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Energy Transition and Water Sustainability

Dr. Buthaina Mahfoud Al Wahaibi
Head of Research and Development
Oman Water and Wastewater Service Company

OUTLINE

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- Climate Change – NET Zero
- Energy Transition towards Renewables
- OWWSC -TE Utilization Master Plan
- OWWSC Challenges and Opportunities
- Water Sustainable Projects

CLIMATE CHANGE

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Greenhouse Gases (GHGs)

Paris Agreement (7% by 2030)

Net Zero (2050)

ENERGY TRANSITION TOWARDS RENEWABLES

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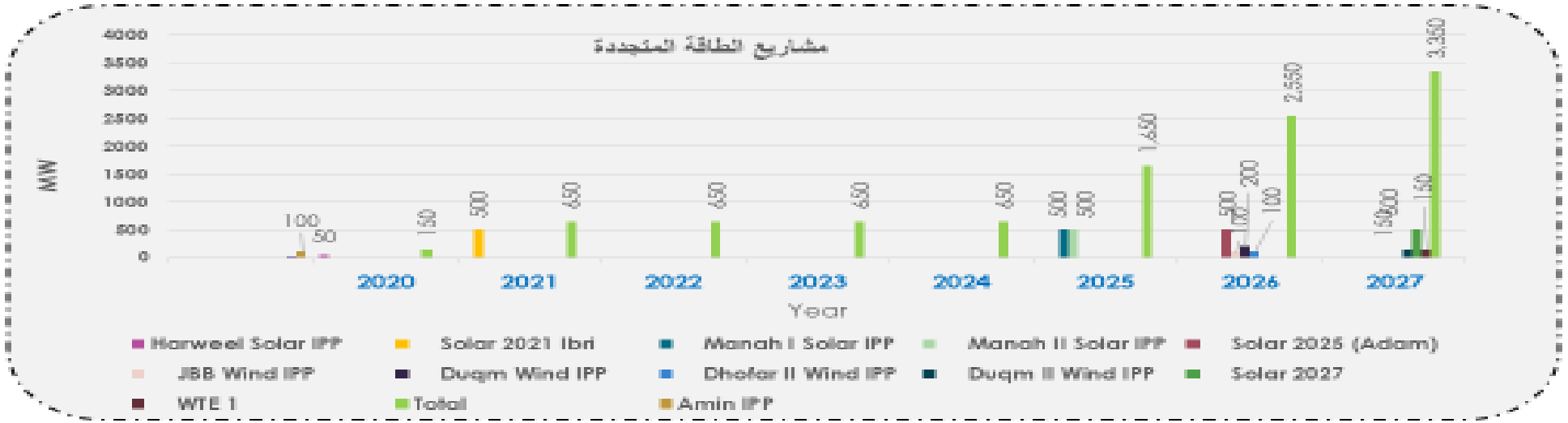

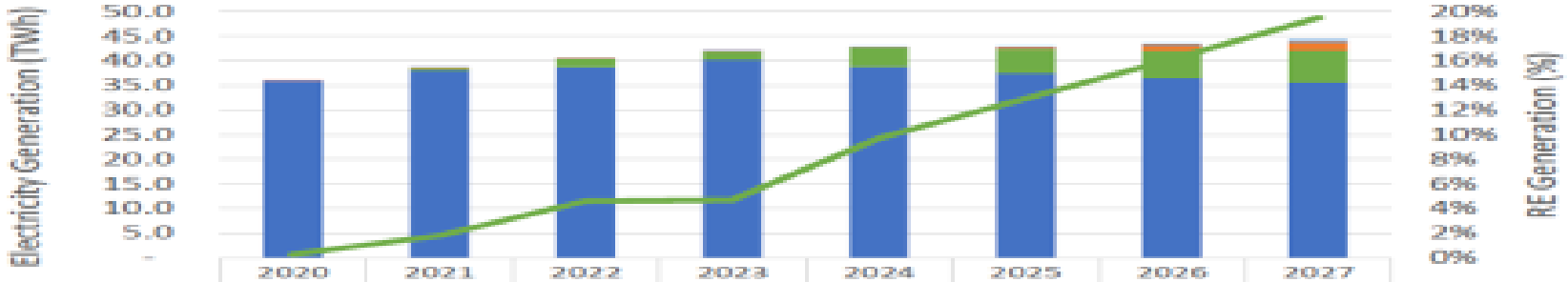

	2020	2021	2022	2023	2024	2025	2026	2027
Private Solar PV Initiatives	-	0.0	0.1	0.1	0.1	0.2	0.3	0.4
Wind	0.1	0.2	0.2	0.2	0.2	0.4	1.3	1.8
Solar PV	-	0.5	1.6	1.7	3.9	5.0	5.5	6.4
Gas-fired Plants	35.9	38.0	38.7	40.1	38.8	37.4	36.5	35.6
RE Generation (%)	0%	2%	5%	5%	10%	13%	16%	20%

Future Renewable Projects (OPWP)

Future Renewable Projects	Schedule Year
Ibri II Solar I	2021
Dhofar Wind	2019
Manah I Solar IPP	2025
Manah II Solar IPP	2025
MIS Solar IPP	2026
JBB Wind IPP	2026
Duqm Wind IPP	2026
Dhofar II Wind IPP 2026	2026
Ras Madrakah Wind IPP	2027
Ibri III Solar IPP 2027	2027
Sadah Wind IPP	2028
WTE	2028

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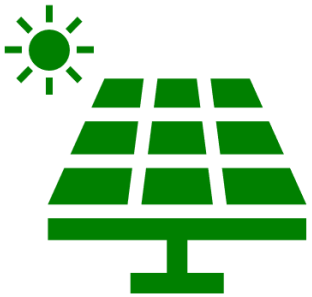

WATER MANAGEMENT (OWWSC)

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- ✓ Improve water security in every region of Oman;
- ✓ Improve the reliability of water and wastewater services;
- ✓ Improve the water quality supplied;
- ✓ Increase access to water and wastewater services;
- ✓ Improve customer satisfaction;
- ✓ Improve operational efficiency;
- ✓ Improve network efficiency;
- ✓ Improve public health outcomes;
- ✓ Reduce environmental impact of water and wastewater sector;
- ✓ Reduce net subsidies to the water and wastewater sector; and
- ✓ Maintain affordability of water and wastewater services.

WASTEWATER TREATMENT TERTIARY TECHNOLOGIES

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OWWSC adopted three main phases of wastewater treatment;

- **Primary Treatment**, "**Mechanical Separation** by a physical and/or chemical settlement of suspended solids, in which (BOD5) of the incoming wastewater is reduced by at least 20% before discharge and (TSS) is reduced by at least 50%".

- **Secondary Treatment**, "Post-primary treatment of wastewater by a process generally involving **Biological Treatment** with a secondary settlement, resulting in (BOD5) removal of at least 85% and (COD) removal of at least 75%".

- **Tertiary Treatment**, "**Filtration and Disinfection System** for further removal and polishing of TE. The treatment removal efficiency is at least 98% for BOD and 97% for COD, 95% for TN, and 99.9% for microbiological".

TREATED WATER QUALITY

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Parameter	Unit	Concession Agreement		** MD 145/93		*** MD 159/05
		* Group 1	Group 2	Std. A	Std. B	
Biochemical Oxygen Demand (BOD_5)	mg/L	< 15	< 15	15	20	20
Chemical Oxygen Demand (COD)	mg/L	-	-	150	200	200
Total Suspended Solids (TSS)	mg/L	< 15	< 20	15	30	30
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	5	10	5
Ammonia Nitrogen (NH_3-N)	mg/L	-	-	5	10	1
Total Nitrogen	mg/L	< 15	< 40	-	-	15
Nitrate (as NO_3)	mg/L	-	-	50	50	15
Total Phosphorus (TP)	mg/L	< 30	< 30	30	30	2
Oil & Grease (O&G)	mg/L	< 5	< 5	0.5	0.5	15
pH		-	-	6 ~ 9	6 ~ 9	6 ~ 9
Fecal Coliform	MPN/100 mL	< 200	< 200	200	1,000	10,000
Nematode Ova	Ova / L	< 1	< 1	< 1	< 1	< 1

* STP Constructed After 1st Jan 2005 ** Wastewater Reuse & Discharge Limit *** Marine Discharge Limit

OWWSC CHALLENGES AND OPPORTUNITIES

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- **QUALITY:** Compliance to MD 145/93 standards is the priority criteria for OWWSC in selection of treatment technology for the STPs and is also major factor determining the overall capital cost expenditure of the project.

- **TECHNOLOGY:** Currently OWWSC employing advanced technologies such as Membrane technology and Ultra-Filtration in order to meet the regulatory requirements and satisfied the customer with excellent quality produced TE.

- **COST:** However, those membrane-based technologies required very high Capital and Operational expenditures, in addition to high level of skilled operators are required due to its complexity dealings with the O&M issues.

COMPREHENSIVE STRATEGY FOR THE WATER MANAGEMENT

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The Cabinet of Ministers has directed to establish a comprehensive strategy for the Water Management in Oman including Treated Effluent utilization, in coordination with the concerned Ministries and Authorities.
This strategy will include;

- Development of National Guidelines for legislations to utilize the treated effluent in addition to the ground water utilization management.
- Maximization of treated effluent reuse in agriculture to enhance and sustain the food security in Oman.
- Implementation Plan for treated effluent network projects.

OWWSC TREATED EFFLUENT MASTER PLAN

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The Haya Water prepared a Master Plan for the reuse of treated water in Muscat Governorate in 2019 and was updated in 2022 to assess the current and future needs of the Treated Effluent.

In addition to ensure the sufficient quantities of treated effluent to the needs of the Muscat Municipality and future needs of other Customers.

Q4 2021 Muscat Governorate statistic

Average of wastewater generation
172,000m3/day

Average of TE production
165,509m3/day

Average of TE utilization
129,097m3/day

78%

MUSCAT GOVERNORATE TE UTILIZATION (2022-2032)

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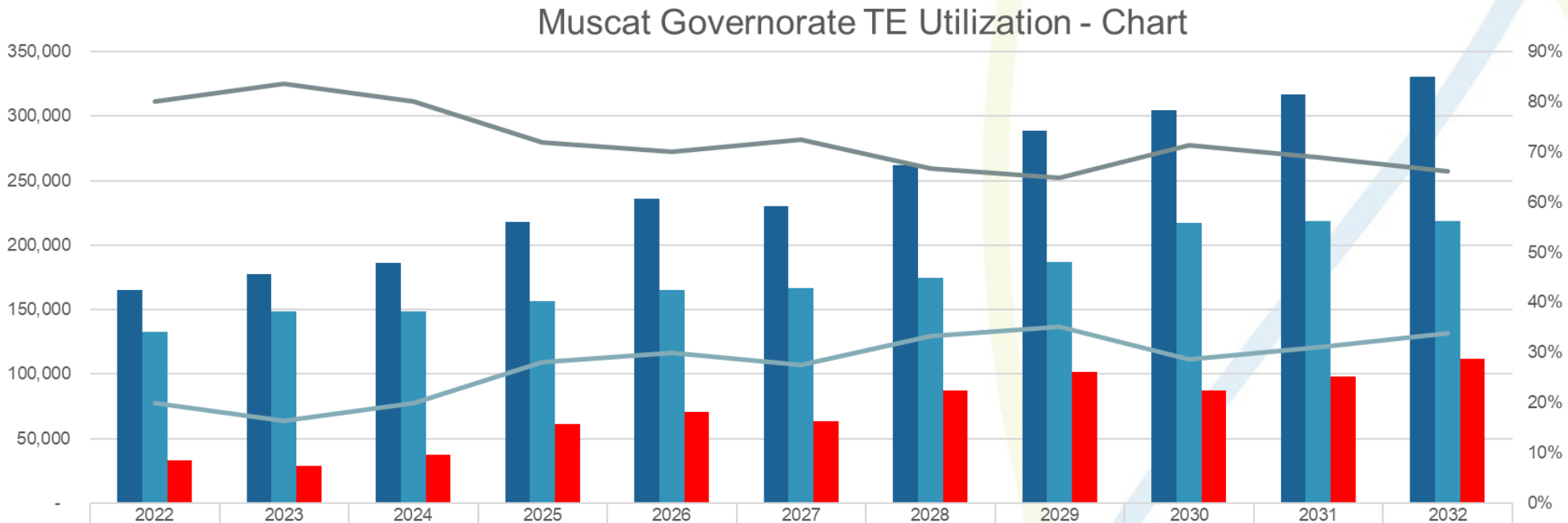

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
TE Production	165,509	177,202	186,065	218,052	235,919	230,338	262,275	288,706	304,547	317,033	330,513
TE Demand	132,427	148,255	148,877	156,764	165,205	166,923	174,967	187,119	217,512	218,784	218,901
TE Balance	33,082	28,948	37,188	61,288	70,715	63,415	87,308	101,588	87,036	98,250	111,612
TE Utilization Percentage (%)	80%	84%	80%	72%	70%	72%	67%	65%	71%	69%	66%
TE Balance Percentage (%)	20%	16%	20%	28%	30%	28%	33%	35%	29%	31%	34%

TREATED WATER REUSE APPLICATIONS IN OMAN

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Urban Reuse	Agriculture Reuse	Environmental Reuse	Potable Reuse	Industrial Reuse
• **Recreational field Irrigation** • **Landscape irrigation** ***Residential, school yards, parks*** • **Fire protection** • Toilet flushing • **Cooling Tower Make-Up Tower Facilities** • Water fountains	• **Food crops Irrigation** • **Processed food crops & Non food crop Irrigation** • Livestock Watering	• **Wetlands** • Aquatic Habitats • River, Lake or Stream Flow Augmentation • **Sea Barrier** • Impoundments *Snowmaking, Fishing, Boating, Swimming* • **Golf course Irrigation**	• Indirect Potable Reuse (Managed Aquifer Recharge)	• **Cooling Towers** • Boiler Water Makeup • Steel production • High-Technology Water Reuse • **Process Water** (mining, crushers etc..) • Prepared Food Manufacturing

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WATER SUSTAINABLE PROJECTS

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SOLAR ENERGY IN DESALINATION PLANTS

Plant	Capacity m3/d	Contracted Specific Power Consumption (kWh/m3)	Remark
Sur IWP	131,837	3.36528	the IWP is equipped with **17 MWp** from solar plant starting from 2023
Sharqiyah IWP	80,000	2.96	the IWP is equipped with **2.6 MWp** from solar plant

SOLAR ENERGY PROJECT IN QURIYAT STP

In this Study, a solar energy project was initiated, as a renewable and green energy. In addition, Demonstrate the technology and obtain experiences with the operation under local conditions.

WATER SUSTAINABLE PROJECTS

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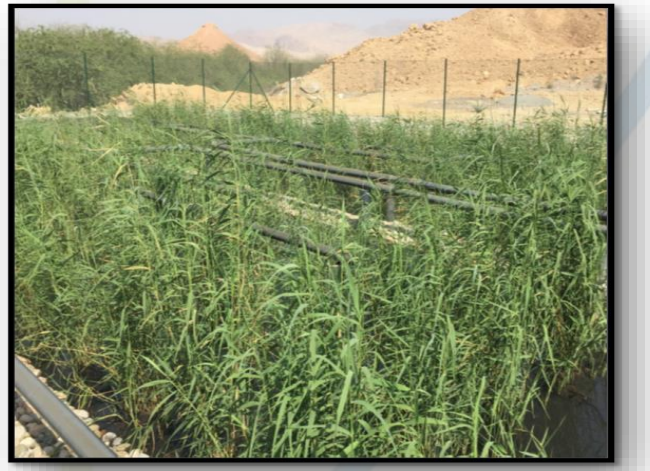
CONSTRUCTED WETLAND SUSTAINABLE TECHNOLOGY

In this study, the performance of constructed wetland technology to treat wastewater was examined its efficiency. The findings demonstrate impressive results achieved that compliance to MD 145/93 standard A.



Al ANSAB WETLANDS

Al Ansab Wetland is a natural wonderland in the heart of Muscat. It provides a showcase for Oman's impressive nature with its abundance of birds life.

The Wetland is home to an amazing 304 species of birds that may be present at different times throughout the year. Al Ansab Wetland is not just a special place for birds, it is also a safe haven for Oman's plants, butterflies and other life species.

WATER SUSTAINABLE PROJECTS

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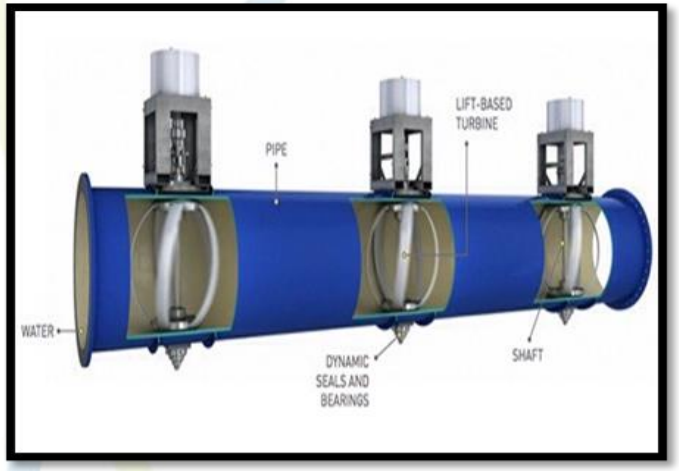
GREEN HYDROGEN

As part of TE utilization , a collaboration with Energy Development Oman Company initiated to utilize TE in production of Green Hydrogen.

HYDROPOWER GENERATION

As part of TE utilization, a study carried out on utilizing the hydropower of TE water supply network as a renewable energy system by using inline Hydropower at TE network to generate electricity.



WATER SUSTAINABLE PROJECTS

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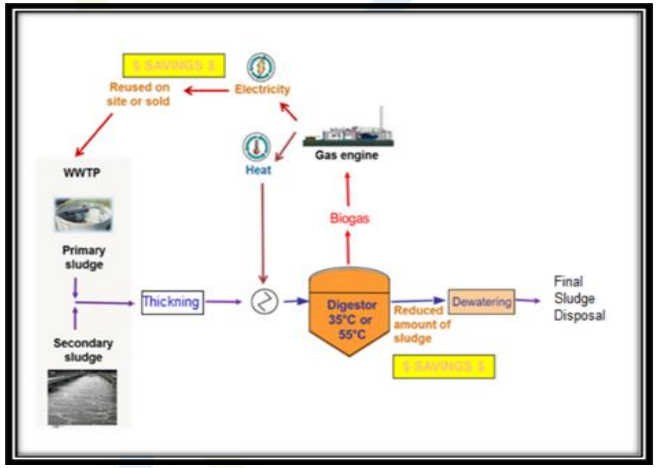
ENERGY MANAGEMENT

To implement the system in cooperation with (GEN Europe) in order to provide advisory and supervisory services and transfer expertise in energy management system field within the company's work area in Al Ansab. Energy saving is expected to be10% tO 20% saving in 2 years.

SLUDGE TO ENERGY

This study, demonstrated the sludge strategy by converting the sludge into energy project. Therefore, contributes to energy security and diversification, matches the growing demand for renewable energy and meeting 2040 vision.



WATER SUSTAINABLE PROJECTS

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Potential of Health and Environmental Risks Associated with Long-Term Application of TE in Agriculture

In regard to TE Utilization, this study was evaluated the effect of using TE on the quality of soil, seasonal (vegetables) and perennial plants (fruits) that were continuously irrigated by TE. Moreover, the study will look for possible applications of TE in agricultural system such as hydroponic and cooling system of greenhouses, so this resource can be utilized efficiently

Million Palm Project with Royal Court Affairs

10 Million Trees with Environmental Authority

Compost Plant (KALA)

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THANK YOU