



**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**

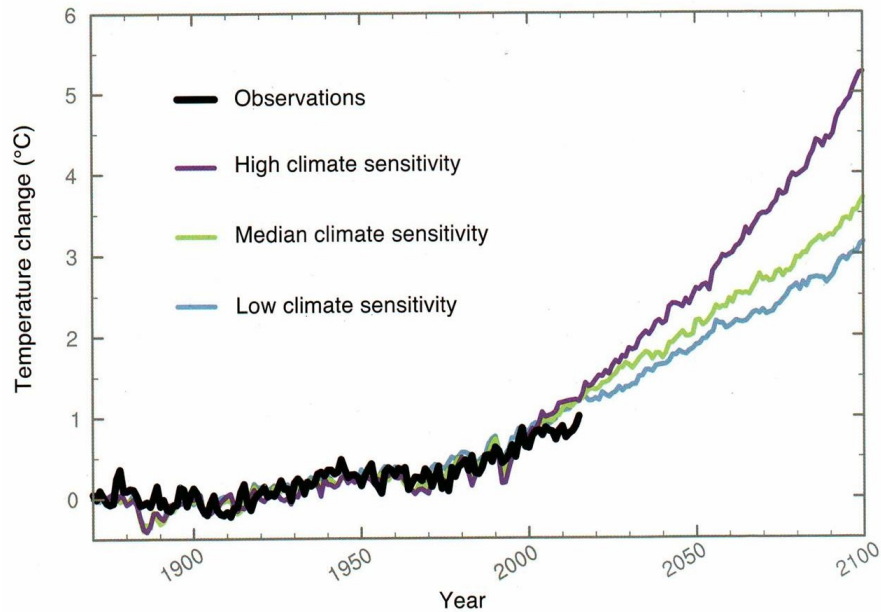
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# Organization

- **Why Renewables and Innovation?**
- **RE Deployment**
- **Challenges**
- **Pakistan RE Landscape**
- **Recommendations**

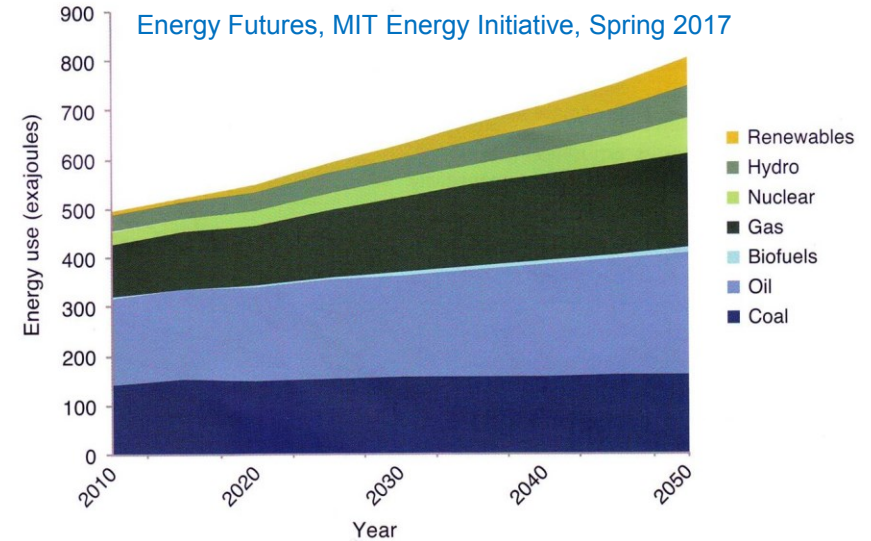
# Why Renewables and Innovation?

Change in global mean temperature from preindustrial levels



## Business as usual!

Global primary energy use under the Paris Agreement



Pakistan located in the foothills of Himalaya



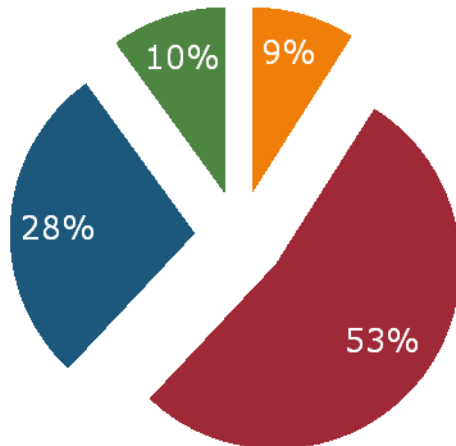
Flash floods in Northern Area

# RE Deployment

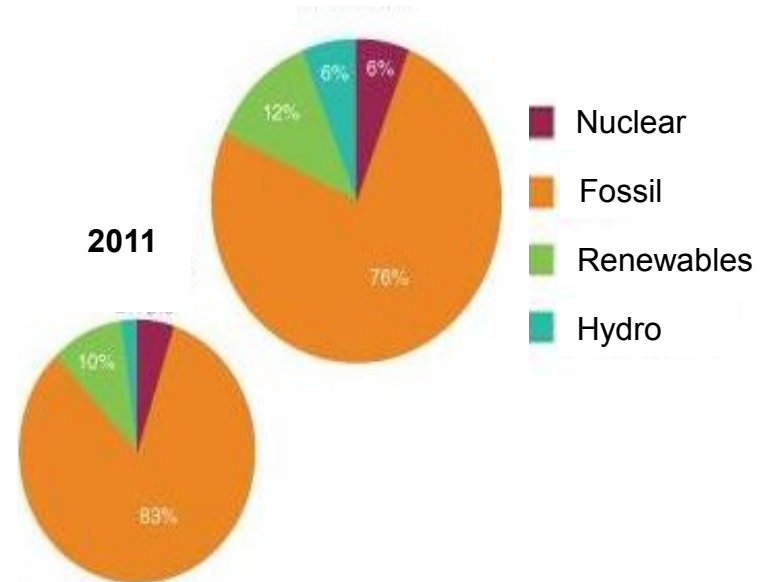
- RE ingress is slow but sure; however not enough!
- Radical innovation is needed to spur deployment

**Pakistan Energy Matrix 2020**

■ Nuclear ■ Fossil Fuel ■ Hydro ■ Renewables



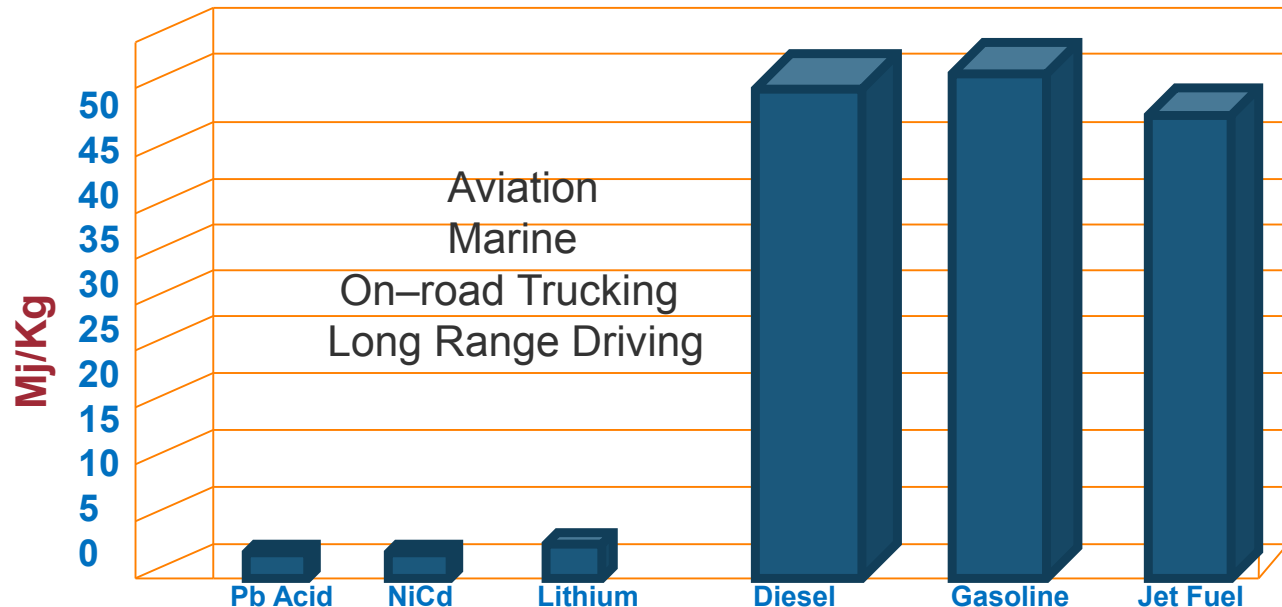
**World Energy Matrix 2020**



<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**

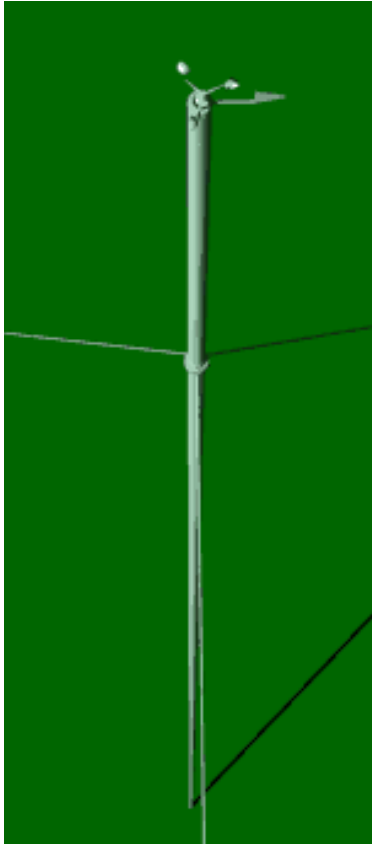
**Mandatory Power Purchase**

**Credit Market Facility**

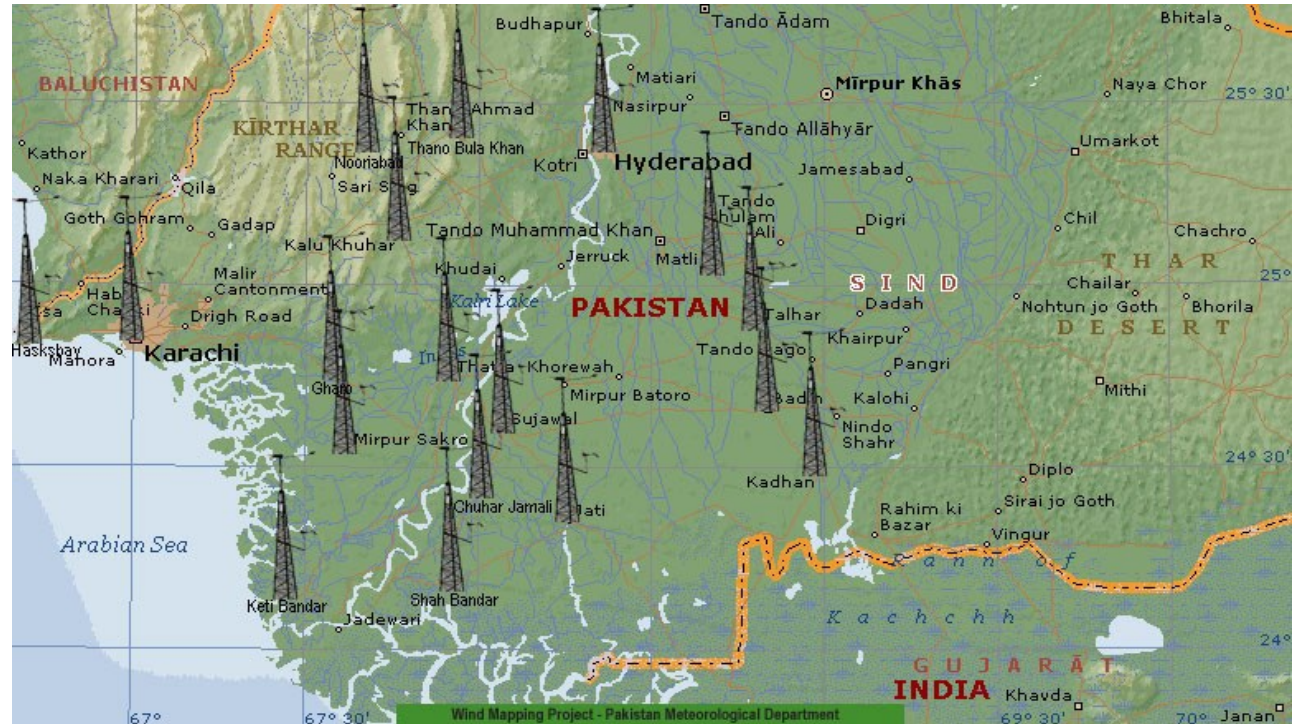
**100% Carbon Credits to IPP**

# Pakistan Wind Corridor

Total potential: 41,000 MW



© DWTMA 1998

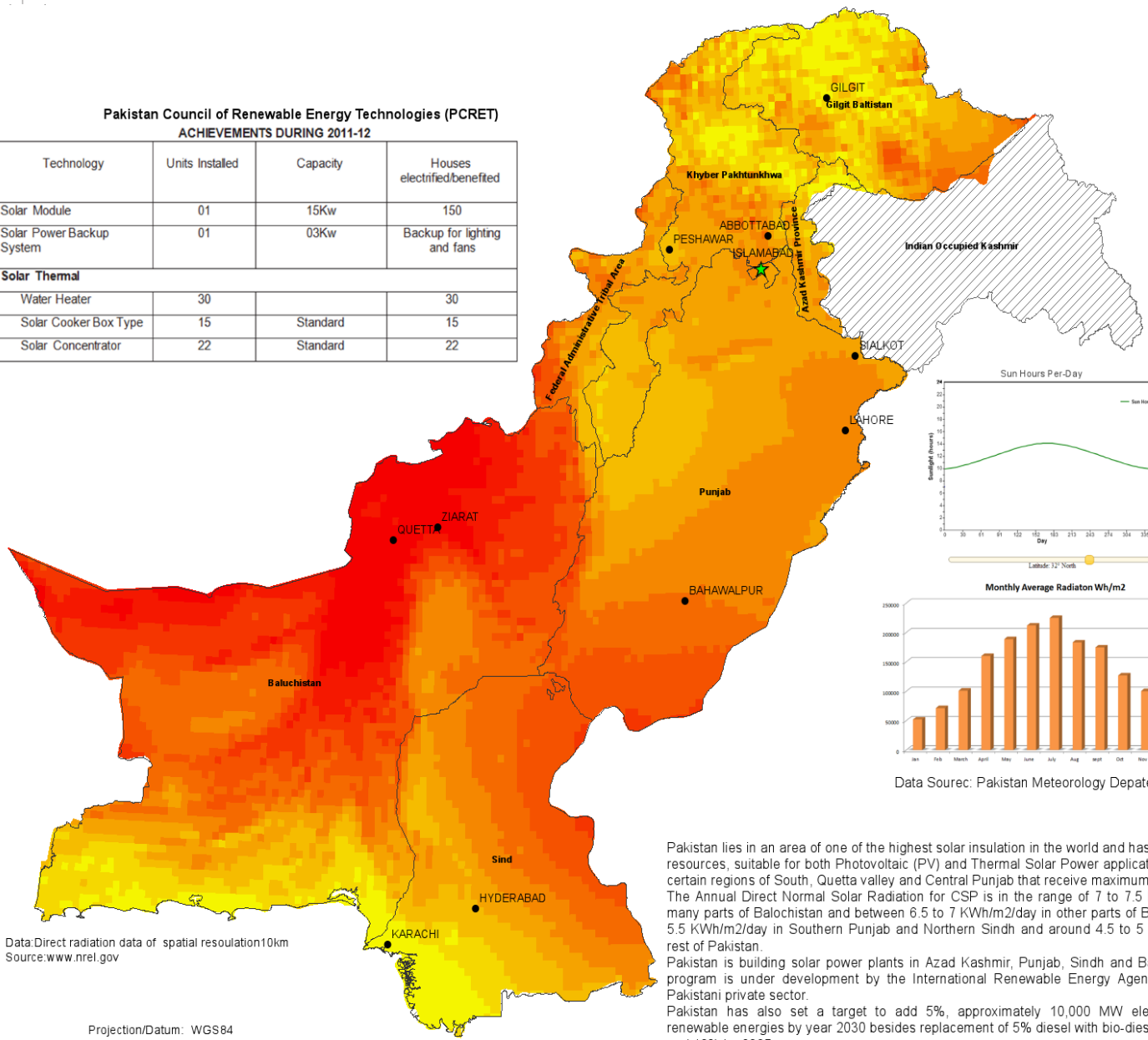


List of 21 stations: Badin, Baghan, Churhar-Jamali, Gharo, Golarchi, Hawks-Bay, Hyderabad, Jati, Kadhan, Karachi, Kati-Bandar, Matli, Mirpur-Sakro, Nooriabad, Sajawal, Shah-Bandar, Talhar, Thano-Bula-Khan, Jamshoro, DHA Karachi, Thatta.

# solar-maps-for-pakistan

## Pakistan Council of Renewable Energy Technologies (PCRET) ACHIEVEMENTS DURING 2011-12

Technology	Units Installed	Capacity	Houses electrified/benefited
Solar Module	01	15Kw	150
Solar Power Backup System	01	03Kw	Backup for lighting and fans
<b>Solar Thermal</b>			
Water Heater	30		30
Solar Cooker Box Type	15	Standard	15
Solar Concentrator	22	Standard	22

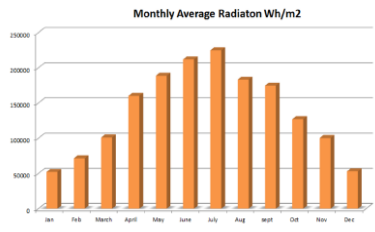
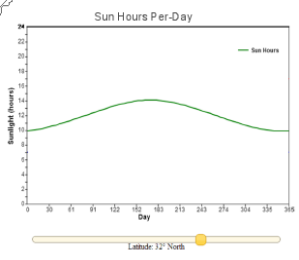


### Legend

- ★ Capital
- Major Cities
- Province/Region Boundary

### Annual Direct Radiation KWh/m<sup>2</sup>/day

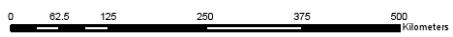
- 3.338 - 3.936
- 3.937 - 4.205
- 4.206 - 4.453
- 4.454 - 4.655
- 4.656 - 4.864
- 4.865 - 5.105
- 5.106 - 5.365
- 5.366 - 5.657
- 5.658 - 6.015
- 6.016 - 6.640



Data Source: Pakistan Meteorology Department

Data: Direct radiation data of spatial resolution 10km  
Source: www.nrel.gov

Projection/Datum: WGS84



Pakistan lies in an area of one of the highest solar insolation 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/m<sup>2</sup>/day in many parts of Balochistan and between 6.5 to 7 KWh/m<sup>2</sup>/day in other parts of Balochistan. 5 to 5.5 KWh/m<sup>2</sup>/day in Southern Punjab and Northern Sindh and around 4.5 to 5 KWh/m<sup>2</sup>/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 2015 and 10% by 2025



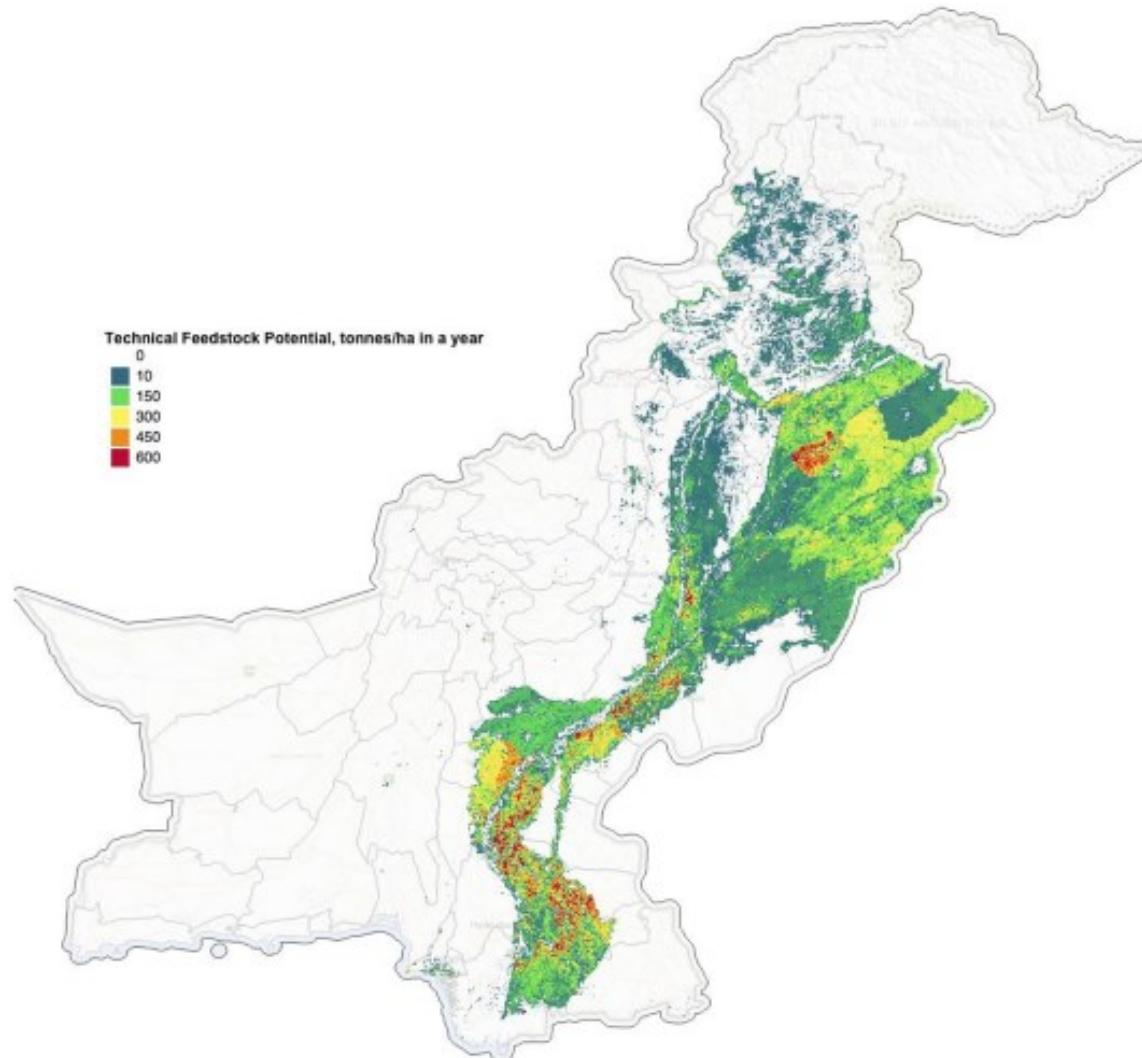
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# Pakistan Biomass Map

<http://documents.worldbank.org/curated/en/104071469432331115/Biomass-resource-mapping-in-Pakistan-final-report-on-biomass-atlas>



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

## Wind Projects Status

<b>Total Commissioned Project capacity</b>	<b>308.2 MW</b>
<b>Total Under construction Project capacity</b>	<b>477.0 MW</b>
<b>Total Projects in Pipeline Capacity</b>	<b>663.0 MW</b>
<b>Total Outlay</b>	<b>1448.2 MW</b>

## Solar Projects Status

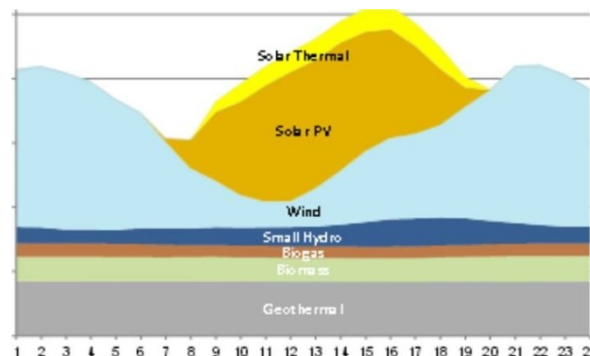
<b>Year</b>	<b>Yearly Cumulative Capacity (MW)</b>
<b>2015</b>	<b>100</b>
<b>2016</b>	<b>400</b>
<b>2017</b>	<b>730</b>
<b>2018</b>	<b>1556</b>

## Bio-energy Projects Status

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

## 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

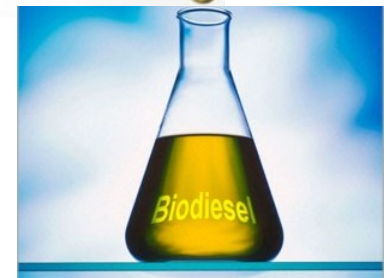
Technology	Rate	Temperature	Conversion %
Conventional	90 minutes Process	70°C	85
Breakthrough	5 minute Process <i>Photocatalyst</i>	25°C (Ambient)	99

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