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A new approach for promoting RE in the Arab Region: The approach for Kuwait

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A new approach for promoting RE in the Arab Region: The approach for Kuwait

Presentation Outline

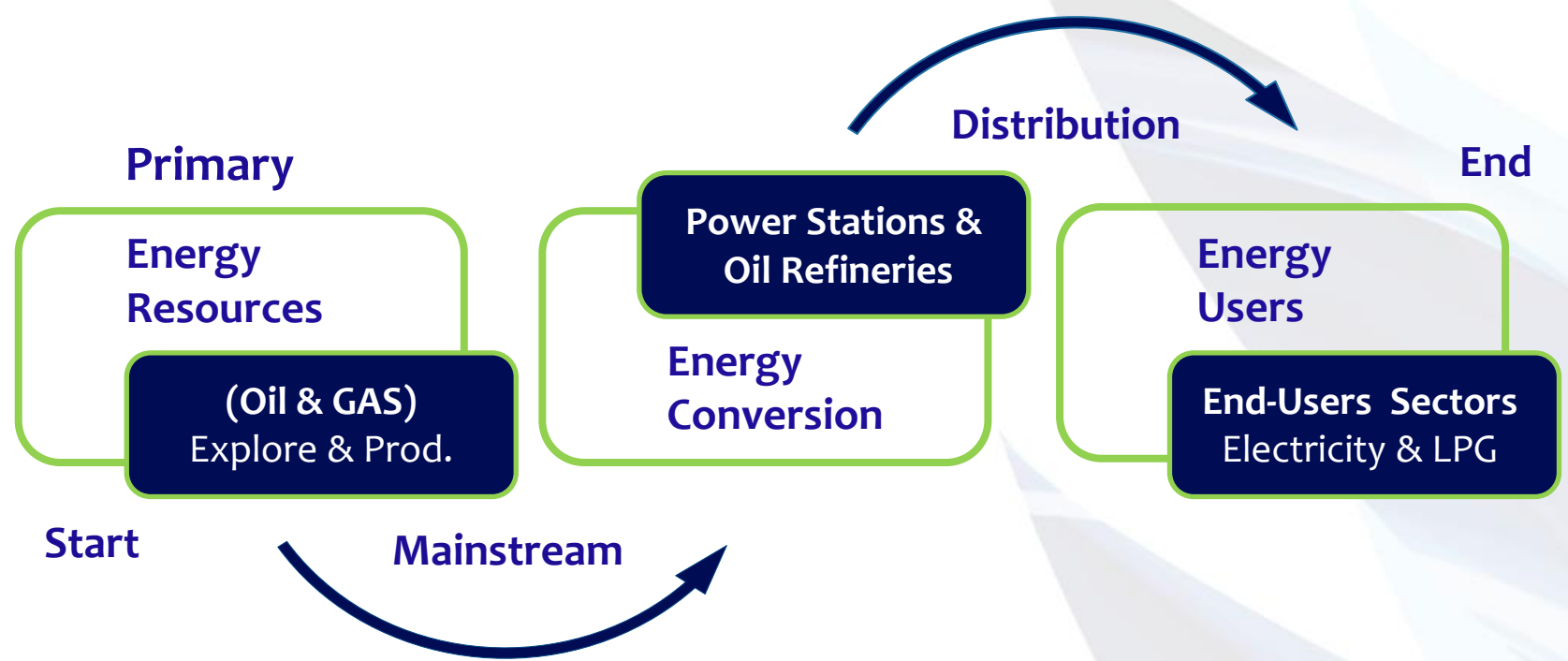
- ▶ Background
- ▶ Energy System: Overview
- ▶ Motivations for Adopting RE Systems in Kuwait
- ▶ Simplified RES of the KISR Power and Water Model (KPW)
- ▶ Electricity Generation Options in Kuwait
- ▶ Optimum Generation Mix Inventory
- ▶ Kuwait RE Current and Future Projects & Challenges for RE

Country Background

- ▶ **Area:** 17,818 km²
- ▶ **Population:** 3.5 million distributed within 6% of total area. Population growth rate 5.9%.
- ▶ **Weather:** Hot dry dusty summer, warm/cool with some rain in winter.
- ▶ **Economy:** In 2012, nominal GDP \$195 billion . About 95% of revenue comes from oil export.
- ▶ **Energy:** Indigenous energy sources are oil and natural gas (mostly associated)



Kuwait & GCC Countries Energy Chain System



The Motivation

Today's pattern and trends in overall demand and supply equations are not sustainable.

Make use of the inherent benefits of efficiency and alternative technologies, through the intergradations of clean strategies.

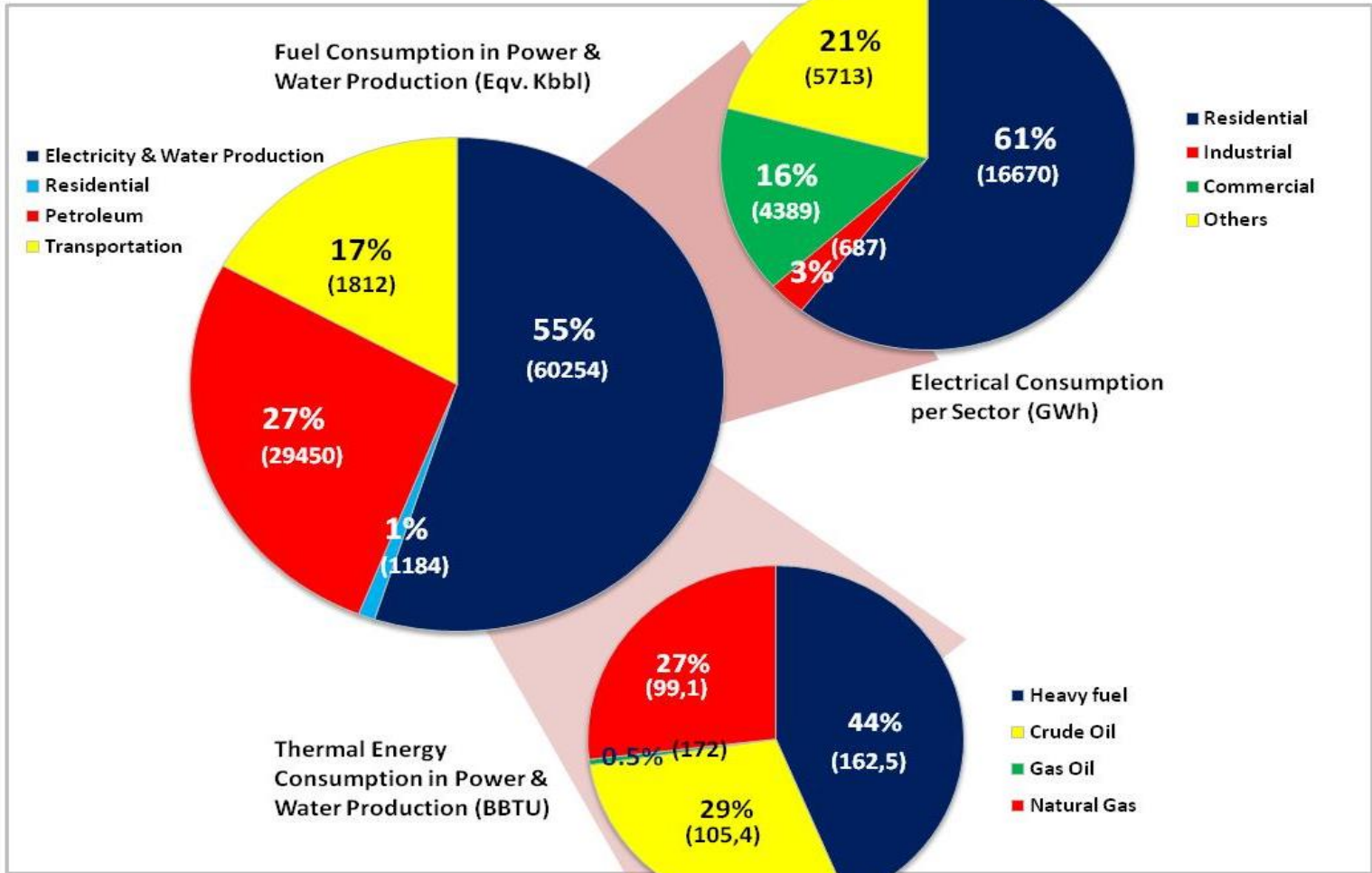
- ▶ Meeting high demand for electricity (Adaption).
- ▶ Reducing or preventing high emission rates (Mitigation).
- ▶ Meeting high demand from new resource (Diversification).

The Expectation

A portfolio of special programs to achieve sustainable targets.

- ▶ End-use efficiency.
- ▶ Sizable share of renewable / alternative technologies.
- ▶ Or a combination with each other.

Current Kuwait Energy Mix & Distributions



The Prospects

Potentials

Can be a significant from the energy security point of view;

- ▶ Slow the growth of energy demand and free valuable resources.
- ▶ promoting clean economic development.
- ▶ Reduce emissions.

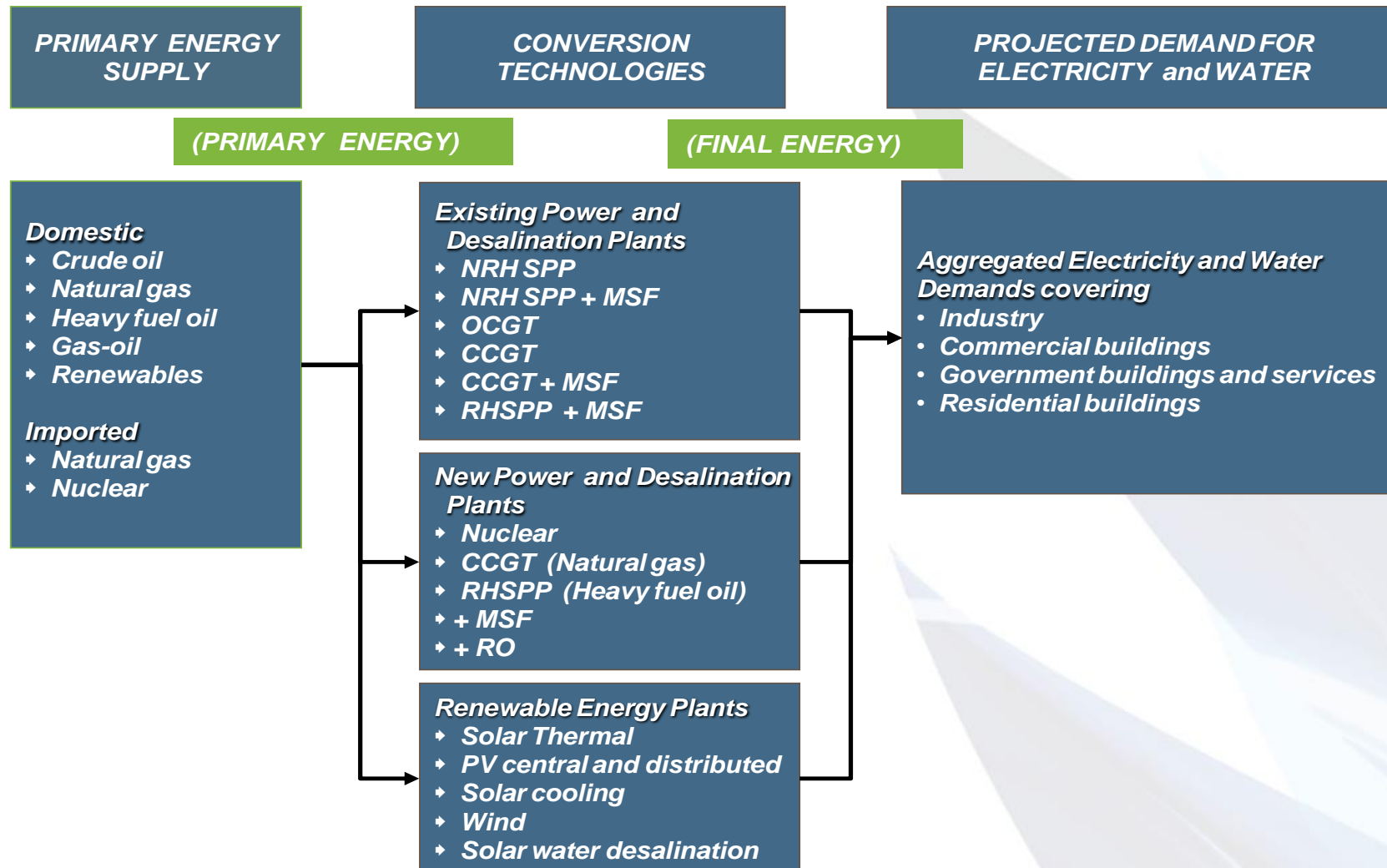
Assuming that;

- ▶ RE would reach its full potential in the next 20 to 50 years;
- ▶ RE could free & replace fossil-fuel peak power generation up to 20% by 2030.
- ▶ RE could curb energy-related global CO₂ emissions concentrations by up to one third by 2050 (compared with a BAU case).

The Objectives

1. A general assessment of the status on present & projected supply (oil & gas) resources, energy demand forecasts, (P&W capacities, fuel consumption) & identify the potential supporting measures driving this evolution.
2. A feasibility study of future RE technology options to forecast the trends of technology development, its characterizations & the economics of contribution in implementing these technologies.
3. An assessment, through a methodology, the impact of introducing RE on the potential financial gains & land-use, as part of the country's energy supply mix.

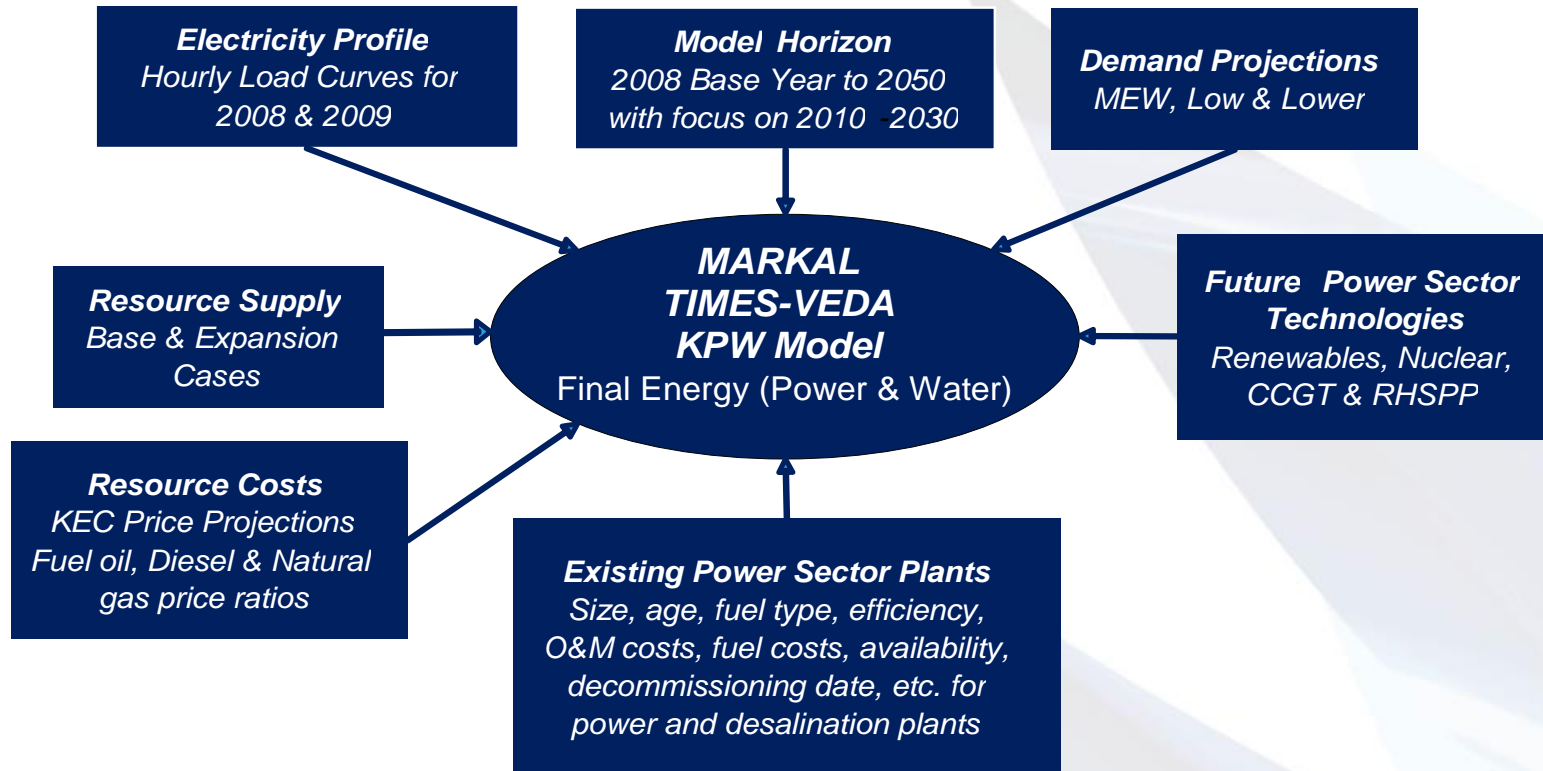
Simplified RES of the KISR Power and Water Model (KPW)



Kuwait RE Scenario Development and Analysis (2010-2035)

Acronym	Description
REF	A policy scenario based on historical fossil fuel development until 2008; fossil fuel demand kept constant after 2008; used as reference simulation to which alternative fossil fuel scenarios following KPC “reference” assumptions are compared for their impact.
REF-RE10	A target scenario that assumes REF technologies within the portfolio of future power plants to identify the cost-effective penetration of RE options that ramps-up from zero share in 2013 to the cost-effective share in 2030. (Suffix: RE10 is for 10% contribution from RE technologies).
REF-RE20	A target scenario that assumes REF technologies within the portfolio of future power plants to identify the cost-effective penetration of RE options that ramps-up from zero share in 2013 to the cost-effective share in 2030. (Suffix: RE20 is for 20% contribution from RE technologies).
REF-ff	A policy scenario based on REF; used as reference simulation to which a minimum fuel utilization constraint is placed on power plants as 60% for existing, 50% for new and 10% peaking. on are compared for their impact on the system. For existing and new plants the minimum constraint is relaxed to 20% with RE. (Suffix: ff is for flexible fossil operation).

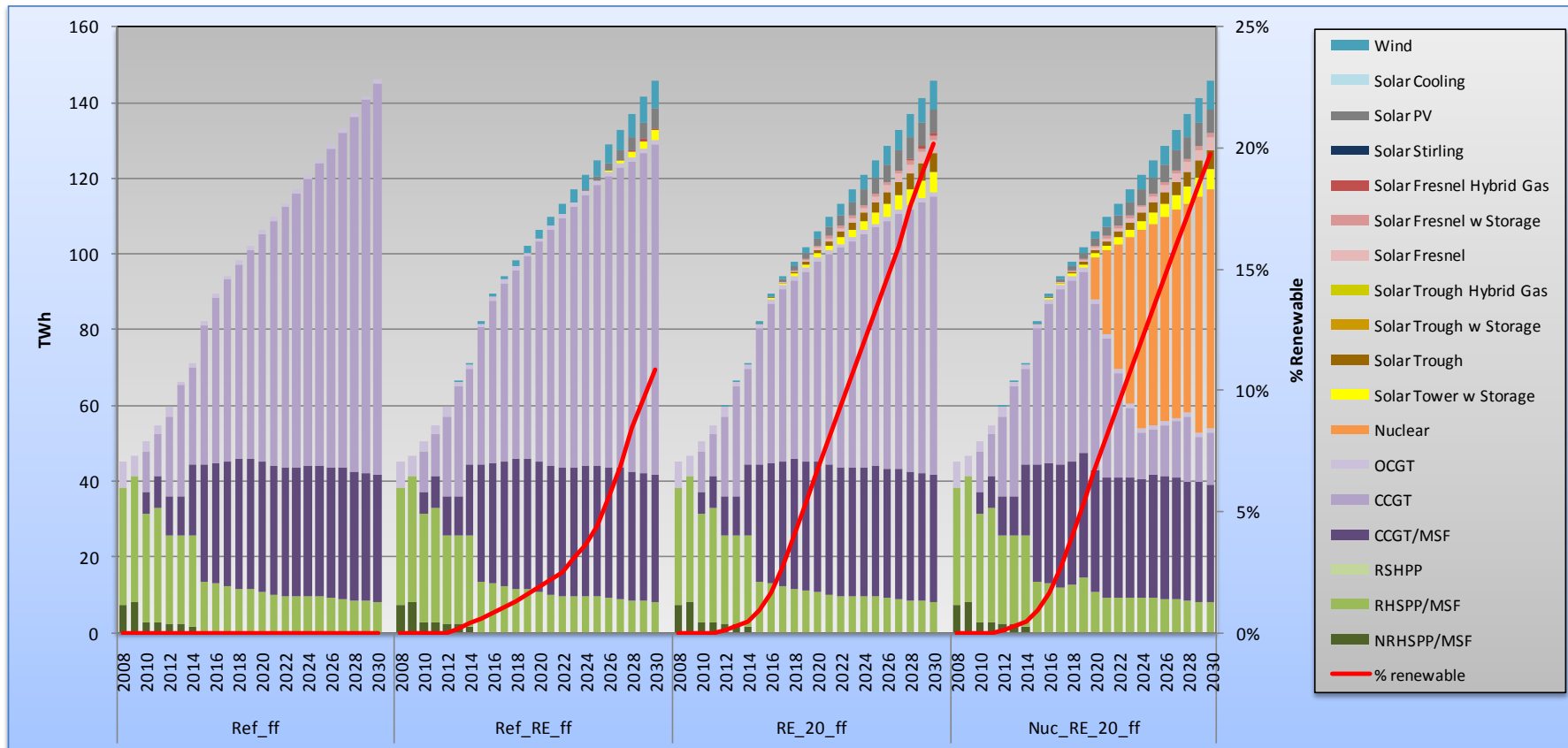
Key Input Parameters



Viable options for Electricity Generation

Technology	LCOE (\$/MWh)	
	2015	2030
Combined Cycle Gas Turbine (CCGT)	97	125
CCGT/Multi-Stage Flash	118	159
Reheat Steam Turbine	160	175
Solar CSP Trough	198	144
Solar CSP Trough + 6 hrs storage	293	217
Solar CSP Trough + 10 hrs storage	212	154
Solar PV Central	165	91
Solar PV Distributed	177	99
Wind	106	82

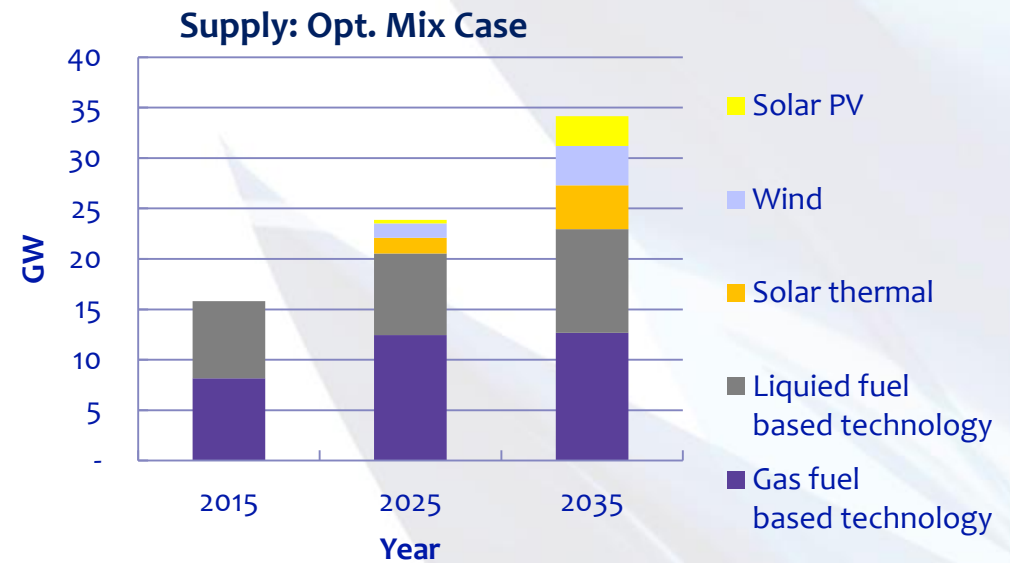
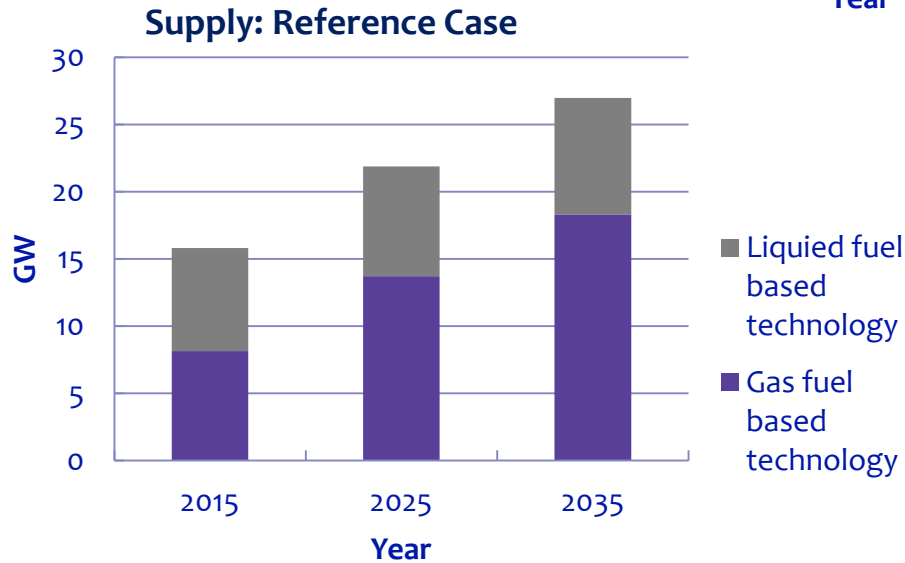
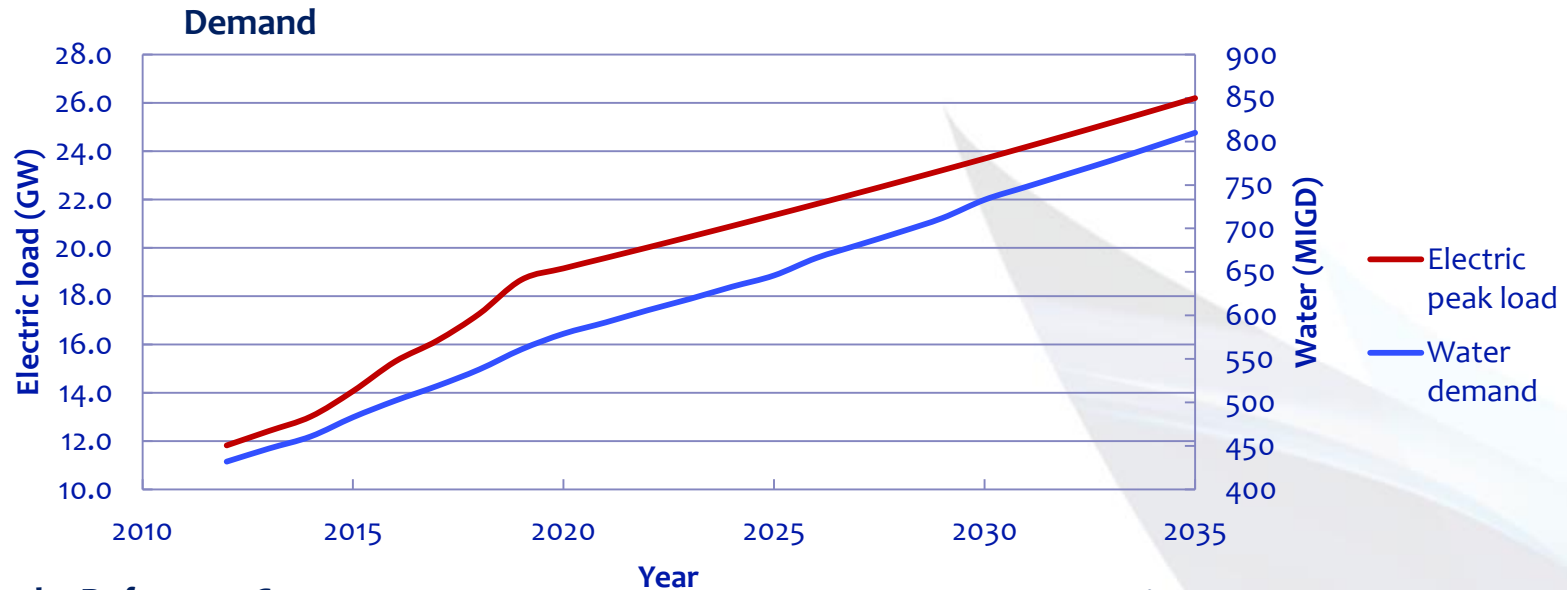
Different electricity generation mix obtained without a RE target, with RE target, without and with Nuclear.



- To achieve the higher RE generation targets, the system requires more intermittent RE capacity.
- For the 15% and 20% cases, only 5 nuclear units are installed by 2030 rather than 6 in the Base and 10% cases.

Source: KISR AE038C report (2011)

Optimum Mix Inventory for Electricity Generation



Main Results by 2035

Issue	Case	
	Reference	Opt. Mix
Total installed capacity of Gas/liquid systems (GW)	27	23
Total installed capacity of RE systems (GW)	0	11
Gas & liquid systems contribution (TWh / per cent)	131 / 100	92.7 / 72
RE contribution (TWh / per cent)	0	35.9 / 28
Required oil equivalent fuel (million barrel)	170	131
CO ₂ emission (million ton)	70	55
Total discounted cost up to 2035 (billion US Dollar)	188	183

Kuwait RE Current and Future Projects

Research and Development & Demonstration Programs at KISR

- RE R&D Demo Park (Wind, CSP, PV Cent. and Striling Dish) , 70 MW (part of 2000 MW by 2035)
- BIPV in new Administration / Centers Buildings, 1 MW
- PV Car Parking Shades with grid connection, 0.5 MW
- Thermal & PV Solar Simulators and Materials testing facilities, 15 labs at KISR (EBRC)

Government Sector

- BIPV & Rooftop in 100 school Buildings (MoEd.), 1 MW
- BIPV & PV Car Shades with Grid connected twin Buildings (MEW & MPW), 1 MW each
- Integrated Solar Combined Cycle (ISCC) & Gas Power Station (MEW), 280 MW

Commercial Sector

- BIPV & Rooftop in new Buildings (KPI), 1 MW
- Rooftop PV on Residential (500 Houses) and Super Markets.
- BIPV & PV Car Shades with Grid connected Petrol Stations (KNPC), 1 MW
- PV for Remote oil & Gas fields various installations (KOC), 30 MW
- PV & Solar Thermal installations (Pan Arab & PAAET), up to 10 MW

Challenges for Renewable Energy

Resource and Power System Integration

- Intermittency, Variability & Capacity credit
- Transmission Availability & Access
- Infrastructure & Building Requirements
- Materials & Resources

Commercialization

- Technology Development, World's Tech. / Manufacturing Forecasts
- Policy and Regulatory Requirements, codes & regulations
- Long-term Integration Targets, Government and investors
- Government Funding loan , Subsidies, Tax-Credits & Feed-in Tariffs ... etc.
- Human Resources & Training

Environmental Impact

- Renewable Energy Footprint Assessments, LCA
- Land –Use, Size & Availability



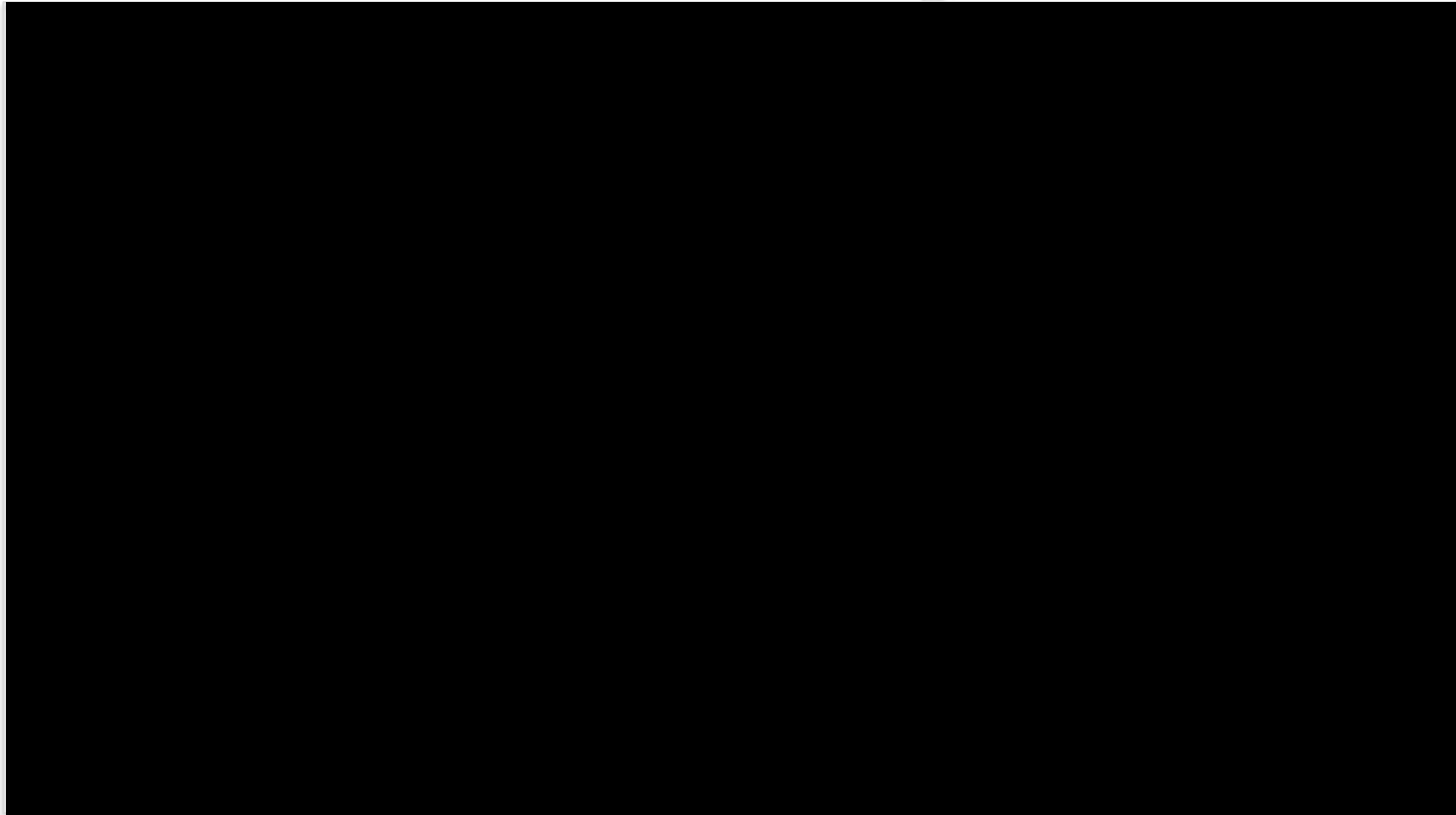
CONCLUSIONS

- ▶ Government's main role should be to set the target, with fixed amount of kWh from renewable resources.
- ▶ It is important to Invest renewable energy and energy efficiency in order to reduce the impact of meeting the national demand and the escalating consumption patterns.
- ▶ Energy created from RETs could gradually substitute Oil and NG as Kuwait's major export item.
- ▶ It is possible that RETs can extend the life-line of the country's oil and gas exports, and in some decades from now, they even have the potential to develop into a major resource of the economy.

And finally,

- ▶ A country portfolio may be combined with Demand Side Management (DSM) options and elements of R,D&D activities in power generation projects, along with commitment to real commercialization and industrial use of large-scale RET applications.

THE SHAGAYA PROJECT - KUWAIT



Renewable Energy Technology Mix - Master Plan for 2005 MW by 2018

Thank you

