Hybrid Solar PV Power Plants

At Wind Power Plants

Webinar on “Hybrid Renewable Power Plants: Opportunities and Challenges"
<table>
<thead>
<tr>
<th>** Capacity **</th>
<th>** 49.5 MW **</th>
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<tbody>
<tr>
<td><strong>Wind Turbine Model</strong></td>
<td><strong>Nordex S77,1.5- HCV</strong></td>
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<tr>
<td><strong>Location</strong></td>
<td><strong>Jhampir, District Thatta</strong></td>
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<tr>
<td><strong>Land Area</strong></td>
<td><strong>1,283 Acres</strong></td>
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<tr>
<td><strong>Total Wind Turbines</strong></td>
<td><strong>33</strong></td>
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<tr>
<td><strong>Benchmark Production</strong></td>
<td><strong>143.55 GWh per annum</strong></td>
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<tr>
<td><strong>Commercial Operations</strong></td>
<td><strong>May 16, 2013</strong></td>
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</tbody>
</table>
JHAMPIR-120 km from Karachi

PAKISTAN SINDH WIND CORRIDOR
Wind Power Plants In Sindh Region

- FFCEL
- ZORLU
- TAPAL
- YUNUS
- FWEL – II
- SAPPHIRE
- HYDRO CHINA
- TGI
- GUL AHMED
- UNITED ENERGY
- FFCEL
- HARTFORD
- TB 1
- TB 2
- TB 3
- SACHAL
- TGS
- TGT
- TENAGA
- METRO
- YUNUSTAPAL
- TGF
- ZAFAIR
- HYDRO CHINA
- HAWA
- JHAMPIR
FFCEL Site

Unutilized Spaces Available within Wind Farm
Growth Trend of Wind Plants - Pakistan

Commissioned = 1240 MW

In Pipeline = 600 MW
• Sindh wind corridor realizable capacity - over ~10 GW
• Tariff lowered to 6.7 – 7 $c/kWh – comparable to any technology
• Potential for Local industry growth
  – Tower manufacturing,
  – Blade and nacelle assembly
  – Services sector
  – Allied component supplies
• However, Grid Evacuation Capacity is limiting factor
• Grid enhancement projects underway - New Projects expected as and when new allocations are available
Opportunity

Grid Allocation 50 MW

Available for Solar

Natural Variation in Wind – 33% Grid Utilization

AEDB worked on concept in 2016-17, found it workable
Interconnected Power Control
Wind & Solar Potential

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Diurnal Pattern of Solar and Wind Resource at FFCEL Plantsite, Jhampir

Value Creation Zone

Hour of the Day

- Wind Speed
- Solar Global Irradiance
Wind Farm Annual Production

Grid Capacity Utilization 33%

Wind Farm Output – 144 GWh
Combined Annual Production

Combined Output – 207GWh

Grid Capacity Utilization 48 %
Conclusion of Study
Results & Benefits

• Pattern of wind & solar resources is conducive for hybrid
• Hybrid Solar assist in smoothing variations in Wind output
• 25 – 40 MW Solar Plant for 50 MW Wind Plant Possible
• ~ 600 MW Solar PV Plants can be installed by next year
• Increased grid utilization factor – from 33% to 48%
• No additional grid infrastructure enhancement needed
• Reduction in overall per unit O&M cost of grid
• Addition of electricity at tariffs lower to overall basket price
• Addition of battery storage viability expected in 2 – 3 years
M/s Hero Future Energies on April 13, 2018 inaugurated a 28.5 MW Solar PV Plant at its 50 MW Wind Power Plant in Karnataka, India under similar Grid Restriction Arrangement.
Progress & Way forward

- Concept has been approved in principle by AEDB and has issued LOIs to interested investors
- FFC has submitted its Feasibility study to AEDB which is under review for approval
- Suitable Upfront tariff for such hybrid Solar PV Projects shall provide stimuli for quick deployment as;
  - No new grid planning / grid development needed
  - Quick installation within 8 – 10 months possible
Thank you