Priority Theme 1: The role of science, technology and innovation to increase substantially the share of renewable energy by 2013

United Nations Inter-Sessional Panel of the Commission on Science and Technology for Development (CSTD) Geneva 6-8 November, 2017

M. Bilal Khan, DIC/PhD
Principal & Dean
US-Pakistan Centre for Energy
National University of Sciences and Technology
Ministry of Science and Technology, Islamabad Pakistan
Organization

• Why Renewables and Innovation?
• RE Deployment
• Challenges
• Pakistan RE Landscape
• Recommendations
Why Renewables and Innovation?

Change in global mean temperature from preindustrial levels

- Observations
- High climate sensitivity
- Median climate sensitivity
- Low climate sensitivity

Pakistan located in the foothills of Himalaya

Business as usual!

Global primary energy use under the Paris Agreement

Energy Futures, MIT Energy Initiative, Spring 2017

Flash floods in Northern Area
RE Deployment

- RE ingress is slow but sure; however not enough!
- Radical innovation is needed to spur deployment

Pakistan Energy Matrix 2020

World Energy Matrix 2020

https://www.worldenergy.org
Challenges

- Variability: leads to grid instability
- Low efficiency: leads to higher costs
- Low energy density: leads to low capacity
- Insensitivity to climate change

Batteries can’t compete with the energy density of liquid fuels
Pakistan Renewable Energy Policy Snapshot

**RE Policy**
- Diversity in energy with greater share of renewables
- Comprehensive framework encouraging utilization of RE

**Incentives**
- Deregulated Power Sector
  - Zero Capacity charge
- Feed-in Tariff
- Mandatory Grid Connection
- Mandatory Power Purchase
- Credit Market Facility
- 100% Carbon Credits to IPP
Pakistan Wind Corridor
Total potential: 41,000 MW

Pakistan lies in an area of one of the highest solar insulations in the world and has immense solar resources, suitable for both Photovoltaic (PV) and Thermal Solar Power applications. There are certain regions of South, Quetta valley and Central Punjab that receive maximum solar radiation. The Annual Direct Normal Solar Radiation for CSP is in the range of 7 to 7.5 kWh/m²/day in many parts of Balochistan and between 6.5 to 7 kWh/m²/day in other parts of Balochistan. 5 to 5.5 kWh/m²/day in Southern Punjab and Northern Sindh and around 4.5 to 5 kWh/m²/day in rest of Pakistan.

Pakistan is building solar power plants in Azad Kashmir, Punjab, Sindh and Balochistan. The program is under development by the International Renewable Energy Agency, China, and Pakistani private sector.

Pakistan has also set a target to add 5%, approximately 10,000 MW electricity through renewable energies by year 2030 besides replacement of 5% diesel with bio-diesel by year 2025 and 10% by 2025.
Pakistan Biomass Map

### RE Projects Status in Pakistan (10% share by 2018)

#### Wind Projects Status

<table>
<thead>
<tr>
<th>Total Commissioned Project capacity</th>
<th>308.2 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Under construction Project capacity</td>
<td>477.0 MW</td>
</tr>
<tr>
<td>Total Projects in Pipeline Capacity</td>
<td>663.0 MW</td>
</tr>
<tr>
<td>Total Outlay</td>
<td>1448.2 MW</td>
</tr>
</tbody>
</table>

#### Solar Projects Status

<table>
<thead>
<tr>
<th>Year</th>
<th>Yearly Cumulative Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>100</td>
</tr>
<tr>
<td>2016</td>
<td>400</td>
</tr>
<tr>
<td>2017</td>
<td>730</td>
</tr>
<tr>
<td>2018</td>
<td>1556</td>
</tr>
</tbody>
</table>

#### Bio-energy Projects Status

| Achieved Commercial Operation Date (COD) | 61.1 MW |
| Achieved Financial Close (F.C) | 41.0 MW |
| Under Letter of Support (LOS) stage | 347.6 MW |
| Under Letter of Intent (LOI) stage | 584.8 MW |
| Under Letter of Support (LOS) stage | 12.0 MW |
| Total Bio-energy outlay | 1046.5 MW |
**Recommendations**

- As opposed to common belief, Renewable Energy is not inexhaustible. The platforms utilizing RE are based on finite sources e.g. Silica, Lithium, etc.
- Increase Investment in Innovation and R&D
- Increment in RE efficiency, energy density and Cycle life
- Digital grid for stability; smart-grid for efficiency
- Augment technology transfer among member states
- Cash complementary cycles of wind and solar
Radical Innovation: Biofuels

- Synergy between solar energy and materials synthesis

<table>
<thead>
<tr>
<th>Technology</th>
<th>Rate</th>
<th>Temperature</th>
<th>Conversion %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>90 minutes Process</td>
<td>70°C</td>
<td>85</td>
</tr>
<tr>
<td>Breakthrough</td>
<td>5 minute Process <em>Photocatalyst</em></td>
<td>25°C (Ambient)</td>
<td>99</td>
</tr>
</tbody>
</table>