Energy Challenges and Opportunities in Oman

وزارة البيئة والشؤون المناخية
MINISTRY OF ENVIRONMENT AND CLIMATE AFFAIRS

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Electricity Demand

- Peak demand is expected to grow at about 9% per year, from 5122 MW in 2014 to 9530 MW in 2021; and
- Average demand from 2852 MW in 2014 to 5373 MW in 2021

Source: AER 2008

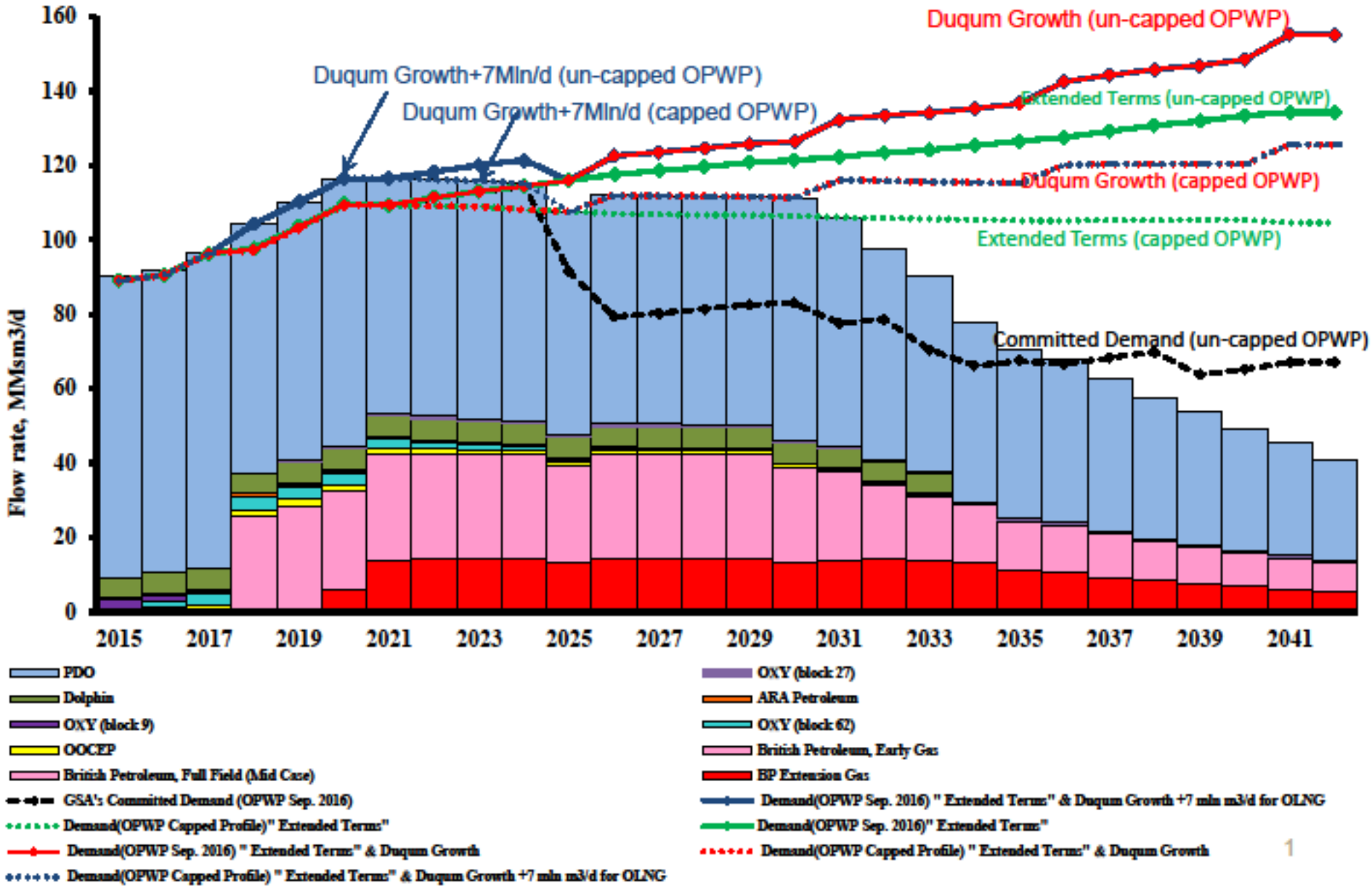
Energy Supply

- Recent developments include tendering for several new Independent Water and Power Projects (IWPPs) including Solar and Wind to nearly double Oman's power generation capacity, which is currently around 4500 MW.
- Privately financed projects planned for Barka/Sohar, Sur, Ghubrah, Salalah, Duqm, Qurayyat, Sharqiyah and Dhofar are set to be operational by 2018.

Source: AER 2008

More information: https://energypedia.info/wiki/Oman_Energy_Situation

Comparison of Different Scenarios



Risk and Priorities

- Given that Oman's electricity is generated by gas-fired facilities, posing a high risk of energy shortage in the event that gas supply be significantly reduced.
- It becomes critical to:
  - Subsidized gas supplies to "Strategic Projects" that generate high socio-economic returns
  - Develop "market driven" liberalization initiatives
  - Develop supportive permitting and regulatory environment
  - Find sustainable alternative fuels/energy sources that either augment or substitute for gas supplies to support other economic activities (i.e. industry)
  - Develop and integrated approach to Energy Governance

Where to Next? Tanfeedh Energy Lab

(18th March – 26th April 2018)

❖ Scope of Lab

1. Natural Gas Management
2. Electricity and Alternative Energy Sources
3. Governance

❖ Sub-themes

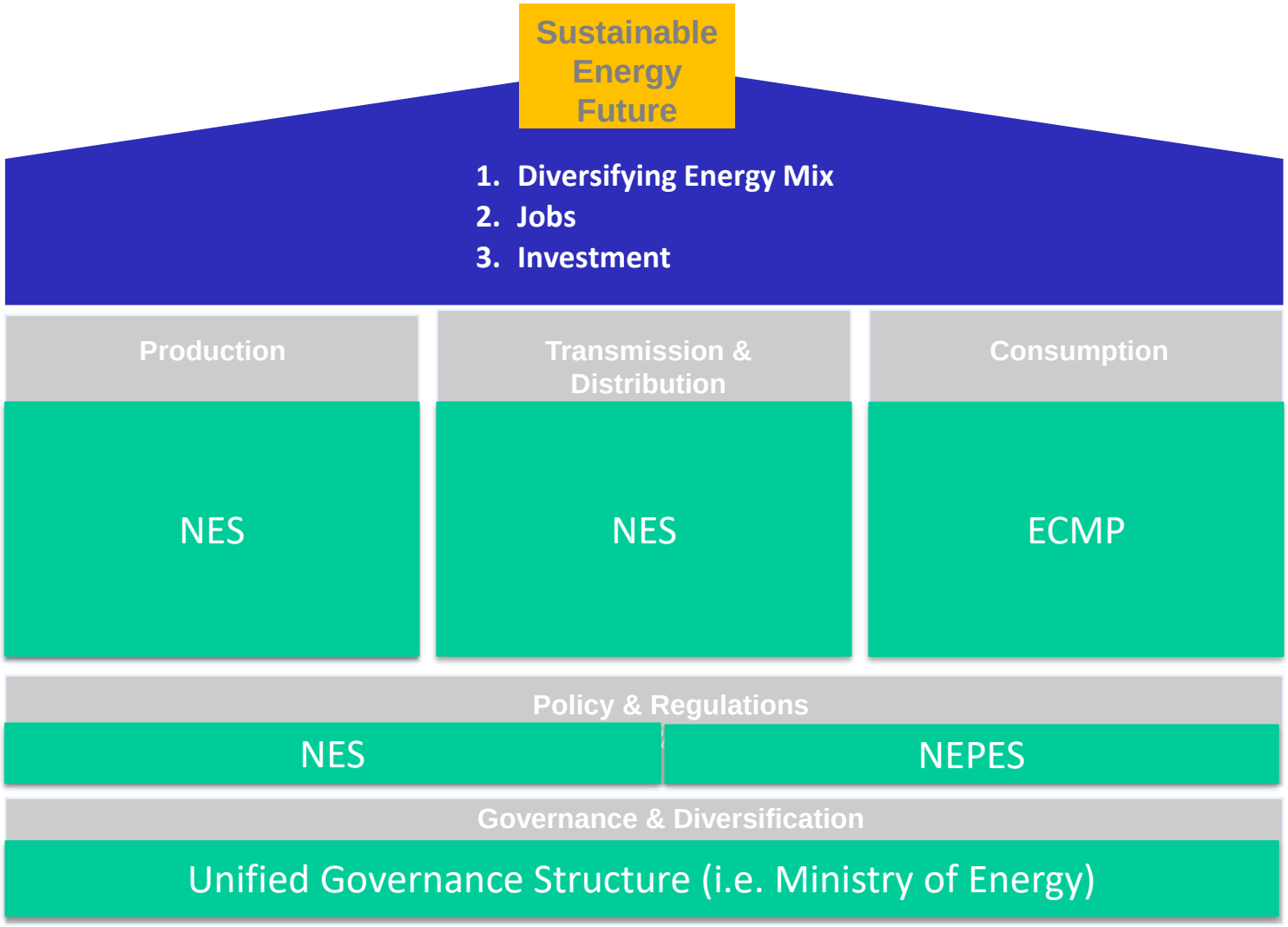
1. Energy Security
2. Economic impacts on Industry
3. Diverse .v. Integrated Governance
4. Efficiency
5. Demand Management
6. Capacity and Capability Development

❖ Outcome

1. A National Energy Strategy
2. Implementation/Action Plan
3. Specific Projects
4. Unified Governance Structure (i.e. Ministry of Energy) - Centralize energy policy under one authority.

Oman's Roadmap

(ECMP = Energy Conservation Master Plan; NES = National Energy Strategy; NEPES = National Environmental Policy for the Energy Sector)



What can Oman do?

- Develop a Policy and Strategic Action plan to facilitate the transition to a diversified sustainable energy portfolio
- Develop (internationally recognized) Standards for different fuel use, thus providing a common platform not case-by-case
- Develop regulations relating to conditions for locating and operation of power generation/industrial applications using different fuels
- Prepare guidelines to facilitate the selection and adoption of environmentally sound fuel sources, process and abatement technologies

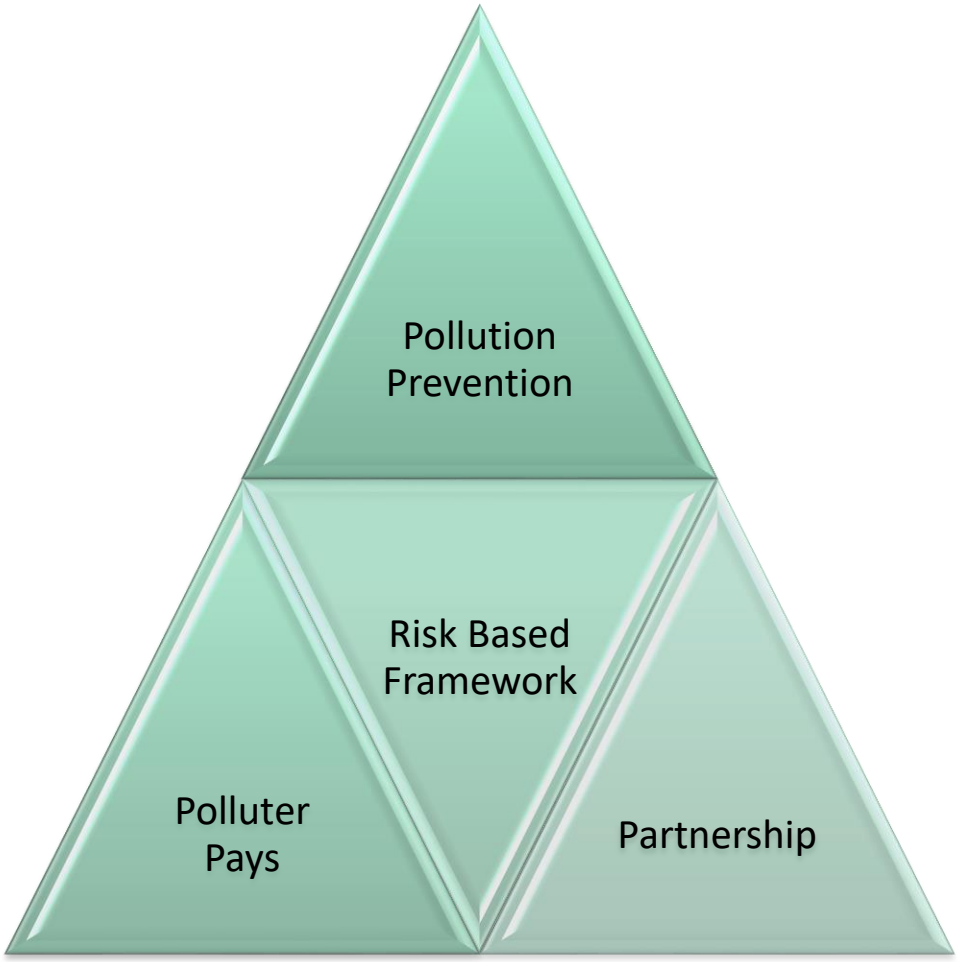
Policy regarding transition to and sustainability of a diversified energy portfolio

- Should be a combination of
  - Legislation,
  - Regulations,
  - Implementation Strategies,
  - Guidelines,
  - Incentives/Disincentives; and
  - Linkage and integration with other relevant MD's and Multi-Lateral Environmental Agreements (such as the Paris Agreement)

Benefits associated with proposed Actions

- Clarity for future projects – no requirement for case by case negotiation
- Management of risk for new investors – encouragement of competition
- Encourage/enable use of different fuels
- Use of international standards minimizes costs/maximizes implementation speed
- Provides clear environmental regulation that makes access to international debt finance simpler

Guiding Principles (3P's) underpinned by an integrated approach



Environmental Factors

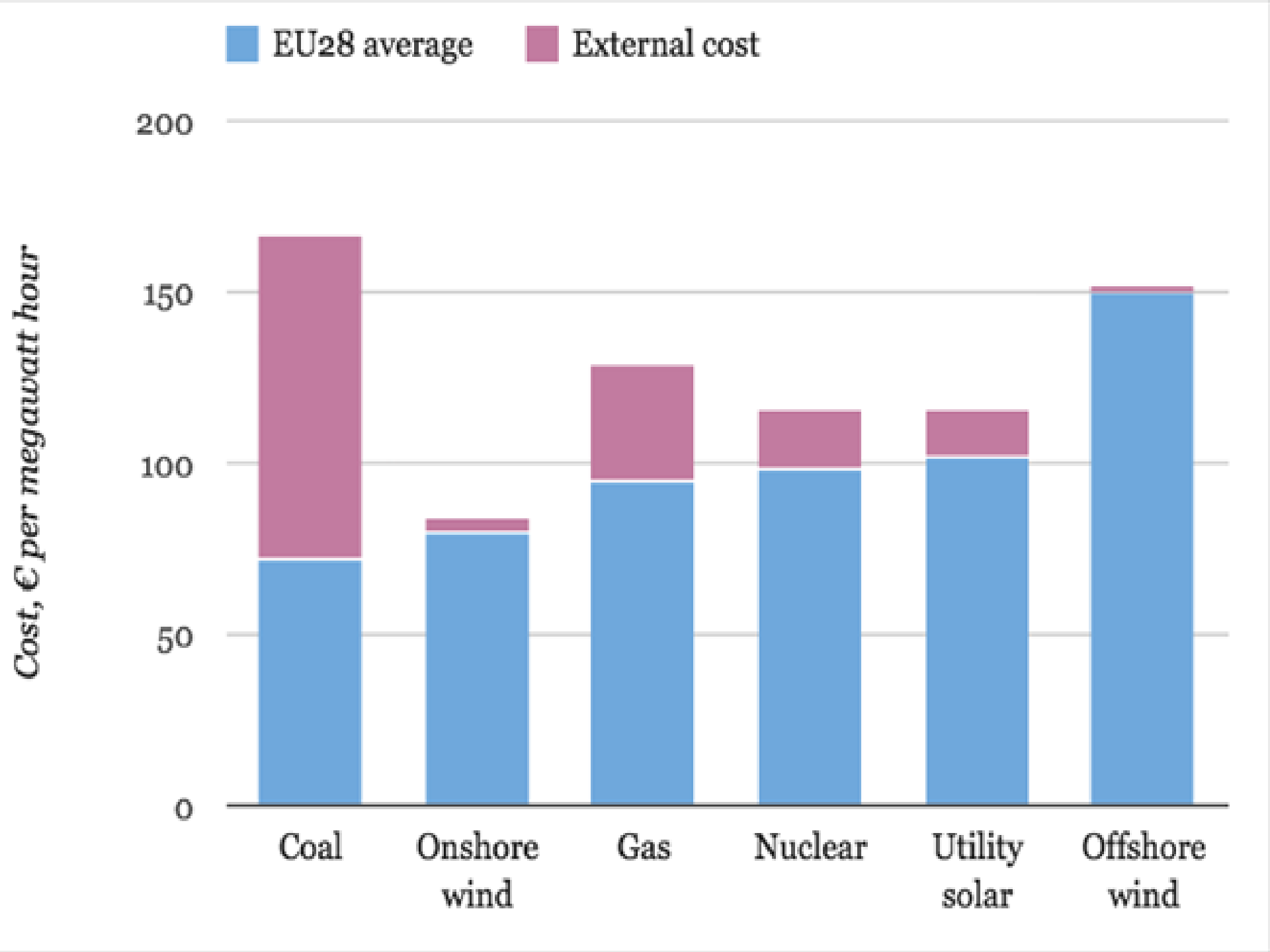
Decision Criteria	Details	
Environment		• **Air** • **Water** *i.e. marine* • **Waste** • **Soil**
		• **Climate change** *i.e. GHG Emission* • **Ecosystems**
Pollutants		• **Nitrogen Oxides** • **Sulphur Oxides** • **Carbon Dioxide** • **Heavy Metals** *i.e. lead, zinc, copper, chromium, nickel, mercury, arsenic, etc*.
		• **Dioxins/Furans** • **Particulate Matter**
Health and Wellbeing		• **Acute and Chronic Respiratory disease** • **Chronic renal failure** • **Liver disease** • **Skin cancer** • **Impaired neurological**
		development in Children • **Correlated with neurodegenerative diseases** *i.e. Alzheimer's and Parkinson's disease*
Externality costs		• **Decontamination/Remediation** • **Waste disposal** • **Healthcare cost**
		• **Ecosystem services** • **Societal reactions**

Comparison of Energy Source .v. Environmental Impacts

Energy Source	**Severity of Impact (Air, Water, Waste, Soil etc…)**
• Coal	• XXXXX
• Petcoke	• XXXX
• Oil	• XXX
• Energy from Waste	• X
• Solar/Wind	• Nil

Externalities - Costs

- Decontamination/Remediation
- Waste disposal
- Human health (intra- and inter-generational)
- Ecosystem services


EU28 average
External cost
200
150
100
50
0
Cost, € per megawatt hour
Coal
Onshore wind
Gas
Nuclear
Utility solar
Offshore wind

Solar Energy

- The level of solar **energy density in Oman is among the highest in the world.**
- There is significant scope for developing solar energy resources throughout Oman
- Solar energy has the potential to provide sufficient electricity to meet all of Oman's domestic electricity requirements and provide some electricity for export.
- High solar energy density is available in all regions of Oman: areas of highest density are desert areas. Areas of lowest density are coastal areas in the southern part of Oman;

Countries	Global Solar Radiation ($kWh/m^2/day$)	Direct Normal Solar Radiation ($kWh/m^2/day$)
Bahrain	6.4	6.5
Kuwait	6.2	6.5
Oman	5.1	6.2
Qatar	5.5	5.6
Saudi Arabia	7.0	6.5
United Arab Emirates	6.5	6.0

Wind Energy

- Significant wind energy potential in coastal areas in the southern part of Oman and in the mountains north of Salalah.
- Wind speeds in these areas are comparable to recorded wind speeds at inland sites in Europe where large numbers of wind turbines are installed and operational.
- Wind speeds are observed to be highest in summer months which coincide with peak periods of electricity demand in Oman;

Best Prospects

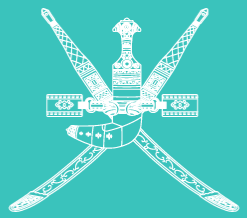
- Power transformation and networking
- Power generation equipment
- Gas-fired turbines
- Dispatch and transmission equipment
- Related software and control systems, including SMART systems and meters
- Energy Management Analytics/Metrics
- Solar and wind projects

Caveats

- Supply of feedstocks
- Price fluctuations depending on global demand
- New/more efficient technologies
- Small scale, decentralized systems are more robust and resilient to perturbations and disasters
- Security issues
- Technology “ransom”

Conclusion

- Despite Oman's extensive potential for power generation through solar energy, it has yet to develop a develop transparent legislative regime designed to regulate the renewable energy sector.
- Oman is taking first tentative steps in renewable energy would already push the Sultanate close to achieving its aim of meeting its provisional ten per cent of its energy needs from renewable sources by 2025.
- Evidence from recent studies has shown that renewable energy, in particular solar and wind energy, has tremendous potential in Oman.
- What remains to be seen is the role that the Government of Oman takes in promoting this. With the right policies and incentives, this could become one of the premier growth industries in the Sultanate over the next decade.



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Shukran/Thank you

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Supplementary Slides

Challenges 1: Energy Supply

- What are the top recommended strategies to maximise benefits to Oman of its energy resources?
- Recommendations
  - Create, Adopt and Implement a Comprehensive Energy Action Plan that can Facilitate the Immediate Implementation of Renewables
  - Establish a Ministry of Energy
  - Establish Small Scale Rooftop and Hybrid Power Generation, which Also Support Local Communities

Challenge 2: Energy Demand

- What are the top recommendations for tackling Oman's domestic energy demand & consumption over the next 25 years?
- Recommendations:
  - Structured Removal of Subsidies.
  - Inducing behavioral change by in the long term targeting public educating cycles and short term by aggressive communication campaign.
  - Centralize energy policy under one authority.

Challenge 3: Research and Development

- What are the top strategies needed to align academia and industry to deliver an enhanced R&D ecosystem in Oman?
- Recommendations:
  - More Omani PhD students to get their PhD's in Oman
  - Bring industry and academia together to establish public-private partnerships for R&D
  - Establishment of research clusters & incubators with universities across the country linked with promotion entities.

Challenge 4: Labour

- What are the top recommended strategies that need to be adopted to align industry and academia to meet Oman's future labour market requirements?
- Recommendations:
  - Establish a coordinating committee comprising from the Ministry of Manpower and Ministry of Education plus selected Industry leaders to address the alignment, of Vocational Training programmes for employability and capacity building.
  - Reduce the government role in delivering education and bolster its role on regulating education.
  - Early streaming of students into vocational training.

Challenge 5: Water-Food-Energy Nexus

- Oman is reaching, the sustainable limit of resource availability – What are the Top Recommended innovative solutions to achieve sustainable growth?
- Recommendations:
  - Renewable energy based desalination should be key to address the issue of water scarcity at small and large scale – focused on cost competitive technologies.
  - Establish and mandate an executive authority focusing on water energy food nexus to identify linkages, develop knowledge, transform ideas and induce behavioral changes.
  - Enforce building codes and standards for sustainable homes to promote water savings and energy efficiency – create green homes environment

Some Energy Source Options

(Generation cost US Cents per kWh)

- Gas (3-5)
- Coal (4-6)
- Pet coke (4-5)
- Oil (5- 6)
- Energy from Waste (8-12)
- Solar (2 - 5)

Relevant Ministries

- The **Ministry of Environment and Climate Affairs** has been established in 2007 and is in charge of formulating environmental policies and prepares plans and programmes of environmental protection, pollution control and nature conservation.
- The **Ministry of Regional Municipalities and Water Resources** was established in 2007 according to the Royal Decree 91/2007.
- The **Ministry of Oil and Gas** supervises the infrastructure of the oil and gas projects related to these sectors and coordinates the state's role in the hydrocarbon sectors. Nevertheless, the Sultan finally approves policies and investments.

Relevant Official Institutions

- The **Authority for Electricity Regulation (AER)** is responsible for the regulations of the electricity and the water sector. It was established in 2004 based on a Royal Degree (78/2004) and according to article 19 of the Law for the Regulation and Privatization of the Electricity and Related Water Sector. The Authority's duty is to secure the provision of electricity and water services in Oman. The following activities are regulated through licensing by the Authority: (1) Generation, transmission, distribution, export, import or supply of electricity, (2) generation of electricity association with desalination of water, (3) central dispatching, (4) development and/or operation of international connections, and (5) functions of the OPWP Company.
- The **Public Authority for Electricity and Water (PAEW)** provides drinking water and electricity services. PAEW is a governmental institution founded on 9th of September 2007 by Royal Decree No. (92/2007), under the requisites of two royal decrees, nos. (58/2009) and (59/2009) issued on October 11, 2009. PAEW has a renewable energy department under the strategy, policies and studies general directorate. PAEW elaborates proposals for the renewable energy strategy of Oman and for pilot projects.
- The **Rural Areas Electricity Company SAOC (RAECO)** is an Omani company which provides electricity to customers all over the Sultanate of Oman. It was established in 2005 according to the electricity sector & related water privatization law pursuant to the royal degree No 78/2004.
- The **Oman Power and Water Procurement Company (OPWP)** is the planning body for power supplies in the country. OPWP is responsible for securing electricity and water production capacities in the country and the single buyer of power and water for all IPP/IWPP projects.
- Established in 2003, the **Oman Electricity Transmission Company** is in charge of the country's electricity transmission networks.