Renewable Energy in Oman
RE Potential and PWP Plans

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PRESENTATION Outline

- Background
- Renewable Energy Strategy
- Challenges
- Other Initiatives
- Q&A

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BACKGROUND

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NAMA Power & Water Procurement Company

SINGLE BUYER, GOVERNMENT-OWNED

- PWP is a regulated entity with obligations to procurement capacity and output via contracts, to meet demand.
- Sells power to NAMA Supply Company (NSC), water to NAMA Water Services, with annual turnover of OMR 900 million.

CONTRACTED CAPACITY

Existing:

- 9,716 MW generation capacity (13 plants).
- 1,336,000 m^3/d desalination capacity (10 plants).

Under construction:

- 1000 MW (Solar PV)
- 600,000 m^3/d.

SUPPLY AREAS

- Main Interconnection System (Northern)
- Ad Duqm (Rabit Phase I: connected since end of 2023)
- Connected to PDO and GCC Countries
- Dhofar (Rabit Phase II by Q1 2027)
- Musandam

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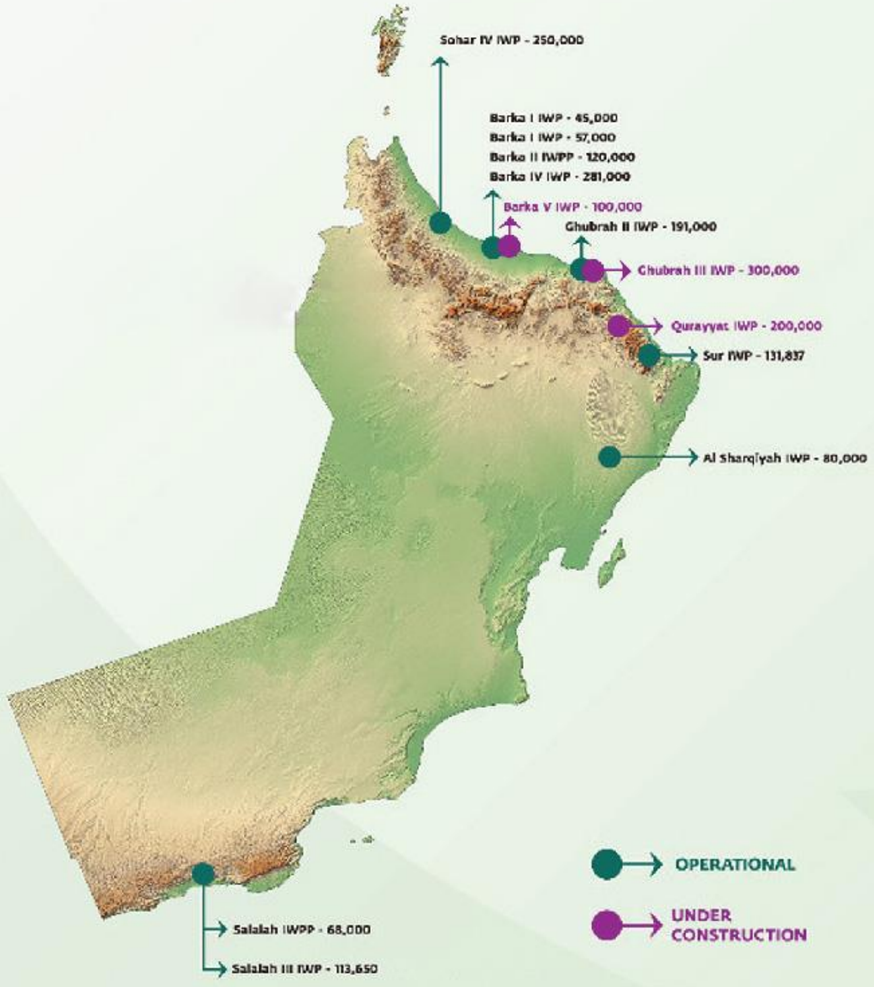

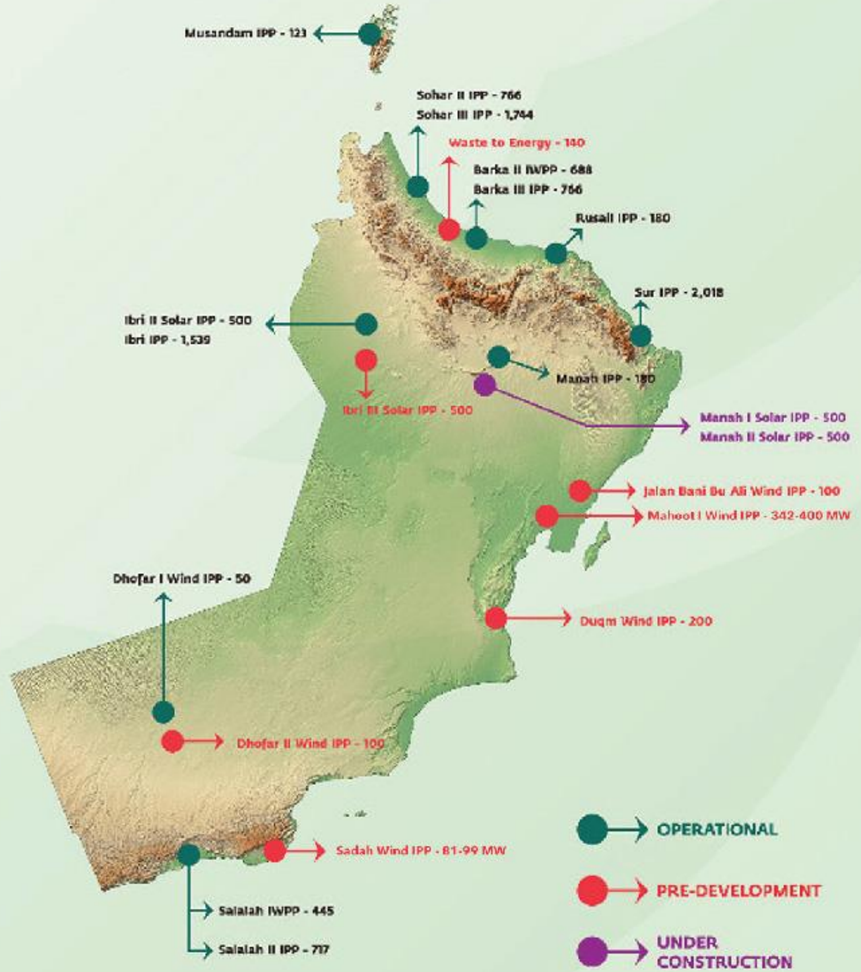

RENEWABLE ENERGY STRATEGY

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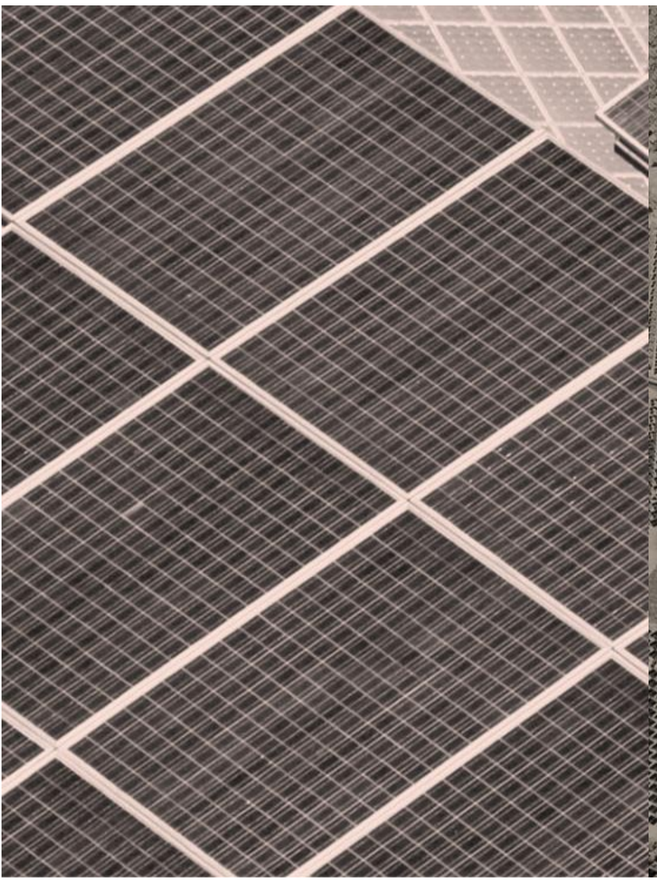
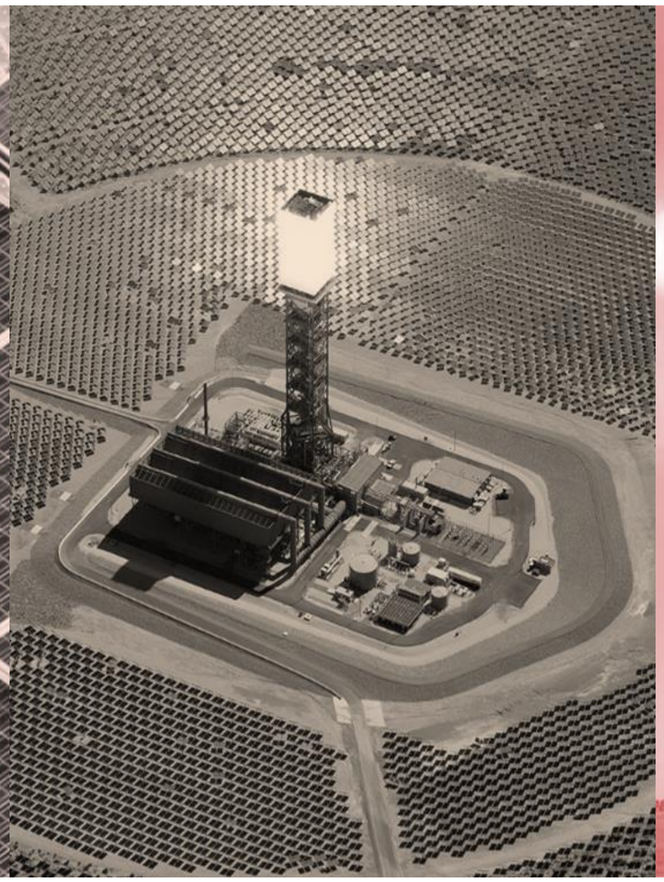
Policy Objectives for Renewable Energy

Based on the 2040 vision, the renewables target is to:

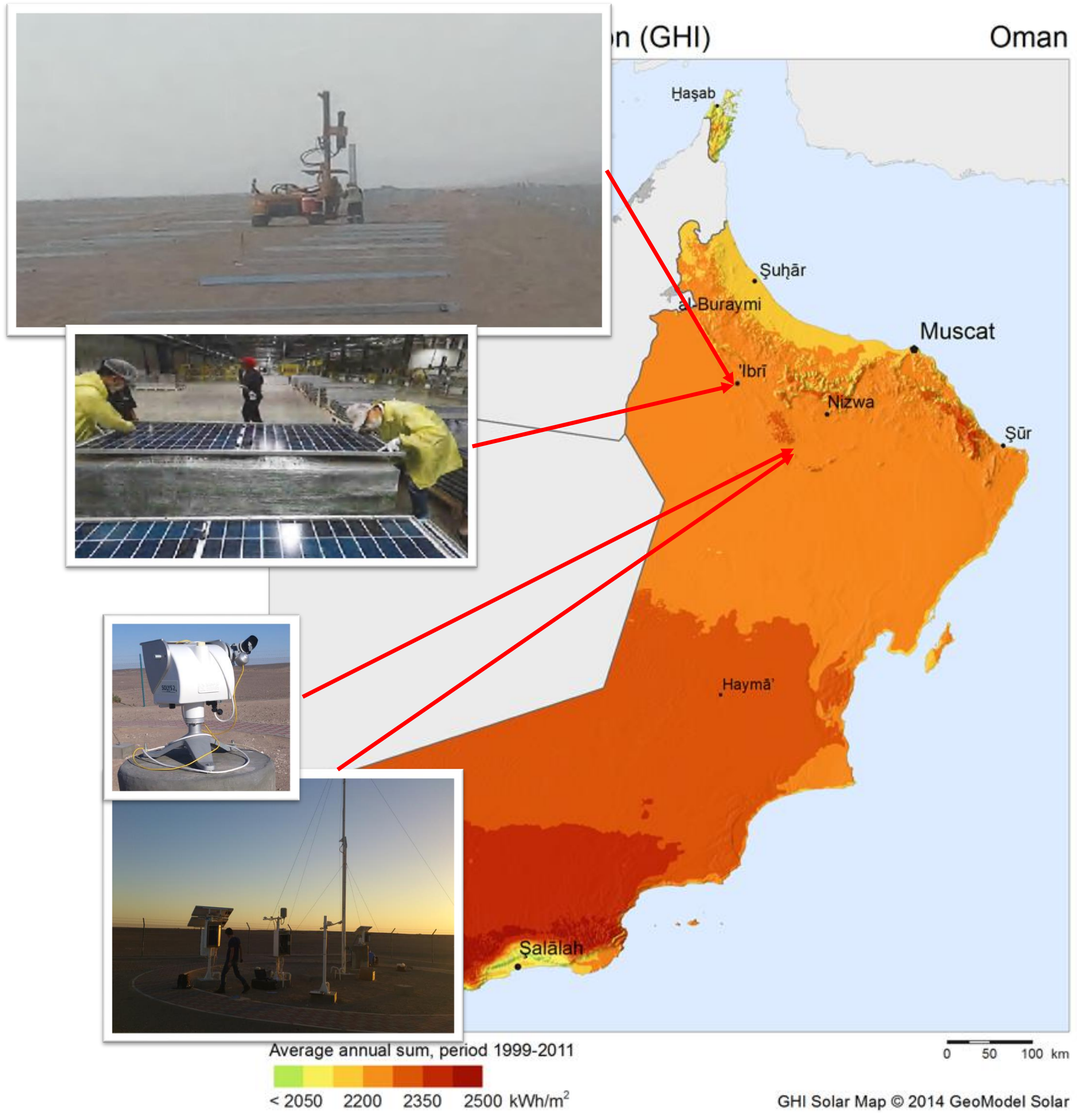
➔**reach 30% generation by 2030 and 35-39% by 2040.**

➔**A key objective of this target is to release domestic gas committed to the power sector, to be available to stimulate industrial and economic development.**

Solar Potential In Oman

- **Solar irradiation levels are high throughout the country, increasing toward the south**
  - Ranging from 2,000 to 2,500 kWh/m^2
  - Sky clearness, at about 342 days in a year.
- **Development is proceeding briskly**
  - The first large scale solar PV project in Northern Oman achieved a ***global record*** low cost in 2019
  - Medium-scale solar PV projects in industrial estates are economic
  - Solar PV projects in parking lots have done well
- **The North-South Interconnect project (Rabit I) opens access to RE in the southern/central Oman as it is in Operation since end of 2023**
- **Large solar PV projects are in progress**
  - 500 MW Ibri Solar is in Operation
  - 1,000 MW is under Construction at Manah
  - More projects in the pipeline



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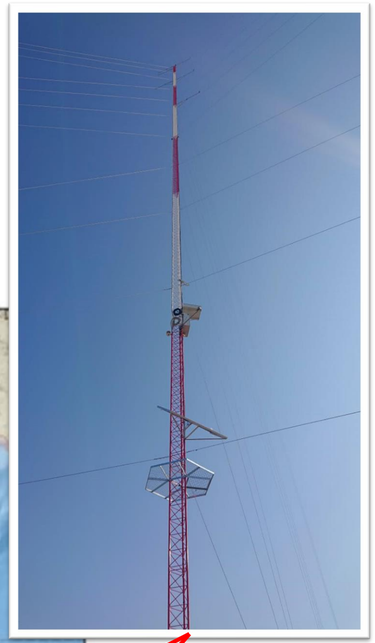
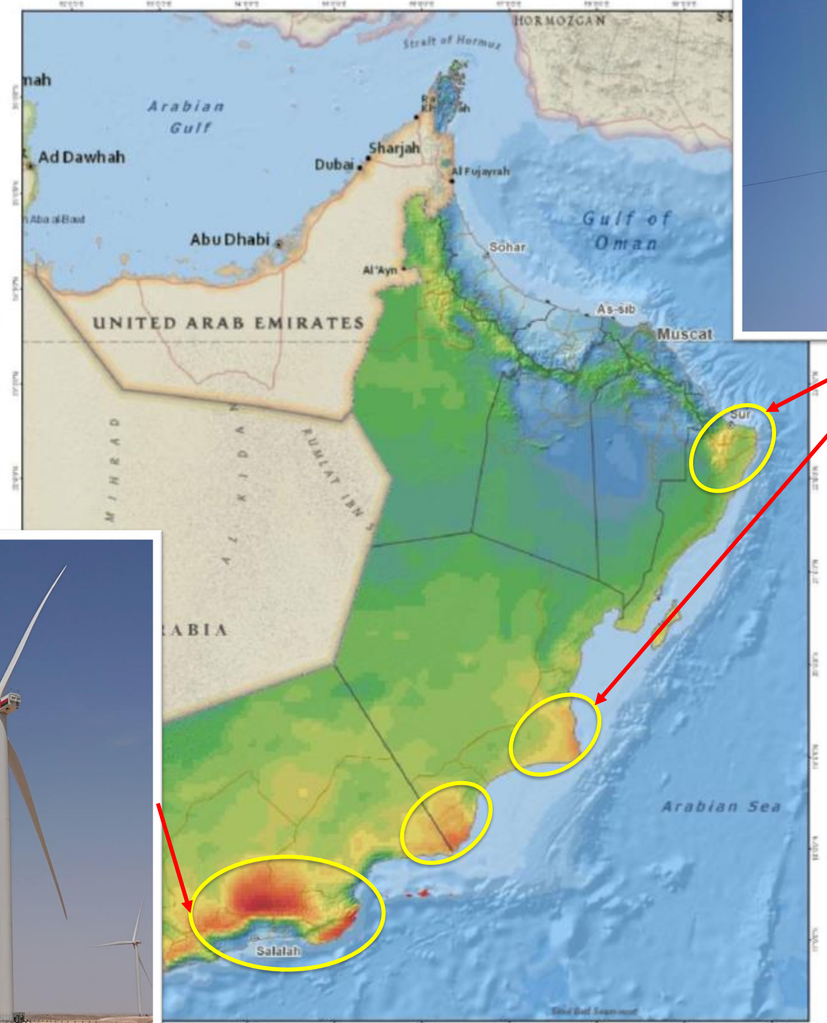
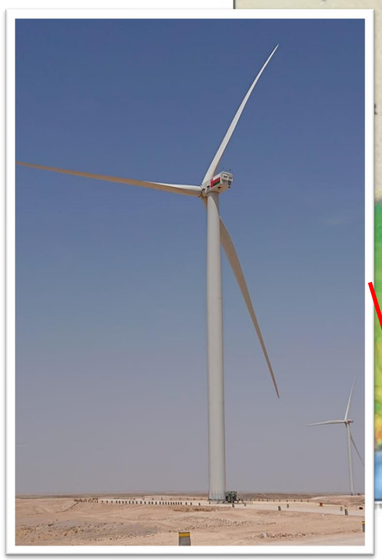
Wind Potential In Oman

- **Oman has world-class potential for wind energy development**
  - Numerous onshore sites have average wind speeds of 8-10 m/s
  - High wind during Summer months and Monsoon season
  - PWP commenced a Wind Resource Assessment in 2020.
  - Offshore development also has large potential
- **Wind potential is concentrated in southern Oman**
  - Best in coastal Dhofar and Thumrait
  - 2nd Best in Duqm, inland Al Wusta
  - Some potential in Sharqiyah
- **The first wind farm is operating**
  - 50 MW, located at Harweel in Dhofar
  - COD achieved in November 2019
  - Operated under a PPA between PWP and NGC
- **The next two wind farms are in early development:**
  - Jalan Bani Bu Ali (about 100 MW)
  - Duqm (about 200 MW)
  - Mahoot (about 300 MW)
  - Harweel Phase II (about 100 MW)
  - Sadah (about 100 MW)
- **And then…**
  - Further projects to follow transmission expansion

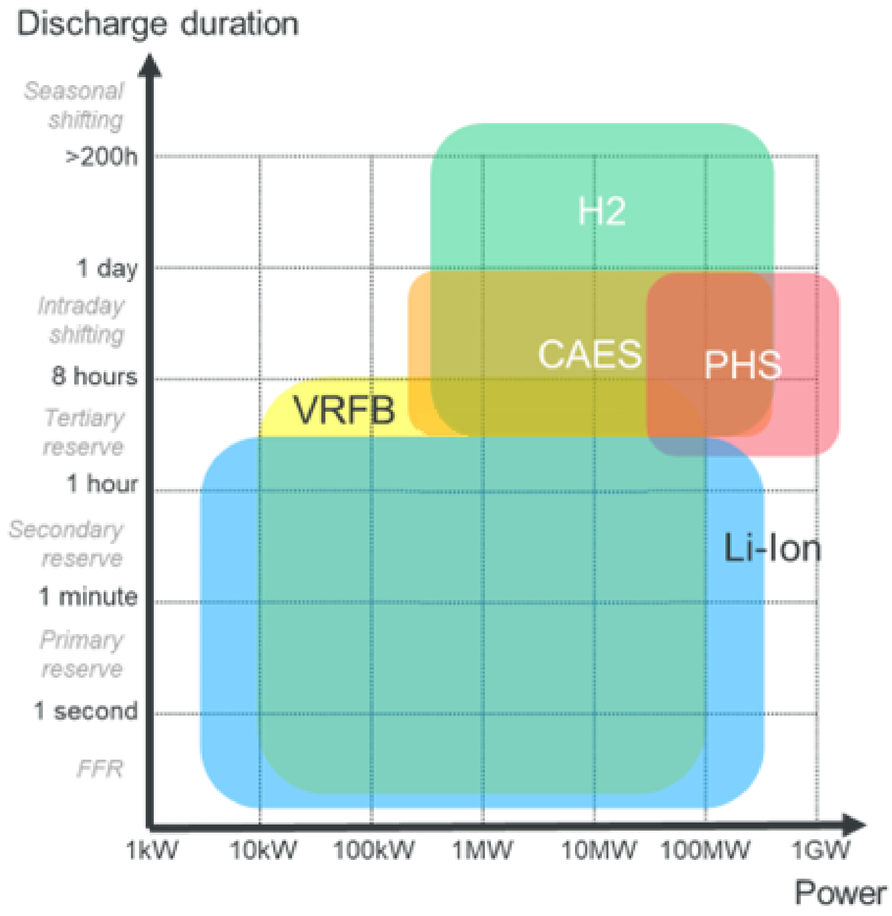






Energy Storage Potential

- PWP about to finalise a strategic study which identified the most optimun generation mix for Oman up to 2040.
- 5 electrical ES technologies were shortlisted considering many dimensions (applications needed, maturity, costs, local weather conditions, etc) :
  - **Pumped-hydro storage (PHS)**
  - **Li-ion batteries**
  - **Vanadium Redox Flow batteries (VRFB)**
  - **Compressed Air Energy Storage (CAES)**
  - **Hydrogen**
- For the next Solar PV IPP PWP exploring the options to include a small scale BESS; co-located with the PV Plant. The main purpose is for frequency control and to inccrease the plant availability during the ramp-up and ramp down moments.



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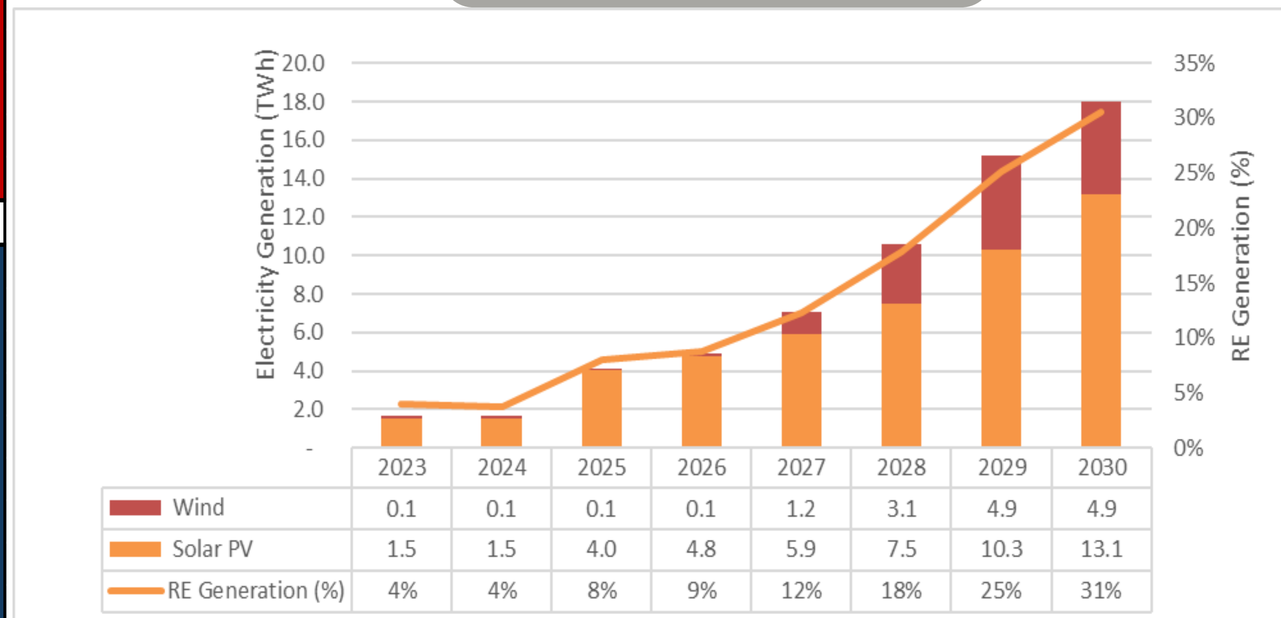
Renewable Energy Development Plan

b) Renewable Energy Projects	2023	2024	2025	2026	2027	2028	2029	2030
Ibri II Solar IPP	500	500	500	500	500	500	500	500
Manah I Solar IPP			500	500	500	500	500	500
Manah II Solar IPP			500	500	500	500	500	500
Ibri III Solar IPP					500	500	500	500
Al Kamil PV 2027						300	300	300
Solar PV 2027						200	200	200
Solar PV IPPs 2029							1,000	1,000
Solar PV IPP 2030								1,000
JBB Wind IPP					100	100	100	100
Duqm Wind IPP						250	250	250
Mahoot I Wind IPP						350	350	350
Dhofar I Wind IPP					50	50	50	50
Dhofar II Wind IPP					120	120	120	120
Sadah Wind IPP						90	90	90
Mahoot II Wind IPP							350	350
Shaleem Wind IPP							100	100
Al Jazir Wind IPP							100	100
Total Renewable Energy Projects	500	500	1,500	1,500	2,270	3,460	5,010	6,010
RE Day Peak Contribution	**460**	**460**	**1,250**	**1,250**	**1,799**	**2,632**	**3,790**	**4,580**
RE Night Peak Contribution	**0**	**0**	**0**	**0**	**147**	**551**	**887**	**887**

30% by 2030
Oman 2040 Vision Target



By 2030, total investment in RE projects under contract to PWP is expected to be in the range of USD 8 – 10 billion

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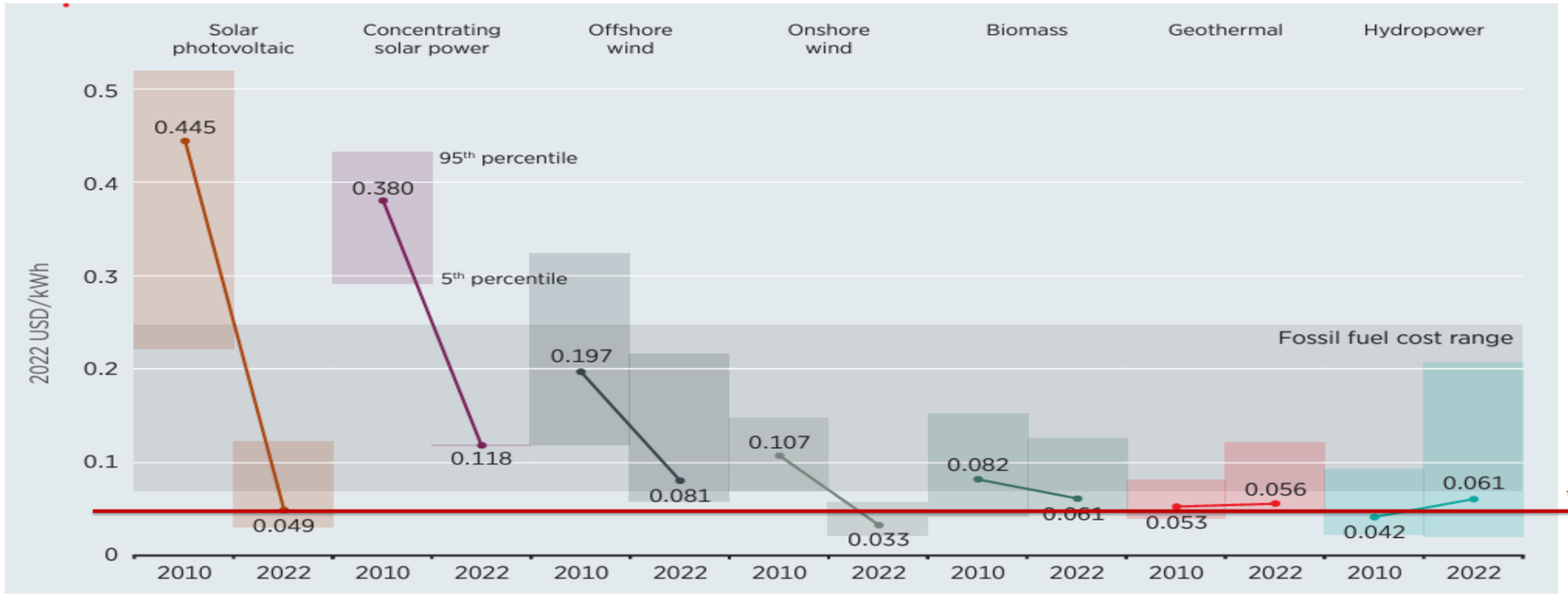
RE Technologies are Cost Competitive

Figure S.4 Global LCOE from newly commissioned utility-scale renewable power technologies, 2021 and 2022



PWP Average Generation Cost

Note: These data are for the year of commissioning. The thick lines are the global weighted average LCOE value derived from the individual plants commissioned in each year. The LCOE is calculated with project-specific installed costs and capacity factors, while the other assumptions, including weighted average cost of capital (WACC), are detailed in Annex I. The grey band represents the fossil fuel-fired power generation cost in 2022, assuming that 2021 fossil gas prices were the correct lifetime benchmark rather than the crisis prices of 2022. While the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

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CHALLENGES

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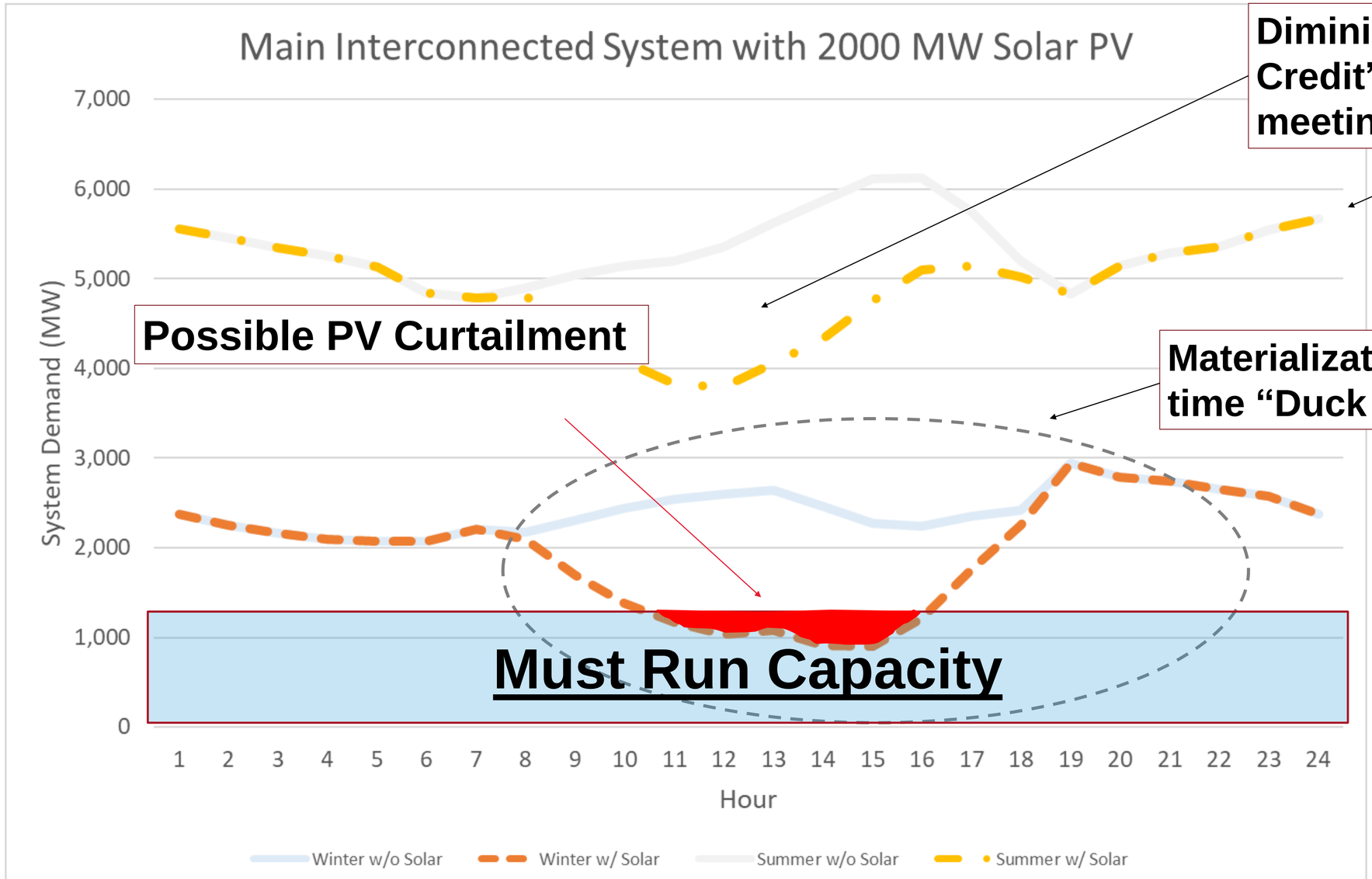
“Duck Curve” Effect, Capacity Credit, Curtailment



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OTHER INITIATIVES

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Vibrant Market: Other Leaders and Initiatives

- **Petroleum Development Oman (PDO)**
  - Amin 100 MW Solar PV launched in 2020
  - The two wind energy IPPs, Riyah-1 and Riyah-2, are of around 100 MW capacity to be completed by Q2 2026
- **OQ**
  - End of 2022, MEM mandated OQ AE the role of national champion.
  - The National Champion should target utility scale renewable energy projects:
  - It will serve large industrial consumers and aggregation of consumers in industrial clusters above 50MW.
- **Government Residential Solar Initiative (Sahim I and II)**
  - Incentives for Rooftop Solar PV Projects in Homes
  - Homeowner pays a fraction of installation costs; Sahim arranges financing, installation, maintenance and monitoring via local, private firms
  - 80,000 home initial target over multi-year period
  - Over 100 MW expected to be installed by 2025
- **ESCO (Energy Service Company) Initiative for Government Buildings**
  - Energy efficiency program funded privately via performance-based savings
  - 14 large buildings initially targeted
  - Rooftop/carpark Solar PV projects will be included
- **Industry initiatives in Economic Free Zones**
  - Over 25 MW of Solar PV projects currently under construction
- **Shell Oman projects in school**

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