Renewable Energy
A Compelling Value Proposition
In the fossil fuel capital

Japan Renewable Energy Institute
6th annual conference, 8 March 2017
1. Why Renewable Energy Has become a Compelling Value Proposition for the Oil Capital?

2. Renewable Energy is much more than green MWs (with Noor Project in Morocco as a case study)

3. Why is Renewable Energy Starting to Gather Pace in the MENA region

4. The shape & size of Saudi Arabia’s own Ambitious Renewable Energy Programme

5. Why ACWA Power is excited?
1. 1 Saudi Arabia – Uniquely blessed

- Unique load profile + Perfect match between the load and resource = unbeatable value proposition

- For this segment of load, during a summer day or winter day, one needs to keep a power plant and run it only for these few hours.

- Thus one must reconcile the impact of capacity factor on cost of energy produced.

Source: ECRA annual report 2013
1.2 Capacity Factor (CF) impact on Gas & HFO LCOE

Capacity Factor has an Exponential impact on LCOE

1.3 Achievable Levelized Cost of Electricity (LCOE) from Renewables

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity Factor</th>
<th>Cost ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>20%</td>
<td>&lt; 4</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>4.5</td>
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<tr>
<td></td>
<td>50%</td>
<td>3.5</td>
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<tr>
<td></td>
<td>60%</td>
<td>3.0</td>
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<tr>
<td></td>
<td>70%</td>
<td>3.0</td>
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<tr>
<td></td>
<td>80%</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>BASE LOAD</td>
<td>12*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12*</td>
</tr>
<tr>
<td>CSP</td>
<td>20%</td>
<td>14</td>
</tr>
<tr>
<td>WIND</td>
<td>20%</td>
<td>14</td>
</tr>
<tr>
<td>WTE</td>
<td></td>
<td>12*</td>
</tr>
</tbody>
</table>

* Assumed 30$ tipping fee per metric Ton

Source: ACWA Power
1.4 Renewables to Compete with Electricity produced with Subsidized Gas

Cost of Electricity (Levelized Tariff) for electricity generated by a combined cycle gas fired power plant with gas at US$ 0.75 /MMBTU (i.e. significantly subsidized fuel cost)

Source: ECRA Report 2013, ACWA Power, SUN & LIFE – See appendix for detailed table source. PV using single axis tracker (30%)
1.5 Complementarity of Renewables in the Energy mix

- The picture of what can be justified TODAY purely on cost competitiveness even with subsidized fossil fuels.
- Also, PV & CSP technically complements well to address peaks cost competitively

Source: pres. KACARE 2012 + ACWA Power analysis of cost
2.1 Renewable Energy is not just cost competitive MWs... but also:

- Employment Creation
- Industrialization
- Economic Value Addition
2.2 Morocco - NOORo Solar Complex

- Total value of the project: USD 3 Billion
- World’s largest solar power complex being developed in three phases
- 510MW with storage for seven hours of dispatch into the night
- Represents 5% of electricity generation capacity of Morocco
- Will supply power to 1.1 million Moroccans by 2018
- When all three phases are fully operational, project will save one million tons of oil equivalent and avoid 3.7 million tons of CO2 emissions per year (equivalent to emissions of 780,000 vehicles)
- The remote under developed city of Ouarzazate is being spectacularly transformed by this solar plant.
- Phase 1 fully operational - 160MW throughout the day light hours and three hours into the night
2.3 Case Study: Noor I CSP Plant (160MW day +3hr @night)

Localization:

30% Industrial integration (Exceeded targets)

$250M Directly invested into Moroccan Economy

Job creation and sustainability:

1,800 Workers on site as direct job creation (peak)

80% Local and National

70 Permanent, Local and Skilled Jobs for O&M

Paving the way Noor II and Noor III

15% Lower tariff than Noor I +10% lower tariff than competitors

50% Solar Field local integration

40% Integration for HTF and Thermal Energy Storage systems
Much More than Renewable Energy

The harnessing of significant renewable domestic energy resources is credit positive from an environmental sustainability perspective, while at the same time permanently reducing Morocco's balance of payment sensitivity to higher energy prices.

From an economic perspective, 1 million TOE represents about 4.8% of energy imports in volume terms in 2015. At last year's oil prices, the savings from reduced imports would have amounted to about 0.3% of GDP.
3. IN MENA REGION RENEWABLE ENERGY DEPLOYMENT STARTING TO GATHER PACE. WHY?

Cost
- < 6 US Cents/KWh is the new norm in utility scale solar PV
- < 5 US Cents/KWh for utility scale wind
- < 15 US Cents/KWh for dispatchable CSP, day and into the night

What is helping us to set new tariff benchmarks
- Transparent, well structured auctions / bids allowing developers to compete on a level playing field
- Competitive financing thanks to high levels of liquidity in a context of historically low base rates
- Improvement in technology, continuous reduction in key component costs, and increasingly efficient construction methods
- Exceptional wind and solar resource enabling high capacity factors
- Learning curve on operation and maintenance allowing to optimize cost
- Reasonable levels of local capacity and capability
4. SAUDI ARABIA’S NATIONAL RENEWABLE ENERGY PROGRAMME
AT LEAST 9.5GW OF RE ON THE GRID BY YEAR 2023

First Projects

300MW PV @ Sakaka, Al Jouf Province
400MW wind @ Midyan, Tabuk Province

First Round 3.45GW

The first 2 projects
Round 2 of 1020MW at 8 locations
Round 3 of 1340MW at 12 Locations
All to be complete by 2020

By 2023 9.5GW

Procurement by the newly established Renewable Energy Project Development Office @ Ministry of Energy, Industry & Mineral Resources
All IPP with 100% private ownership
Increasing levels of local content
Objective to progressively increase Saudi Nationals in the workforce
Diversified Renewables Asset Base

(Gross MW)

- **Morocco**
  - 630 MW
- **South Africa**
  - 150 MW
- **Jordan**
  - 100 MWe
- **UAE**
  - 200 MWe
Thank you