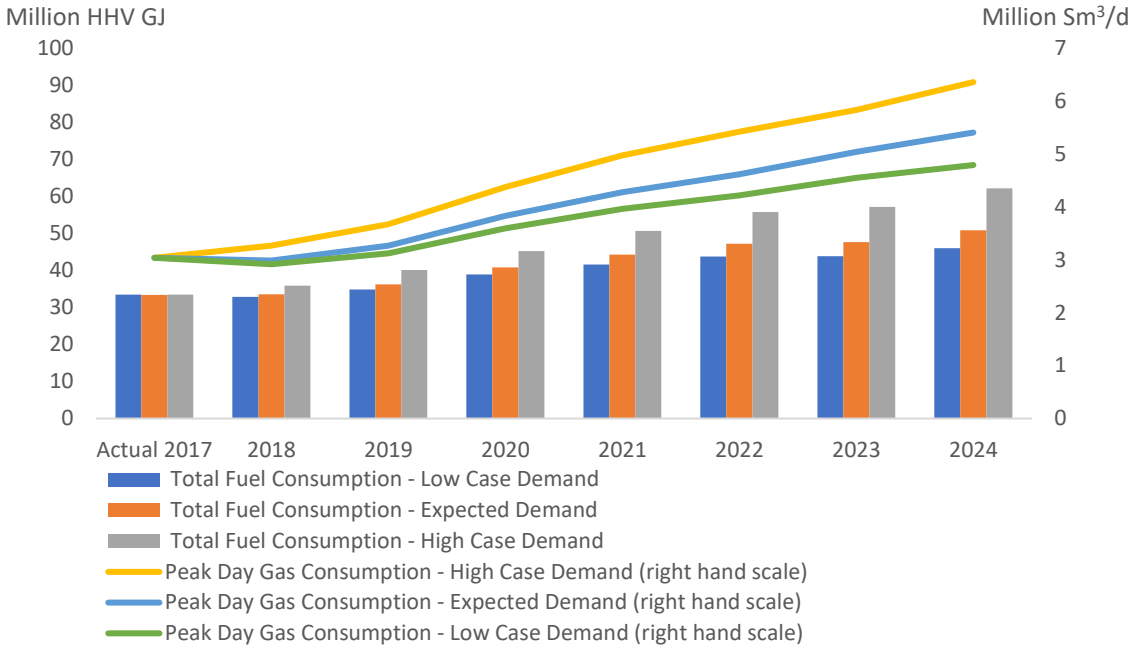
Both power generation plants in the Dhofar Power System (DPS) use natural gas as a fuel source. Total natural gas consumption in 2017 was 855 million Sm^3 (equivalent to 2.33 million Sm^3/d), about 4% higher than in 2016, whereas electricity production grew by 6%. This reflects an improvement in natural gas utilization, as transmission grid improvements and gas supply issues have been resolved that enabled higher dispatch of Salalah IWPP relative to older and less efficient units in Rusail. The peak daily natural gas consumption was 3.0 million Sm^3 in 2017 compared to 3.6 million Sm^3 in 2016.

Projected Fuel Requirements

OPWP has prepared projections for the fuel requirements of the Dhofar Power System over the 2017-2023 period for each of the three demand scenarios, illustrated in Figure 16. The projections include the impacts of the following new plants: (1) Salalah II IPP in January 2018, (2) Dhofar I Wind IPP (50 MW) at Harweel in 2020, and (3) Dhofar II Wind IPP (150 MW) in 2023.

Overall fuel consumption is expected to increase at an average rate of about 6% per year in the Expected Demand scenario. Under the Low Case demand scenario, fuel consumption increases at an average of 5% per year, whilst in the High Case demand scenario, it grows at an average rate of 9% per year. These growth rates in fuel consumption compare to energy demand growth of 7%, 5%, and 9% respectively. Compared to the previous 7-Year Statement, gas consumption in 2023 is expected to be about 10% less, at the same energy demand level, which is due mainly to the development of the Dhofar II Wind IPP.

Figure 17 Projected Fuel Requirements – DPS



	Actual 2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Expected Demand									
Gas Consumption (million Sm³/d)									
Annual Average	2.3	2.4	2.5	2.9	3.1	3.3	3.3	3.6	6%
Peak Day	3.0	3.0	3.3	3.8	4.3	4.6	5.0	5.4	9%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**33**	**34**	**36**	**41**	**44**	**47**	**48**	**51**	**6%**
Gas	*33*	*34*	*36*	*41*	*44*	*47*	*48*	*51*	*6%*
Diesel Fuel	-	-	-	-	-	-	-	-	-
Low Case Demand									
Gas Consumption (million Sm³/d)									
Annual Average	2.3	2.3	2.4	2.7	2.9	3.1	3.1	3.2	5%
Peak Day	3.0	2.9	3.1	3.6	4.0	4.2	4.6	4.8	7%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**33**	**33**	**35**	**39**	**42**	**44**	**44**	**46**	**5%**
Gas	*33*	*33*	*35*	*39*	*42*	*44*	*44*	*46*	*5%*
Diesel Fuel	-	-	-	-	-	-	-	-	-
High Case Demand									
Gas Consumption (million Sm³/d)									
Annual Average	2.3	2.5	2.8	3.2	3.6	3.9	4.0	4.4	9%
Peak Day	3.0	3.3	3.7	4.4	5.0	5.4	5.8	6.4	11%
Diesel Fuel Consumption (million litres)	-	-	-	-	-	-	-	-	-
Total Fuel Consumption (million HHV GJ)[a]	**33**	**36**	**40**	**45**	**51**	**56**	**57**	**62**	**9%**
Gas	*33*	*36*	*40*	*45*	*51*	*56*	*57*	*62*	*9%*
Diesel Fuel	-	-	-	-	-	-	-	-	-

[a] Based on natural gas HHV of 1050 BTU/scf

SECTION 3 WATER

3.1 MAIN INTERCONNECTED SYSTEM

The Main Interconnected System (MIS) serves the largest population area and the greatest demand for potable water in the Sultanate. OPWP provides desalinated water to the Public Authority for Electricity and Water (PAEW), the principal "water department". PAEW is responsible for potable water supply to consumers. The MIS is an integrated network that currently serves the potable water requirements of the Governorates of Muscat, Batinah South, Ad Dakhiliyah, Batinah North, and Al Buraymi. The MIS will expand to include supply to the Governorate of Ad Dhahirah upon completion of a new transmission pipeline in 2020.

OPWP also provides desalinated water to Majis Industrial Services Company (MISC), as backup supply to the MISC desalination plant, which supplies process water used by industry in the Sohar Industrial Port area. [15]

The MIS consists of three supply zones, each of which has sources of desalinated water under contract to OPWP, well water supply that is operated by PAEW, and transmission facilities that allow water transfer between zones under the management of PAEW. The supply zones are as follows:

- **Muscat Zone** includes the potable water demands of the Governorate of Muscat. The current sources of desalinated water for this zone are Ghubrah IWPP, Ghubrah II IWP, Qurayyat Temporary IWP, and transfers from the Barka Zone.
- **Barka Zone** includes the potable water demands of the Governorates of Batinah South and Ad Dakhiliyah. The current sources of desalinated water for this zone are Barka IWPP and Barka II IWPP.
- **Sohar Zone** includes the potable water demands of the Governorates of Batinah North and Al Buraymi, with the addition water demand from the Governorate of Ad Dhahirah from 2020 onwards.[16] The current source of desalinated water for this zone is Sohar IWPP.

DEMAND FOR WATER

PAEW has provided OPWP with projections of average and peak water demand for the MIS, shown in Figure 18. Peak demand represents the daily demand (including network losses) during the week of highest demand of the year.[17]

PAEW has provided two demand scenarios – Base and High – which together address uncertainty in demand growth. Both forecast scenarios are driven fundamentally by population growth, distribution network expansion, and growth in per-capita water consumption. The PAEW demand

[15] MISC supplies its customers from its own RO plant which was commissioned in December 2011. During the 7-year period from 2018 to 2024, OPWP is requested to provide desalinated water to MISC during maintenance and unplanned plant outages at the MISC RO plant. In practice, backup supply has been required for short duration. The expected water demand from MISC for this purpose is not of material volume in comparison to PAEW demand in the Sohar zone, and is not included in the demand projections.

[16] The water demand of Ad Dhahirah Governorate is not included in Sohar Zone or MIS demand projections until the date of planned connection in 2020.

[17] AER has requested further clarity of the peak to average ratios used in developing the water demand forecast. PAEW and OPWP are critically reviewing the data that is being used.

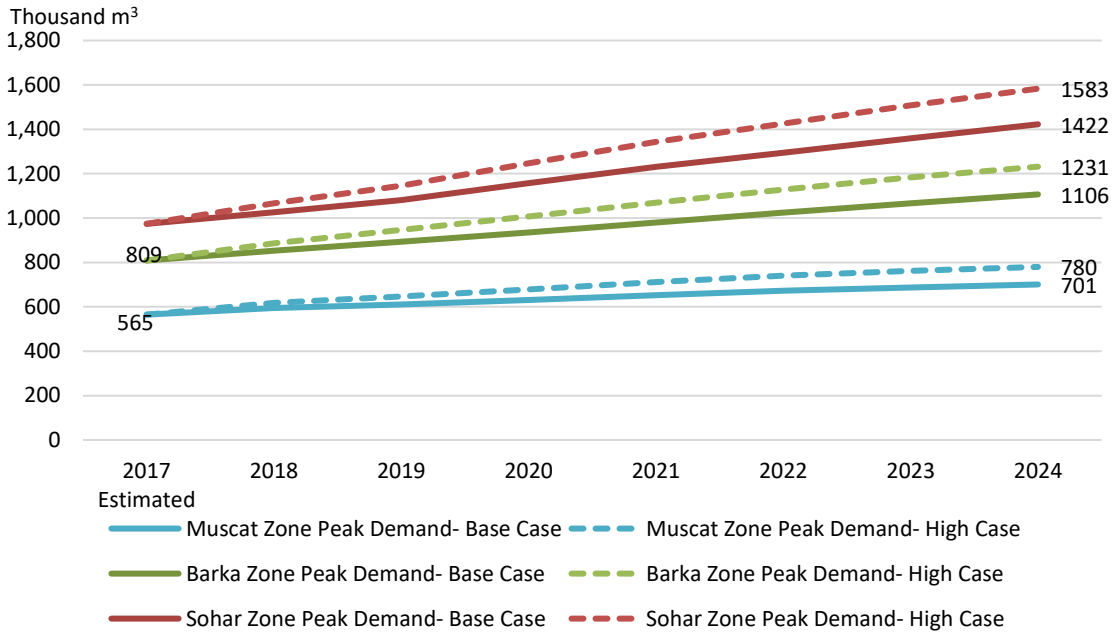
forecasts derive from population forecast scenarios published by the National Center for Statistics and Information (NCSI).[18]

The PAEW forecast for 2018 to 2024 exceeds the forecast presented in the previous 7 Year Statement, Issue 11. The increase in peak demand is about 5% in the Base Case (118,000 m^3/d) and about 3% in the High Case (83,000 m^3/d).

PAEW's Base and High Case scenarios differ primarily in assumptions for the near-term pace of population growth. The High Case scenario assumes higher growth reflecting a continuation of the strong trends in population growth and housing expansion witnessed in the past years. It projects average annual growth of about 7% over the forecast horizon to 2024. The High Case scenario aims to establish a plausible upper bound to water demand in order to plan for adequate supply.

OPWP notes that annual demand growth has been relatively high in recent years: 99,000 m^3/d in 2015, 78,000 m^3/d in 2016, and 77,000 m^3/d in 2017. The latter two years' growth have occurred during the economic slowdown. PAEW projects average demand growth of 65,000 m^3/d in the Base Case and 88,000 m^3/d in the High Case for the next 7 years.[19] In this context, the High Case appears to represent a plausible planning target, though there may be upside potential even to this, in an economic recovery scenario.[20]

Figure 18 Water Demand Projections – MIS



[18] National Centre for Statistics and Information, "Population Projections in the Sultanate of Oman, 2015-2040", 2014 (in Arabic); Population Statistics Bulletin, Issue 6, 2016.

[19] The relatively low growth rates reflect PAEW's expectation that budget constraints will reduce the pace of network expansion to areas that are currently served by water tankers. The water tankers are also supplied by the water network. However, experience demonstrates that consumers supplied by tankers will typically double their water demand upon connection to the water network.

[20] OPWP has prepared a demand forecast (not shown) on the basis of econometric impacts on population, which suggests a High Case scenario where demand may be about 9% higher by 2024 than the PAEW forecast. The pace of network connection may constrain demand realization. However, it is also plausible that PAEW may be directed to resume its network expansion during an economic growth period.

	2017 Estimated [a]	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Base Case Scenario				Thousand m^3/d					
Muscat zone									
Peak Demand	565	595	610	630	652	672	687	701	3%
Average Annual Demand	494	496	507	524	542	559	571	582	2%
Barka zone									
Peak Demand	244	257	283	305	327	353	379	406	8%
Average Annual Demand	154	216	238	257	276	298	321	343	12%
Sohar zone									
Peak Demand	165	174	187	222	251	270	293	316	10%
Average Annual Demand	144	145	157	187	212	228	247	265	9%
Total MIS									
Peak Demand	**974**	**1026**	**1081**	**1158**	**1231**	**1294**	**1359**	**1422**	**6%**
Change from 2017-2023 Statement	-11	10	14	16	29	50	65	-	
Average Annual Demand	**793**	**857**	**902**	**968**	**1031**	**1084**	**1139**	**1191**	**6%**
Change from 2017-2023 Statement	-23	19	25	28	41	61	73	-	
High Case Scenario									
Muscat zone									
Peak Demand	565	618	647	679	712	740	762	780	5%
Average Annual Demand	494	514	535	561	588	611	629	643	4%
Barka zone									
Peak Demand	244	267	300	328	357	388	420	452	9%
Average Annual Demand	154	224	251	275	299	326	353	379	14%
Sohar zone									
Peak Demand	165	181	198	239	274	297	325	352	11%
Average Annual Demand	144	150	166	201	230	249	271	293	11%
Total MIS									
Peak Demand	**974**	**1067**	**1145**	**1246**	**1343**	**1426**	**1507**	**1583**	**7%**
Change from 2017-2023 Statement	-53	-15	-12	-9	4	26	41	-	
Average Annual Demand	**793**	**888**	**952**	**1037**	**1117**	**1187**	**1253**	**1315**	**7%**
Change from 2017-2023 Statement	-55	0	5	9	23	42	55	-	

WATER SUPPLY RESOURCES

The sources of potable water supply include operating water desalination plants, new desalination plants under construction or procurement, and PAEW sources. The water desalination resources that are under contract with OPWP in the MIS are summarized in Table 7.

OPWP's contracted sources of desalinated water in the MIS are described as follows:

- **Ghubrah IWPP**. Owned and operated by Ghubrah Power and Desalination Company under a PWPA with OPWP, the Ghubrah IWPP comprises five MSF units with a current capacity of 140,200 m^3/d (31 MIGD). The PWPA for water desalination units will expire in September 2018. All desalination units are expected to be decommissioned upon contract expiry.

- **Barka IWPP**. Owned by ACWA Power Barka and operated under a PWPA with OPWP, the Barka IWPP was originally contracted with a desalination capacity of 91,200 m^3/d (20 MIGD) using MSF technology, and has added RO capacity of 45,000 m^3/d (10 MIGD) in 2014 and 57,000 m^3/d (12.5 MIGD) in 2016. The supply contracts for Barka IWPP are scheduled to expire in December 2021. The current agreement provides contracted desalinated capacity of the RO plants, while the MSF units are intended to remain on standby, to be utilized as a contingency reserve.

- **Barka II IWPP.** Owned by SMN Power Barka and operated under a PWPA with OPWP, the Barka II IWPP has a capacity of 120,000 m^3/d (26 MIGD) using RO technology. The PWPA will expire in March 2024.

- **Sohar IWPP.** Owned by Sohar Power Company and operated under a PWPA with OPWP, Sohar IWPP has a desalination capacity of 150,000 m^3/d (33 MIGD), using MSF units. The PWPA will expire in March 2022.

- **Ghubrah II IWP.** Owned by Muscat City Desalination Company and operated under a WPA with OPWP, the plant has contracted desalination capacity of 191,000 m^3/d (42 MIGD) using RO technology.

- **Qurayyat IWP.** Awarded in December 2014 to the Qurayyat Desalination Company, and to be operated under a WPA with OPWP, Qurayyat IWP has contracted desalination capacity of 200,000 m^3/d (44 MIGD), using RO technology. It is currently expected to begin commercial operation in Q2, 2018.

- **Barka IV IWP.** Awarded in November 2015 to Barka Desalination Company, and to be operated under a WPA with OPWP with contracted capacity of 281,000 m^3/d (62 MIGD), using RO technology, Barka IV IWP is expected to begin commercial operation on schedule in Q2, 2018.

- **Sohar III IWP.** Awarded in November 2015 to Myah Gulf Desalination Company, and to be operated under a WPA with OPWP with contracted capacity of 250,000 m^3/d (55 MIGD), using RO technology, Sohar III IWP is currently expected to begin commercial operation in Q4, 2018.

- **Qurayyat Temporary IWP.** Owned by Muscat Water LLC, and operated under a WPA with OPWP, the Qurayyat Temporary IWP has contracted capacity of 8,000 m^3/d (1.8 MIGD), using RO technology. The WPA expires in June 2018, and allows for extension for up to an additional four years. This project provides water supply to Qurayyat town until supply is available from PAEW's Wadi Dayqah project or other source.

Table 7 Water Desalination Plants – MIS

Project	Contracted Capacity	Contract Type	Plant Owner	Plant Status	Technology	Contract Expiry
Barka IWPP	91,200 m^3/d	PWPA	ACWA Power Barka (SAOG)	Operational	MSF	2021
	45,000 m^3/d	WPA		Operational	RO	2021
	57,000 m^3/d	WPA		Operational	RO	2021
Barka II IWPP	120,000 m^3/d	PWPA	SMN Barka Power Co. (SAOC)	Operational	RO	2024
Barka IV IWP	281,000 m^3/d	WPA	Barka Desalination Co. (SAOC)	Under construction	RO	2038
Ghubrah IWPP	140,200 m^3/d	PWPA	Al Ghubrah Power and Desalination Co. (SAOC)	Operational	MSF	2018
Sohar IWPP	150,000 m^3/d	PWPA	Sohar Power Co. (SAOG)	Operational	MSF	2022
Ghubrah II IWP	191,000 m^3/d	WPA	Muscat City Desalination Co. (SAOC)	Operational	RO	2038
Qurayyat IWP	200,000 m^3/d	WPA	Qurayyat Desalination Co. (SAOC)	Under construction	RO	2037
Qurayyat Temporary IWP	8,000 m^3/d	WPA	Muscat Water LLC	Operational	RO	2018
Sohar III IWP	250,000 m^3/d	WPA	Myah Gulf Desalination Co. (SAOC)	Under construction	RO	2038

In addition to the foregoing sources that are under contract to OPWP, PAEW operates wellfields at several locations in the MIS that offset the need for water desalination capacity. The production capacity from these sources is shown in aggregate by year in Figures 18A, 18B, 18C and 18D. The Government has a policy to limit water extraction from wellfields to allow natural replenishment of underground aquifers. Some wellfields are experiencing a decline in water quality due to encroaching salinity from over-use. Hence, wellfields are considered as emergency water resources, and the extent of their availability during the forecast period is somewhat uncertain.

RESOURCE ADEQUACY AND DEVELOPMENT PLAN - MIS

The expansion plan for water desalination capacity aims to meet peak demand, plus a 14.3% margin for supply security. The reserve margin is a provision that allows supply during a temporary failure of the transmission network or a desalination plant. This represents a system security measure that is analogous to the generation security standard used to assess power generation capacity requirements. PAEW is currently reviewing the margin requirement, with assistance from OPWP.

OPWP's assessment of resource adequacy and development plans is presented by supply zone. It shows the extent of transfers between zones, inter-zonal reserve sharing, and constraints that are otherwise not evident in a summary presentation of the MIS.

Muscat Zone

The Muscat zone is currently supplied by the Ghubrah IWPP, Ghubrah II IWP, Qurayyat Temporary IWP, and PAEW resources which include wellfields and a temporary RO plant at Ghubrah. Qurayyat IWP is expected to begin commercial operation in the latter part of Q2 2018. A partial allocation of its full capacity is included in OPWP's supply balance as the expected contribution from pre-COD water, based on the current status of commissioning activities. Currently, local resources within the Muscat zone are not sufficient to meet demand, and water transfers from the Barka IWPPs are required to provide for the balance.

Figure 18A provides a summary of annual water supply requirements and supply sources in the Muscat zone. Each year, the available transfer to Muscat from Barka diminishes. The transmission facility provides for transfers from Barka to Ad Dakhliyya and Muscat, and is the only source of desalinated water supply for Ad Dakhliyya. The transmission facility has a fixed capacity, and as water demand in Ad Dakhliyya increases, the volume available for transfer to Muscat declines. For the Muscat zone, rising demand and the constraint on Barka transfers contribute to a decline in reserves. In 2019, reserve capacity in the Muscat zone is no longer sufficient to meet the capacity target, and by 2021 peak demand in Muscat is projected to exceed supply sources.

OPWP will procure two projects to provide additional water desalination capacity within the Muscat zone: Ghubrah III IWP and Wadi Dayqah IWP. They are described as follows:

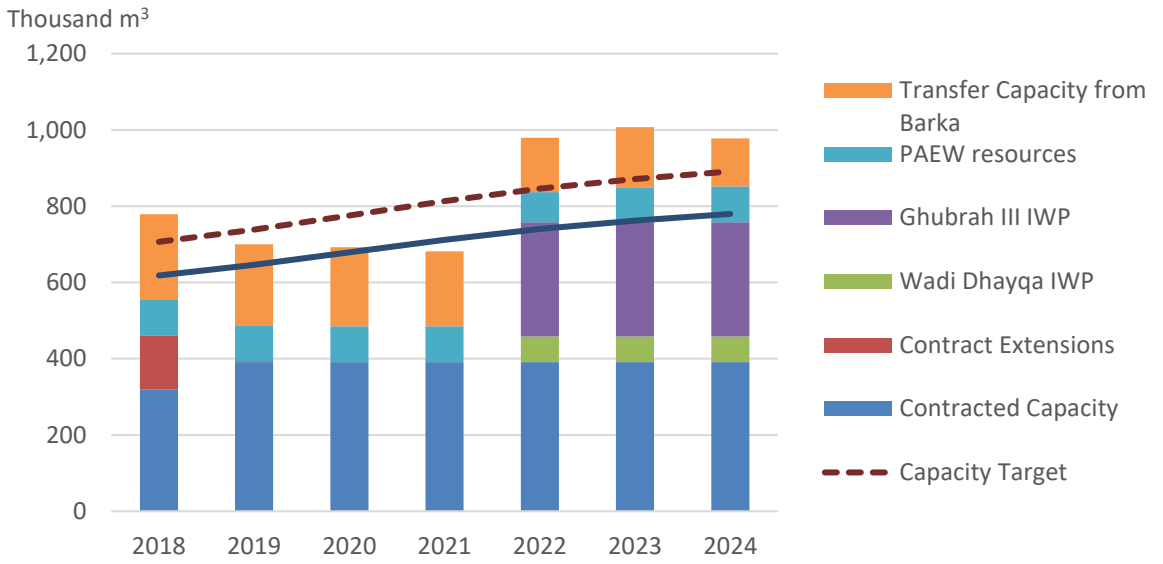
- **Ghubrah III IWP.** The project will have capacity of 300,000 m^3/d, using RO technology. OPWP began the procurement process in 2016, but PAEW put the procurement process on temporary hold in 2017 pending reassessment of water demand. The procurement process resumed in Q4 2017 on PAEW's direction, and Ghubrah III IWP is now scheduled for commercial operation in Q1 2022. The project will be located on a portion of the site occupied by Ghubrah IWPP, which is retiring and being decommissioned in 2018.

- **Wadi Dayqah IWP.** This project is designed as a dual-purpose facility to take water from the Wadi Dayqah reservoir for both agricultural and potable water supply. It will include an RO plant to provide for potable water. The capacity for potable water supply will be 67,000 m^3/d, though this may be increased for short-term emergencies subject to irrigation requirements. PAEW prepared the design concept and requested OPWP to procure the project in Q4 2017. The COD is currently scheduled for Q1 2022, though this may be revised to an earlier date subject to the ongoing technical assessment.

These capacity additions will make the Muscat zone self-sufficient in water supply from 2022 through the end of the forecast period in 2024. Resources are sufficient to meet the capacity target in each of these years.

With respect to 2021, considering a supply deficit of 30,000 m^3/d against peak demand, PAEW finds this to be an acceptable risk considering it is a High Case demand scenario. There is no deficit to peak demand in the Base Case demand scenario. PAEW also expects that there are demand management and loss reduction opportunities that may be put into effect to mitigate this level of deficit, should it occur.

Figure 19A Resource Adequacy and Development Plan – Muscat Zone



	2018	2019	2020	2021	2022	2023	2024
Muscat Zone			Thousand m³/d				
Average Annual Demand	514	535	561	588	611	629	643
Peak Demand	618	647	679	712	740	762	780
Peak Demand + Margin	707	739	776	813	846	871	891
Contracted Capacity			Thousand m³/d				
Ghubrah II IWP	191	191	191	191	191	191	191
Qurayyat Temporary IWP	8		-	-	-	-	-
Qurayyat IWP	120	200	200	200	200	200	200
Prospective Capacity							
Ghubrah I IWPP Extension	141	-	-	-	-	-	-
Qurayyat Temporary IWP	-	3	-	-	-	-	-
Wadi Dayqah IWP	-	-	-	-	67	67	67
Ghubrah III IWP	-	-	-	-	300	300	300
PAEW Resources							
Maximum Well Output[a]	94	94	94	94	79	92	94
Total Muscat Zone Capacity	**554**	**488**	**485**	**485**	**837**	**850**	**852**
Reserve over Peak Demand	-65	-159	-194	-227	97	88	72
Reserve over Peak Demand + Margin	-153	-251	-291	-328	-9	-21	-39
Transfers							
Available Transfer Capacity from Barka to Muscat[b]	225	212	207	197	143	158	126
Needed Transfer from Barka to Muscat[c]	65	159	194	197	0	0	0
Muscat Zone Capacity + Transfer Capacity	**779**	**700**	**692**	**682**	**980**	**1008**	**978**
Reserve over Peak Demand (shortfall)	161	53	13	-30	240	246	198
Reserve over Peak Demand + Margin (shortfall)	72	-39	-83	-132	134	137	87

[a]Based on PAEW planning model.
[b]Available transfer capacity is the transmission capacity less the peak demand requirement of Ad Dakhliyyah, subject to availability of Barka resources.
[c]Transfer required to meet Muscat peak demand, subject to maximum available transfer capacity.

Barka Zone

The Barka zone is currently supplied by the Barka IWPP, Barka II IWPP, and PAEW-operated wellfield resources. The Barka IV IWP is under construction and expected to begin commercial operation in Q2 2018. These resources currently exceed the demand requirements within the Barka zone, and enable transfers to support the needs of the Muscat zone, as well as providing reserves in case of need in the Sohar zone.

Figure 19B provides a summary of annual water supply requirements and supply sources in the Barka zone. The reserve over peak demand diminishes steadily due to the increasing transfer requirement to the Muscat zone. By 2021, transfers from Sohar are needed to boost the available Barka capacity for transfer to Muscat. The reserve over peak demand is quite low at that time.

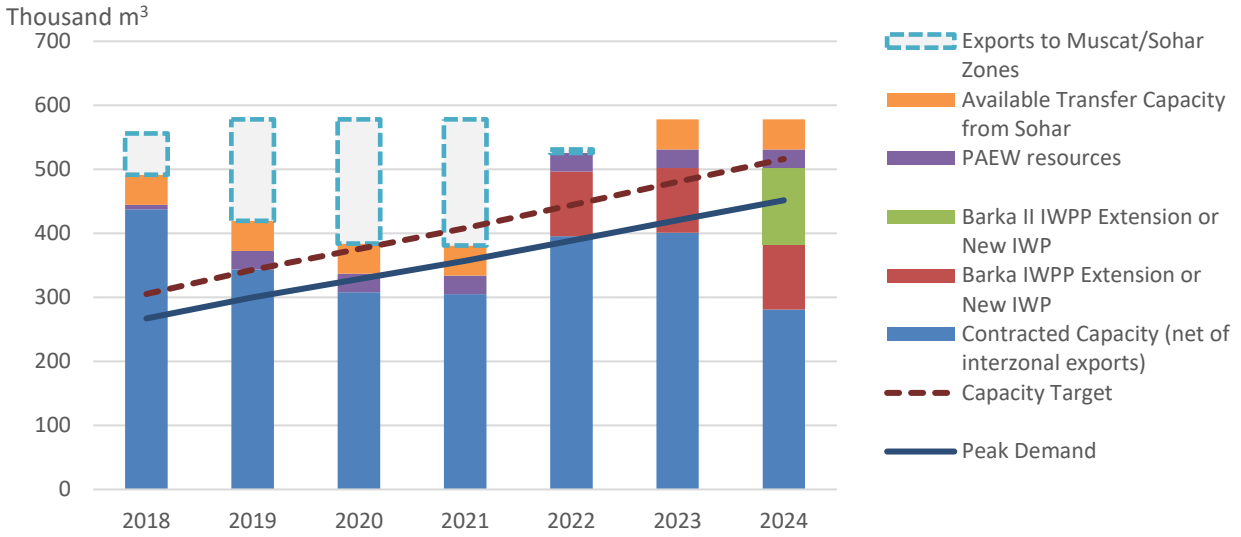
There are three developments in 2022: (1) new capacity in the Muscat zone is expected to eliminate the need for further transfers from the Barka zone, (2) the Barka IWPP PWPA expires, such that 101,000 m^3/d of capacity must be replaced, and (3) the Sohar zone requires a relatively modest transfer of capacity during the peak period due to expiry of the Sohar IWPP PWPA.

In 2018, OPWP will procure replacement capacity for the 2022 Barka IWPP contract expiration, initially via negotiation for extension with the Barka IWPP owners. If negotiations are not satisfactory then OPWP will initiate procurement of a new IWP of similar capacity in Q2 2018.

In 2024, the Barka II IWPP PWPA expires, such that 120,000 m^3/d of capacity must be replaced. OPWP will similarly initiate a negotiation for contact extension with the owners in 2020, and if necessary will procure new capacity for COD in 2024.

These procurement actions are expected to secure sufficient capacity to meet targets at a reasonable cost and provide for demand growth in this supply zone.

Figure 19B Resource Adequacy and Development Plan – Barka Zone



	2018	2019	2020	2021	2022	2023	2024
Barka Zone				Thousand m3/d			
Average Annual Demand	224	251	275	299	326	353	379
Peak Demand	267	300	328	357	388	420	452
Peak Demand + Margin	305	343	375	408	444	480	516
Contracted Capacity				Thousand m³/d			
Barka I IWPP (RO)	101	101	101	101	-	-	-
Barka I IWPP (MSF- standby only)	91	91	91	91	-	-	-
Barka II IWPP	120	120	120	120	120	120	-
Barka IV IWP	281	281	281	281	281	281	281
Prospective Capacity							
Barka IWPP Extension or New IWP	-	-	-	-	101	101	101
Barka II Extension or New IWP\							120
PAEW Resources							
Maximum Well Output[a]	7	29	29	29	29	29	29
Total Barka Zone Capacity	**509**	**531**	**531**	**531**	**531**	**531**	**531**
Reserve over Peak Demand	242	231	203	174	143	111	79
Reserve over Peak Demand + Margin	204	188	156	123	87	51	15
Transfers							
Available Transfer Capacity from Sohar to Barka[b]	47	47	47	47	0	47	47
Available Transfer Capacity from Muscat to Barka[c]							
Needed Transfer from Barka to Muscat	-65	-159	-194	-197	0	0	0
Needed Transfer from Barka to Sohar	0	0	0	0	-5	0	0
Needed Transfer from Sohar to Barka[d]	0	0	0	23	0	0	0
All Resources + Transfers	**491**	**419**	**384**	**381**	**526**	**578**	**578**
Reserve over Peak Demand (shortfall)	224	119	56	24	137	158	126
Reserve over Peak Demand + Margin (shortfall)	186	76	9	-27	82	98	62

[a] Based on PAEW planning model.

[b] The transfer capacity is 69,000 m³/d to Suwaiq, reducing to 47,000 m³/d for transfer to Barka, subject to reserves available in Sohar.

[c] Transfer capacity from Muscat becomes available upon completion of a PAEW pumping station at Ghubrah. This permits Muscat zone resources to contribute to the Ad Dakhliyya demand in the Barka zone, if required.

[d] Transfer from Sohar is needed in 2021 to South Batinah, to increase Barka capacity to provide for Muscat requirements.

Sohar Zone

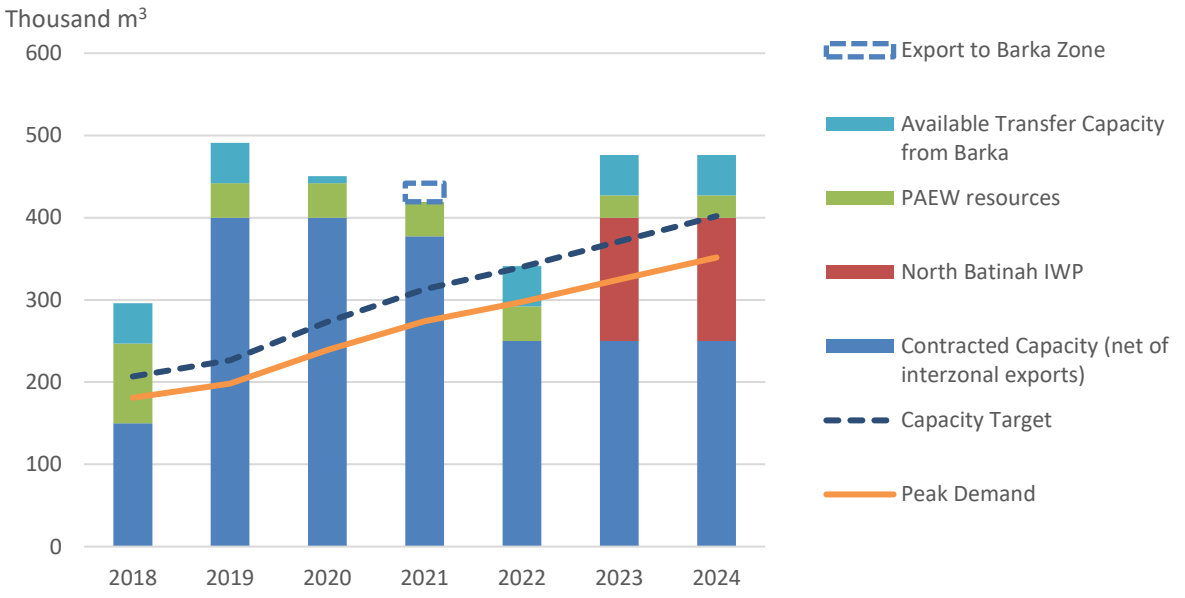
The Sohar zone is currently supplied by the Sohar IWPP and PAEW-operated wellfield resources. The Sohar III IWP is under construction and expected to begin commercial operation in Q1 2019. These resources will exceed the demand requirements of the Sohar zone through 2021. The Sohar III IWP was procured to begin operations in 2018.

Figure 19C provides a summary of annual water supply requirements and supply sources in the Sohar zone.

The Sohar IWPP PWPA expires in March 2022, creating a need for additional capacity. OPWP plans to procure a new facility, shown as North Batinah IWP with capacity of 150,000 m^3/d, through a tendering process that begins in 2018. The owners of Sohar IWPP will have the opportunity to propose an extension to the existing PWPA, which may be awarded instead of the North Batinah IWP subject to meeting the economic cost benchmark of an equivalent-capacity RO plant. In case of procurement of the new North Batinah IWP, OPWP anticipates COD in Q1 2023.

Figure 19C indicates that this timing for the North Batinah IWP implies a modest supply deficit in 2022. At that time, the Barka zone is expected to have sufficient reserve to provide capacity via transfer. Upon completion of the North Batinah IWP, reserves meet the planning target for the remainder of the forecast period.

Figure 19C Resource Adequacy and Development Plan – Sohar Zone



	2018	2019	2020	2021	2022	2023	2024
Sohar Zone				Thousand m3/d			
Average Annual Demand	150	166	201	230	249	271	293
Peak Demand	181	198	239	274	297	325	352
Peak Demand + Margin	207	227	273	313	340	371	402
Contracted Capacity				Thousand m³/d			
Sohar I IWPP	150	150	150	150	-	-	-
Sohar III IWP	-	250	250	250	250	250	250
Prospective Capacity							
North Batinah IWP	-	-	-	-	-	150	150
PAEW Resources							
Maximum Well Output[a]	97	42	42	42	42	27	27
Total Sohar Zone Capacity	**247**	**442**	**442**	**442**	**292**	**427**	**427**
Reserve over Peak Demand	66	244	203	168	-5	102	75
Reserve over Peak Demand + Margin	40	215	169	129	-48	56	25
Transfers							
Available Transfer Capacity from Barka to Sohar[b]	49	49	9	0	49	49	49
Needed Transfer from Barka to Sohar[c]	0	0	0	0	5	0	0
Needed Transfer from Sohar to Barka[d]	0	0	0	-23	0	0	0
All Resources + Transfers	**296**	**491**	**451**	**442**	**341**	**476**	**476**
Reserve over Peak Demand (shortfall)	115	293	212	168	44	151	124
Reserve over Peak Demand + Margin (shortfall)	89	264	178	129	1	105	74

[a] Based on PAEW planning model.
[b] The transfer capacity is 49,000 m³/d to Sohar, subject to reserves available in Barka.
[c] Transfer from Barka is needed in 2022 to meet peak demand in Sohar.
[d] Transfer from Sohar to South Batinah in Barka is needed in 2021, to increase Barka capacity to provide for Muscat requirements.

MIS Summary

In summary, the resource development plan provides for target reserve margins in most years. However, in the Muscat zone, the present analysis suggests that resource adequacy may be vulnerable until new capacity becomes available in 2022. During the period from 2021 to 2022, resource adequacy throughout the MIS depends upon interzonal transfers, with a relatively tight reserve margin, and is vulnerable should new projects become delayed during construction. OPWP and PAEW plan to work together to anticipate potential difficulties and to develop supply mitigation plans should they prove to be necessary. OPWP's 2017 study of the feasibility of mobile RO units, and recent experience with temporary RO facilities, were useful preparatory exercises to manage such contingencies.

3.2 SHARQIYAH WATER NETWORK

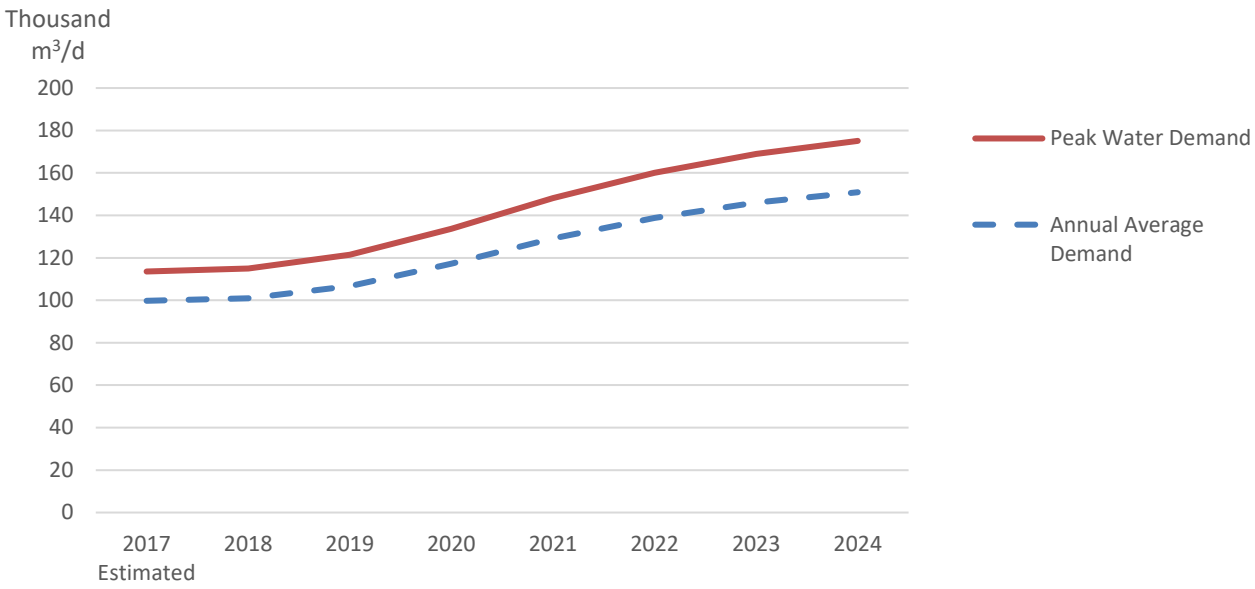
The Sharqiyah Water Network is developed and operated by PAEW, serving the northeastern region of the Governorate of Ash Sharqiyah South. It is not connected with the MIS. OPWP provides desalinated water to PAEW from the Sur II IWP. PAEW provides water to other communities of the Governorate of Ash Sharqiyah South from its own resources, including wells and RO plants.

DEMAND FOR WATER

The PAEW forecast of water demand for the Sharqiyah Zone is shown in Figure 20. Sharqiyah Zone refers to the area served by the Sharqiyah Water Network that is or will be connected to OPWP water desalination plants.

PAEW projects average growth for peak and annual average demand at 6% over the 7-year horizon, which is less than the forecast provided for the previous 7-Year Statement, Issue 11. The growth rate is not constant. PAEW is extending the Sharqiyah Water Network and increasing transmission capacity to the new Aseelah IWP by 2021. In pace with the network developments, demand growth is projected at 1% in 2018, 5% in 2019, 11% in 2020, and 10% in 2021. Consumers are observed to increase demand sharply when they are able to switch from tanker supply to network supply, as will be occurring during this period. By 2024, PAEW expects the growth rate to have fallen to 3.5%, as the bulk of network expansion projects will have been completed.

Figure 20 Water Demand Projections – Sharqiyah Water Network



	2017 Estimated[a]	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
	Thousand m³/d								
Peak Water Demand	**114**	**115**	**121**	**134**	**148**	**160**	**169**	**175**	**6%**
Change from 2017-2023 Statement	*-9*	*-15*	*-19*	*-20*	*-17*	*-13*	*-12*	-	
Annual Average Demand	**100**	**101**	**107**	**117**	**129**	**139**	**146**	**151**	**6%**
Change from 2017-2023 Statement	*-6*	*-11*	*-14*	*-15*	*-13*	*-10*	*-9*	-	

[a] Full-year water demand for 2017 is based on the actual outturn consumption up to the month of August 2017.

WATER SUPPLY SOURCES

The supply sources available to meet water demand include existing water desalination plants, new desalination plants under construction or procurement, and PAEW sources. The resources that are under contract with OPWP through WPAs to provide desalinated water production in the Sharqiyah Zone are summarized in Table 8.

Table 8 Water Desalination Plants – Sharqiyah Water Network

Project Name	Contracted Capacity	Contract Type	Project Company	Project Status	Technology	Contract Expiry
Aseelah IWP	80,000 m^3/d	WPA	Al Asilah Desalination Company (SAOC)	Under construction	RO	2041
Aseelah Temporary IWP	10,000 m^3/d	WPA	Muscat Water (LLC)	Under construction	RO	2021
Sur II IWP	131,000 m^3/d	WPA	Sharqiyah Desalination Company (SAOG)	Operational	RO	2029

OPWP's contracted sources of desalinated water for the Sharqiyah Zone include the following:

- **Sur II IWP**. Owned and operated by Sharqiyah Desalination Company under a WPA with OPWP, Sur II IWP has contracted capacity of 131,000 m^3/d (29 MIGD), using RO technology. This includes the recent 48,000 m^3/d expansion, which was completed in 2017.
- **Aseelah Temporary IWP**. Awarded in January 2016 to Muscat Water LLC, to be operated under a WPA with OPWP with contracted capacity of 10,000 m^3/d (2.2 MIGD), using RO technology, Aseelah Temporary IWP is expected to begin commercial operation in June 2018. The contract is set to expire in 2021, but has an option for contract renewal of up to two years.
- **Aseelah IWP.** Awarded in December 2017 to Al Asilah Desalination Company, to be operated under a WPA with OPWP with contracted capacity of 80,000 m^3/d (17 MIGD), using RO technology, Aseelah IWP is expected to begin commercial operation in April 2021.

In addition to the capacity under contract to OPWP, PAEW has wells at several locations. They may be utilized, to a limited degree, for water supply when desalinated water capacity is not sufficient to meet demand.

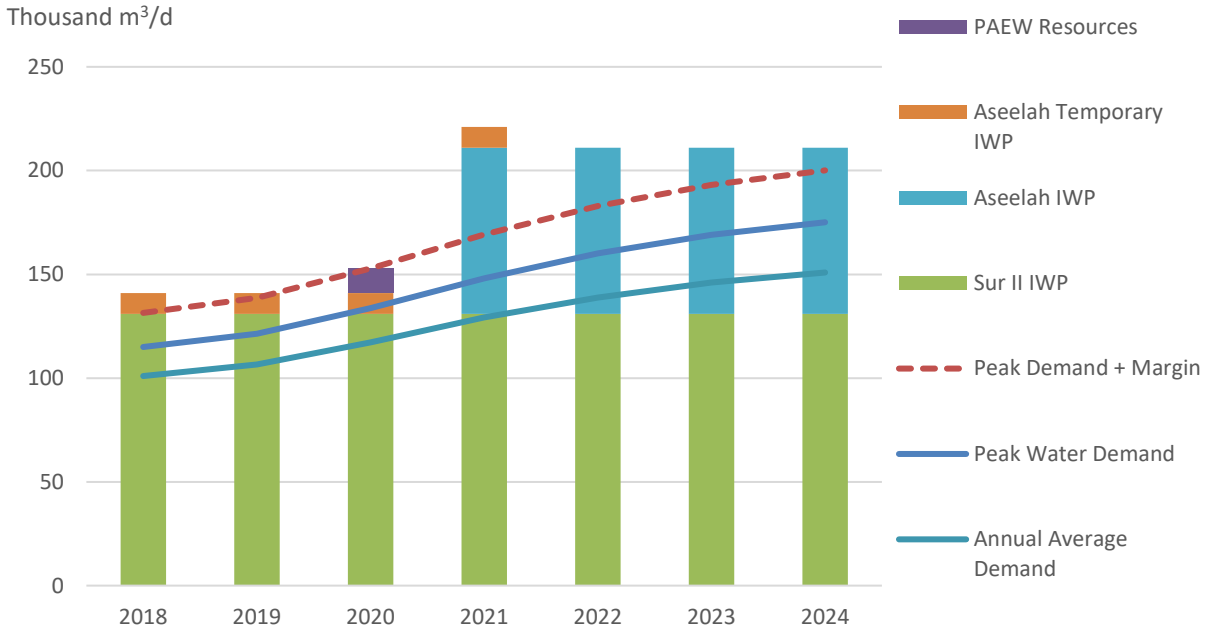
RESOURCE ADEQUECY AND DEVELOPMENT PLAN

The capacity target for the Sharqiyah Zone is a margin of 14.3% over peak demand, as it is for the MIS. Figure 21 compares the capacity target to the supply plan.

The figure demonstrates that contracted capacity is sufficient to meet in all years except 2020. In 2020, the existing capacity is sufficient to meet peak water demand, but with only a slight margin that is below the target. PAEW well resources are considered as an emergency supply source if a deficit should arise.

The Aseelah IWP was awarded by OPWP in Q4, 2017 and is expected to achieve COD on schedule in Q2, 2021. From 2021 onwards, desalinated water capacity is expected to meet the capacity target requirements.

Figure 21 Resource Adequacy and Development Plan – Sharqiyah Water Network



	2018	2019	2020	2021	2022	2023	2024
Supply Requirements				Thousand m³/d			
Peak Water Demand	**115**	**121**	**134**	**148**	**160**	**169**	**175**
Peak Demand + Margin	**131**	**139**	**153**	**169**	**183**	**193**	**200**
Contracted Capacity							
Sur II IWP	131	131	131	131	131	131	131
Aseelah Temporary IWP[a]	10	10	10	10	0	0	0
Aseelah IWP[b]	0	0	0	80	80	80	80
Total Contracted Capacity	**141**	**141**	**141**	**221**	**211**	**211**	**211**
Reserve over Peak Demand (Shortfall)	**26**	**20**	**7**	**73**	**51**	**42**	**36**
Reserve over Peak Demand + Margin (Shortfall)	**10**	**2**	**-12**	**52**	**28**	**18**	**11**
PAEW Resources Supply[c]	0	0	12	0	0	0	0

[a] Expected COD for Aseelah Temporary IWP is in Q2 2018.

[b] Expected COD for Aseelah IWP is in Q2 2021.

[c] PAEW wells or tankers supply are considered only as an emergency supply in the near term.

3.3 DHOFAR WATER NETWORK

The Directorate General of Water (DGW) in the Office of the Minister of State and Governor of Dhofar is the principal "water department" responsible for potable water supply to consumers, and for the development, operation and maintenance of the Dhofar Water Network. OPWP provides desalinated water to DGW.

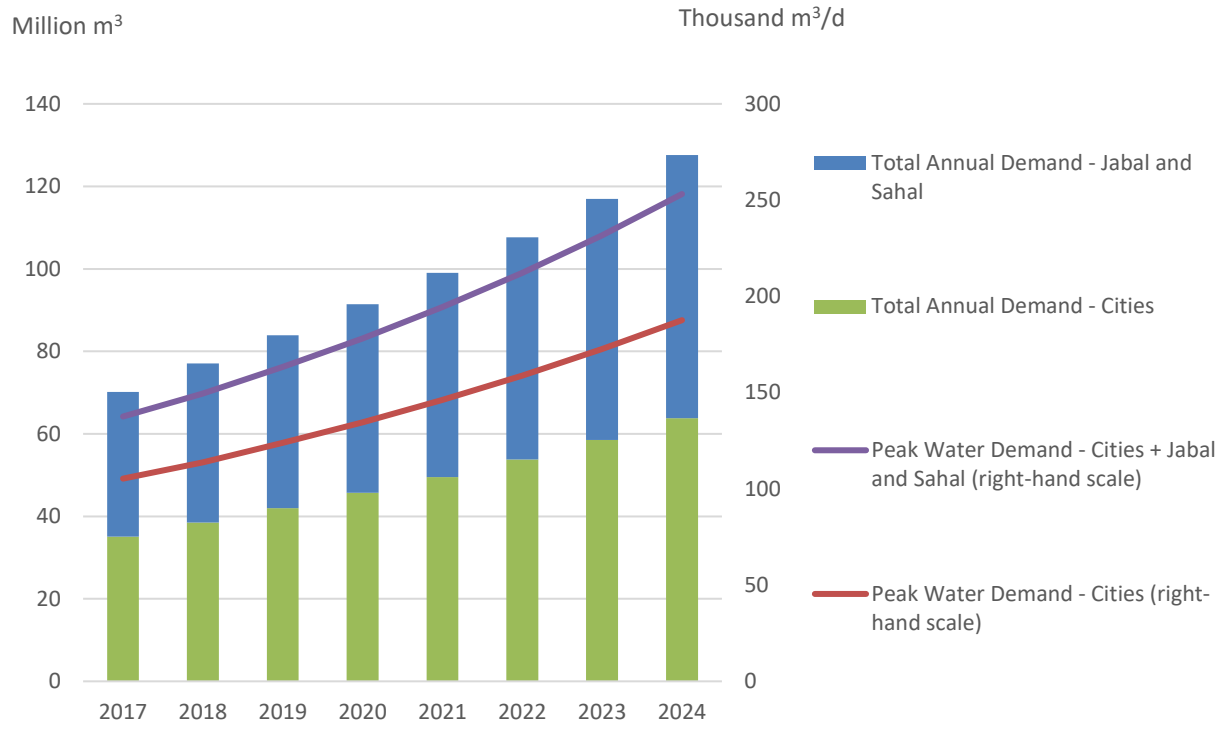
DEMAND FOR WATER

DGW has provided OPWP with the water demand projection for the Governorate of Dhofar, shown in Figure 21. It includes the aggregated potable water demands of the wilayats of Salalah, Taqah and Marbat.

DGW has differentiated the forecast into two demand groups: (1) Cities of Salalah, Taqah, and Mirbat, which comprise demand served by the existing water distribution network; and (2) Jebel/Sahal, which represents the demand in Jebel and Sahal areas that are not currently connected to the network. The Jebel/ Sahal demand is currently served by local wells and by tankers. DGW has plans to expand its network to supply the Jebel/Sahal communities during the forecast period. The expansion plans are under study and have not yet been approved by the Government. However, the water supply plan considers a scenario in which the expansion occurs.

The projected growth rate is unchanged from the projection included in the previous 7-Year Statement, representing 9% growth per year for peak and annual demand over the forecast period. The wilayat of Salalah comprised around 91% of the total water consumption in 2017. This share is projected to decline slightly over the next 7 years due to higher growth rates in the wilayats of Marbat and Taqah. The respective growth rates for the wilayats of Salalah, and Taqah and Mirbat are 8%, 12%, and 21% annually during the forecast period.

Figure 22 Water Demand Projections – Dhofar Water Network



	2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Peak Water Demand				Thousand m³/d					
Cities (Network)	105	114	124	135	146	159	173	188	9%
Jabal and Sahal (Non-network)	32	36	39	44	48	53	59	66	11%
Total	**138**	**150**	**163**	**178**	**194**	**212**	**232**	**253**	**9%**
Change from 2017-2023 Statement	*1*	*0*	*0*	*0*	*0*	*0*	*0*	-	
Annual Demand				Million m³					
Cities (Network)	35	39	42	46	50	54	59	64	9%
Jabal and Sahal (Non-network)	11	12	13	15	16	18	20	22	10%
Total	**46**	**51**	**55**	**60**	**66**	**72**	**78**	**86**	**9%**
Change from 2017-2023 Statement	*-0.2*	*0*	*0*	*0*	*0*	*0*	*0*	-	

WATER SUPPLY SOURCES

The sources of water supply include water desalination plants under contract to OPWP and groundwater resources operated by DGW. OPWP has two water desalination plants under contract for water supply to DGW. They are described in Table 9 and as follows:

- **Salalah IWPP.** Owned and operated by Sembcorp Salalah Power and Water Company under a PWPA with OPWP, Salalah IWPP has a capacity of 68,000 m^3/d (15 MIGD), using RO technology, and was commissioned in 2012.

- **Salalah III IWP.** Awarded in December 2017 to Dhofar Desalination Company, to be operated under a WPA with OPWP with contracted capacity of 113,650 m^3/d, Salalah III IWP is scheduled to begin commercial operations in Q1 2020.

In addition to this desalination capacity, DGW uses a network of groundwater sources to meet the balance of water demand. DGW estimates that the groundwater supplies have a total capacity of around 100,000 m^3/d to 110,000 m^3/d (including 70,000 m^3/d in the cities). DGW plans to utilize desalinated water to meet average and peak demand requirements, and to utilize groundwater from wells only as a reserve for emergency supply. This is also consistent with national policy to limit ground well production to replenish aquifers.

Table 9 Water Desalination Plants – Dhofar Water Network

Project Name	Contracted Capacity	Contract Type	Project Company	Project Status	Technology	Contract Expiry
Salalah IWPP	68,000 m^3/d	PWPA	Sembcorp Salalah Power & Water Company (SAOC)	Operational	RO	2027
Salalah III IWP	113,650 m^3/d	WPA	Dhofar Desalination Company (SAOC)	Under Construction	RO	2040

RESOURCE ADEQUECY AND DEVELOPMENT PLAN

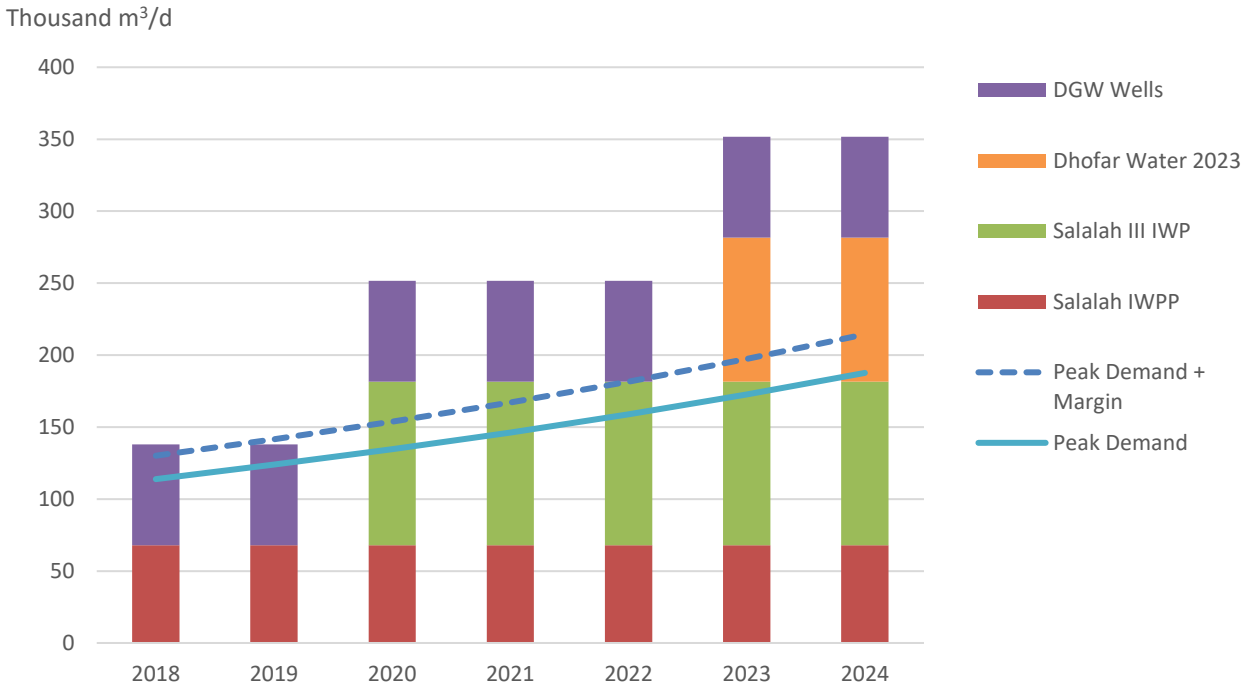
The resource adequacy presentation addresses two scenarios: (1) Dhofar Cities' demand only, and (2) Dhofar Cities' and Jebel/Sahal demand, which corresponds to DGW's proposed network expansion plan. The capacity target assumes the same 14.3% reserve margin standard as the MIS and Sharqiyah Zone in the northern regions of the Sultanate.[21]

Figure 23 provides a summary of the demand/supply balance for the next 7 years under the first scenario, restricting demand to the current extent of the Dhofar Water Network. Until completion of the Salalah III IWP in 2020, desalinated water capacity is not sufficient to meet demand and must be supplemented by groundwater. DGW wells capacity is expected to meet the balance of demand and reserve target.

The two contracted water desalination plants have sufficient capacity to meet peak water demand until 2024. Additional desalinated water capacity would be needed at that time to fulfill DGW's objective that groundwater capacity should be reserved for emergency supply only.

OPWP and DGW have selected a site at Raysut for a new Dhofar Water project the projected capacity need. It is nominally specified with a capacity of 100,000 m^3/d, pending MOF approval. This capacity level would address demand growth in this scenario for at least 3-4 years beyond 2024, depending upon the extent of demand from tankers supply to the Jebel and Sahal areas.

Figure 23 Resource Adequacy and Development Plan – Dhofar Cities Only



[21] The basis for and appropriate value of this margin is under review by OPWP.

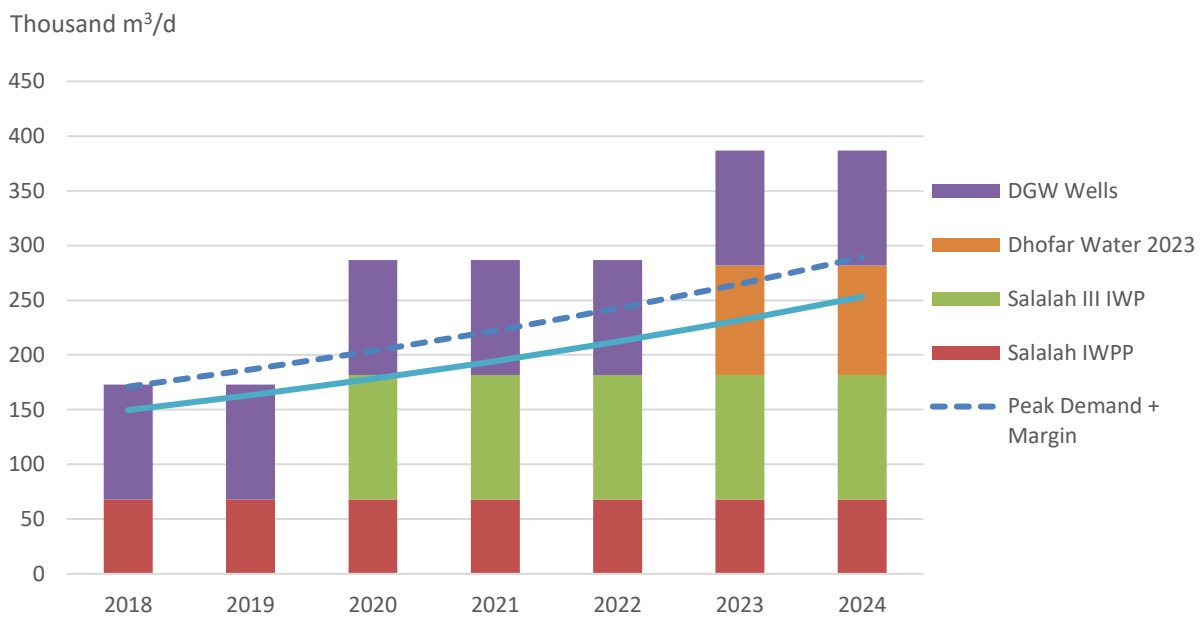
	2018	2019	2020	2021	2022	2023	2024
Supply Requirements				Thousand m^3/d			
Cities Peak Demand	**114**	**124**	**135**	**146**	**159**	**173**	**188**
Cities Peak Demand + Margin	**130**	**142**	**154**	**167**	**181**	**197**	**214**
Contracted Capacity							
Salalah IWPP	68	68	68	68	68	68	68
Salalah III IWP			114	114	114	114	114
Total Contracted Supply	68	68	182	182	182	182	182
Prospective Capacity Contracts							
Dhofar Water 2023						100	100
Total Water Desalination Resources	**68**	**68**	**182**	**182**	**182**	**282**	**282**
Reserve over Peak Demand (Shortfall)	-46	-56	47	35	23	109	94
Reserve over Peak Demand + Margin (Shortfall)	-62	-74	28	15	0	84	67
DGW Resources							
DGW Well Supply Capacity[a]	70	70	70	70	70	70	70
DGW Groundwater Supply at Peak Demand	46	56	0	0	0	0	0

[a] Representing the wells capacity inside the cities only. Total DGW wells capacity has an approximate supply range of 100,000 m^3/d to 110,000 m^3/d.

Figure 24 shows the demand-supply balance for the second scenario, considering network expansion to include water demand in the Jebel/Sahal areas. It illustrates that groundwater supply would be required in every year except 2020 to supplement desalinated water supply to meet aggregate peak demand until the new Dhofar IWP is available. Considering that DGW has specified the well capacity of the Jebel/Sahal areas as being in the range of 30,000 to 40,000 m^3/d, it appears that this capacity may be exceeded by 2020 and that incremental demand may be required from tankers supplied from the Dhofar Water Network at least from that time. In this case, desalinated water from Salalah IWP and Salalah III IWP would not be sufficient to meet the network's total water supply needs through 2023 as shown in Figure 22. This suggests an earlier COD for the new IWP.

OPWP projects that that the new Dhofar IWP project could begin commercial operations in 2023 if the procurement process is approved to begin in 2018. At the proposed capacity level of 100,000 m^3/d, it would meet peak demand requirements at least through 2025.

Figure 24 Resource Adequacy and Development Plan – Dhofar Cities, Jabal, and Sahal



	2018	2019	2020	2021	2022	2023	2024
Supply Requirements			Thousand m³/d				
Peak Demand - Cities (Network)	114	124	135	146	159	173	188
Peak Demand - Jabal and Sahal (Non-network)	36	39	44	48	53	59	66
Total Peak Demand	**150**	**163**	**178**	**194**	**212**	**232**	**253**
Total Peak Demand + Margin	**171**	**187**	**204**	**222**	**243**	**265**	**289**
Contracted Capacity							
Salalah IWPP	68	68	68	68	68	68	68
Salalah III IWP	-	-	114	114	114	114	114
Total Contracted Capacity	**68**	**68**	**182**	**182**	**182**	**182**	**182**
Prospective Capacity							
Dhofar Water 2022	-	-	-	-	-	100	100
Total Water Desalination Resources	**68**	**68**	**182**	**182**	**182**	**282**	**282**
Reserve over Peak Demand (Shortfall)	-82	-95	3	-13	-31	50	28
Reserve over Peak Demand + Margin (Shortfall)	-103	-119	-22	-41	-61	17	-8
DGW Resources							
DGW Well Supply Capacity[a]	105	105	105	105	105	105	105
DGW Groundwater Supply at Peak Demand	**82**	**95**	**0**	**13**	**31**	**0**	**0**

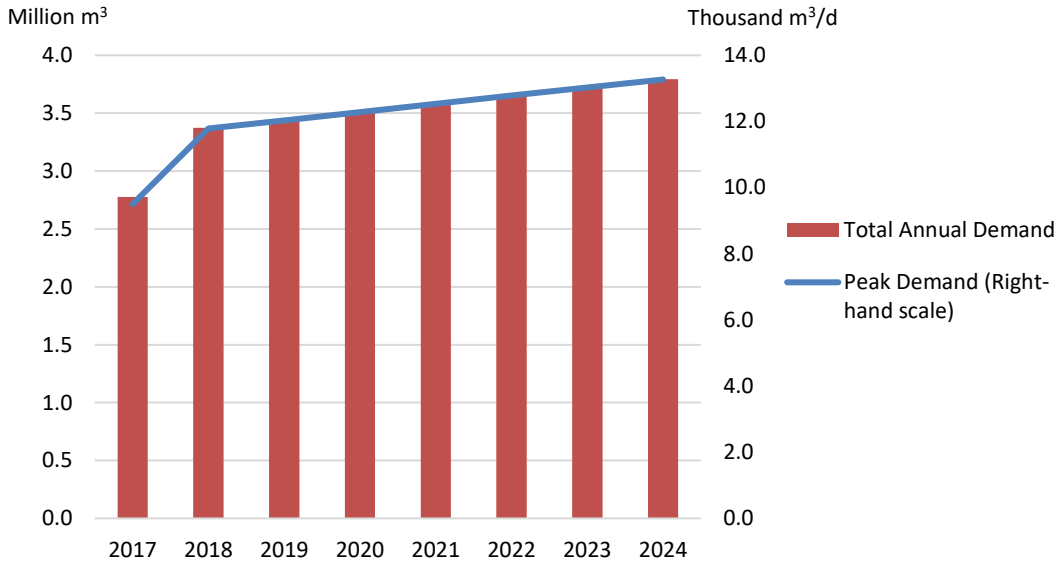
[a] Total wells supply is shown as 105,000 m³/d, considering an approximate capacity range of 100,000 m³/d to 110,000 m³/d. This range includes wells capacity within the cities (70,000 m³/d) and supply outside the cities.

3.4 MUSANDAM WATER NETWORK

DEMAND FOR WATER

PAEW has provided OPWP with the water demand projections for the Khasab City area of the Musandam Zone. These projections are shown in Figure 27. PAEW expects the peak demand to grow by 5% per annum in the next 7 years driven by the existing and new developments in the area. The forecast is essentially unchanged from that provided by PAEW for the previous 7-Year Statement.

Figure 25 Peak Water Demand Projections – Musandam (Khasab City)



	2017	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
					Thousand m³/d				
Peak Demand	**9.5**	**11.8**	**12.0**	**12.3**	**12.5**	**12.8**	**13.0**	**13.3**	**5%**
Change from 2017-2023 Statement	*0.0*	*1.8*	*1.6*	*1.3*	*1.0*	*0.6*	*0.2*	-	
					Million m³				
Total Annual Demand	**2.8**	**3.4**	**3.4**	**3.5**	**3.6**	**3.6**	**3.7**	**3.8**	**5%**
Change from 2017-2023 Statement	*0.0*	*0.5*	*0.4*	*0.4*	*0.2*	*0.1*	*0.0*	-	

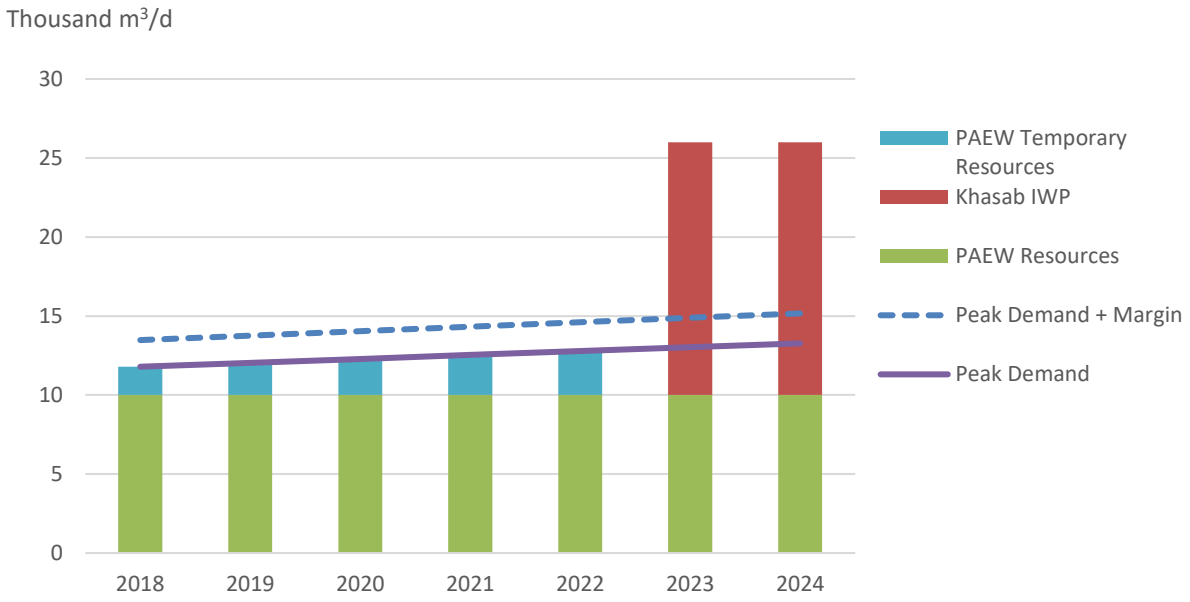
RESOURCES ADEQUECY AND DEVELOPMENT PLAN

The Musandam Zone is currently served by small desalination plants – one in Kumzar (450 m^3/d) that is owned and operated by RAECO, and three PAEW plants with combined capacity of about 3,500 m^3/d – and by wells.

At PAEW's request, OPWP initiated procurement in 2016 for a new IWP to serve Khasab City, with capacity of about 16,000 m^3/d (3.5 MIGD). The RFP is expected to be released in Q1, 2018 to commence operation in Q2, 2022.

Figure 28 compares the desalination capacity target with the prospective water sources. The prospective Khasab IWP would have sufficient capacity to meet water capacity requirements from 2022 onwards, allowing PAEW to discontinue wells production for aquifer recharge.

Figure 26 Water Supply and Demand Balance – Musandam (Khasab City)



	2018	2019	2020	2021	2022	2023	2024	Average Growth (%)
Supply Requirements				Thousand m3/d				
Peak Demand	**11.8**	**12.0**	**12.3**	**12.5**	**12.8**	**13.0**	**13.3**	**5%**
Peak Demand + Margin	**13.5**	**13.8**	**14.0**	**14.3**	**14.6**	**14.9**	**15.2**	
Existing Capacity								
PAEW Resources[a]	10	10	10	10	10	10	10	
Prospective Capacity								
Khasab IWP						16.0	16.0	
PAEW Temporary Resources	1.8	2.0	2.3	2.5	2.8	-	-	
Total Capacity	**12**	**12**	**12**	**13**	**13**	**26**	**26**	
Reserve over Peak Demand (Shortfall)	-	-	-	-	-	13.0	12.7	
Reserve over Peak Demand + Margin (Shortfall)	-1.7	-1.7	-1.8	-1.8	-1.8	11.1	10.8	

[a] PAEW Wells and small desalination plants are currently sufficient to meet capacity needs with no margin.

SECTION 4 PROCURMENT ACTIVITIES

4.1 POWER PROJECTS

Current/Near-Term Procurement Activities

OPWP's current and near-term procurement activities for power projects include the following, and are summarized in Table 10:

- **Ibri II Solar IPP.** In December 2017, OPWP issued the RFQ to procure a 500 MW Solar PV project at Ibri. The RFP issue is expected in Q4 2017, and award by Q4 2018, for 2021 COD.
- **Power 2022.** The Power 2022 capacity procurement has several components, including the sale of assets of the existing Manah IPP, which transfers to the government in April 2020, and procurement of at least 700 MW of capacity for operation in 2022. This latter component will be tendered using a new procurement methodology in which existing generators and new plant may compete. The RFQ process is proceeding in two stages, in which the first stage is restricted to existing generators with expiring P(W)PAs. The first stage RFQ will be issued in Q1 2018. The second stage RFQ will be issued to prospective bidders for new capacity in Q3 2018. The RFQ for the Manah asset sale will be issued in the same time period. OPWP expects RFPs to be issued in Q4 2018, bids to be due in Q2 2019, and that awards would be announced in Q4 2019. Qualified bidders will have the opportunity to propose P(W)PA terms in the range of 4 to 15 years.
- **Duqm Clean Coal IPP.** OPWP plans to procure a 1,200 MW clean coal IPP located at Duqm. The project has been submitted to the AER for approval, and assuming approval within Q1, OPWP is prepared to issue the RFQ in Q2 2018. The RFP would be issued in Q4 2018 with bids due in Q3 2019. OPWP plans to award the project in Q1 2020, and that the first 600 MW block would begin commercial operation in Q2 2024, followed by full power in Q2 2025.
- **Solar IPP 2022.** OPWP plans to start procurement of its second Solar IPP toward the end of 2018, to achieve commercial operation in 2022. This project may also have installed capacity of 500 MW or more, subject to our site and market evaluations. We expect to issue the RFQ in Q4 2018, followed by RFP in Q2 2019, and award in Q4 2019, for COD in Q2 2022.
- **Waste to Energy.** OPWP in coordination with Be'ah and AER expects to complete a feasibility study by August 2018 of a Waste-to-Energy plant, in preparation for procurement. The facility is expected to utilize waste from a municipal landfill in Barka, and produce around 50 MW under a PPA with OPWP. Subject to approval, OPWP expects to issue the RFQ in Q4 2018, RFP in Q1 2019, and to award the project in Q3 2019 for COD in Q4 2022.
- **Solar IPP 2023.** OPWP plans to launch the third of the series of solar IPP procurements toward the end of 2019, to achieve commercial operation in 2023. This project may also have installed capacity of 500 MW or more, subject to our site and market evaluations.
- **Wind IPPs 2023.** OPWP plans to procure two wind IPPs toward the end of 2019, in different locations, to achieve commercial operation in 2023. The expected locations are in Duqm and Dhofar, and their installed capacities are expected to be in the range of 150 MW to 200 MW each. They are shown in Table 9 as two separate procurements, though they may be procured in a single tender, depending on OPWP's market assessment.

Table 10 Power Project Procurement Activities in 2018-2019

	System	Capacity	RFQ	RFP	Bids Due	Award Anticipated	COD
Ibri II Solar IPP	MIS	500	Q4, 2017	Q2, 2018	Q3, 2018	Q4, 2018	Q2, 2021
Power 2022 A: Existing Plants and New Capacity	MIS	700	Q1, 2018 (Existing) Q3, 2018 (New)	Q4, 2018	Q2, 2019	Q4, 2019	Q1, 2022
Power 2022 B:[a] Sale of Manah Assets	MIS	264	Q3, 2018	Q4, 2018	Q2, 2019	Q4, 2019	Q2, 2020
Waste to Energy	MIS	50	Q4, 2018	Q1, 2019	Q2, 2019	Q3, 2019	Q4, 2022
Duqm Clean Coal IPP [b]	Duqm/ MIS	TBD	Q2, 2018	Q4, 2018	Q3, 2019	Q1, 2020	Q1, 2025
Solar IPP 2022	MIS	500	Q4, 2018	Q2, 2019	Q3, 2019	Q4, 2019	Q2, 2022
Solar IPP 2023	MIS	500	Q4, 2019	Q2, 2020	Q3, 2020	Q4, 2020	Q2, 2023
Wind IPP 2023	Duqm/ MIS	200	Q4, 2019	Q2, 2020	Q3, 2020	Q4, 2020	Q2, 2023
Dhofar II Wind IPP 2023	Dhofar	150	Q4, 2019	Q2, 2020	Q3, 2020	Q4, 2020	Q2, 2023

[a] The procurement activity refers to the existing Manah IPP, tendering for continued operation under a new PPA commencing after the transfer of assets on 30 April 2020. If this option is selected, then the tender process may commence in Q3 2018

[b] The procurement plan is assuming that approvals are received by Q1, 2018

Future Procurement Activities

From 2020 to 2024, OPWP anticipates the following procurement activities:

- **Power 2024.** OPWP plans to initiate a second procurement round in 2020 for new PPAs that would begin in 2024. Similarly to Power 2022, existing generators with expiring or expired P(W)PAs, bidders for new capacity, and participants in the spot market may be eligible to participate in this competition, subject to qualification. Contract awards are anticipated to occur in 2021.
- **RE IPPs.** OPWP plans to continue to procure new solar and/or wind IPPs on an annual basis during this period.
- **Clean Coal II IPP.** The Fuel Diversification Policy envisions up to 3,000 MW of coal-fired capacity to be developed by 2030. Subject to Government approval, OPWP may initiate procurement of the second Clean Coal IPP (Clean Coal II) in around 2022 for COD in 2028. The capacity level would be specified at that time.

In addition to these initiatives to procure projects via long-term P(W)PAs, OPWP may procure short-term capacity or energy via transactions with neighboring power systems, and plans to develop a Demand Response program in which demand reductions will be contracted with participating electricity customers.

4.2 WATER PROJECTS

Current/Near-Term Procurement Activities

OPWP's current and near-term procurement activities for water projects include the following, and are summarized in Table 11:

- **Khasab IWP.** OPWP began bidder prequalification for the Khasab IWP in Q4 2016. The procurement process encountered delays due to finalization of the site, and the RFP is now planned for release in Q2 2018. The Khasab IWP will be contracted for capacity of 16,000 m^3/d (3.5 MIGD) using RO technology, for COD in Q3 2022.

- **Ghubrah III IWP.** OPWP expects to begin the procurement process in Q1 2018 for capacity of 300,000 m^3/d (66 MIGD) at Ghubrah, to commence operation in Q1, 2022.

- **Barka IWPP Extension or new Barka V IWP.** OPWP will procure about 101,000 m^3/d (22 MIGD) at Barka for operation beginning in Q1 2022. The Barka IWPP P(W)PAs expire at the end of 2021, and the project owners will have the opportunity to bid for a extension in Q1 2018. If the proposed contract extension does not meet OPWP's economic purchase standard, then OPWP will initiate procurement of new capacity, beginning with RFQ issue in Q2 2018, for COD in Q1 2022.

- **North Batinah IWP.** OPWP expects to initiate procurement in Q2 2018 for new IWP capacity of 150,000 m^3/d (33 MIGD) in the North Batinah region, for COD in 2023.

- **Wadi Dayqah IWP.** In Q3 2018, OPWP expects to begin procurement of capacity in the range of 90,000 to 125,000 m^3/d (20-27.5 MIGD) at the Wadi Dayqah reservoir near Qurayyat. It is a dual purpose project, providing both potable water and irrigation water for agriculture. The potable water requirement is about 67,000 m^3/d. The scheduled COD will be by Q1, 2022.

- **Dhofar Water 2023.** OPWP has initiated a study for the Dhofar Water 2023 project, which may have a capacity of 100,000 m^3/d (22 MIGD), subject to MOF and regulatory approvals. The required commercial operation date may be around 2023, which would imply that initial procurement stages would begin in Q4 2018.

- **Massirah IWP.** PAEW has requested OPWP to procure an IWP to provide capacity of 10,000 m^3/d (2.2 MIGD) at Massirah Island in the Governorate of Ash Sharqiyah South. Following technical assessments, OPWP expects to issue the RFQ in Q4, 2018, and that the scheduled COD would be Q1, 2023.

Table 11 Water Project(s) Procurement Activities in 2018-2019

	System	Capacity	RFQ	RFP	Bids Due	Award Anticipated	COD
Khasab IWP [a]	Musandam Water Network	3.5 MIGD	Completed	Q2, 2018	Q4, 2018	Q1, 2019	Q3, 2022
Ghubrah III IWP	MIS	66 MIGD	Q1, 2018	Q2, 2018	Q4, 2018	Q1, 2019	Q1, 2022
Barka IWPP Extension or New Barka IV IWP	MIS	22 MIGD	Q1, 2018	Q2, 2018	Q4, 2018	Q1, 2019	Q1, 2022
North Batinah IWP	MIS	33 MIGD	Q2, 2018	Q3, 2018	Q2, 2019	Q3, 2019	Q1, 2023
Dhofar Water 2023[a]	Dhofar Water Network	22 MIGD	Q4, 2018	Q1, 2019	Q3, 2019	Q1, 2020	Q1, 2023
Wadi Dayqah IWP [a]	MIS	27.5 MIGD	Q3, 2018	Q4, 2018	Q2, 2019	Q3, 2019	Q1, 2022
Massirah IWP	Massirah	2.2 MIGD	Q4, 2018	Q1, 2019	Q3, 2019	Q1, 2020	Q1, 2023

[a]Subject to securing the site and other critical approvals (if relevant)

Future Procurement Activities

From 2020 to 2024, OPWP may procure additional water desalination capacity projects. For example, in 2020 OPWP expects to begin procurement of capacity at Barka, for operation in 2024, via extension of the Barka II P(W)PA or a new IWP of similar capacity. However, the Government is currently working on a plan for restructuring of the water sector into a number of regional companies, which may come to fruition in this time period. OPWP's future role as procurer of water desalination capacity will be determined through this process.