Renewable Energy Resource Mapping of Pakistan

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Sequence of Presentation . . .

- Brief Introduction of Alternative Energy Development Board (AEDB)- the Client of WB-RE Mapping Project
- Salient Features of Renewable Energy Policy
- Potential of Renewable Energy Resources in Pakistan
- Current Status of Renewable Energy Projects
- World Bank Initiative- Wind, Solar and Biomass Mapping
- Status of RE Mapping Project
- Questions/Discussion

Alternative Energy Development Board (AEDB)

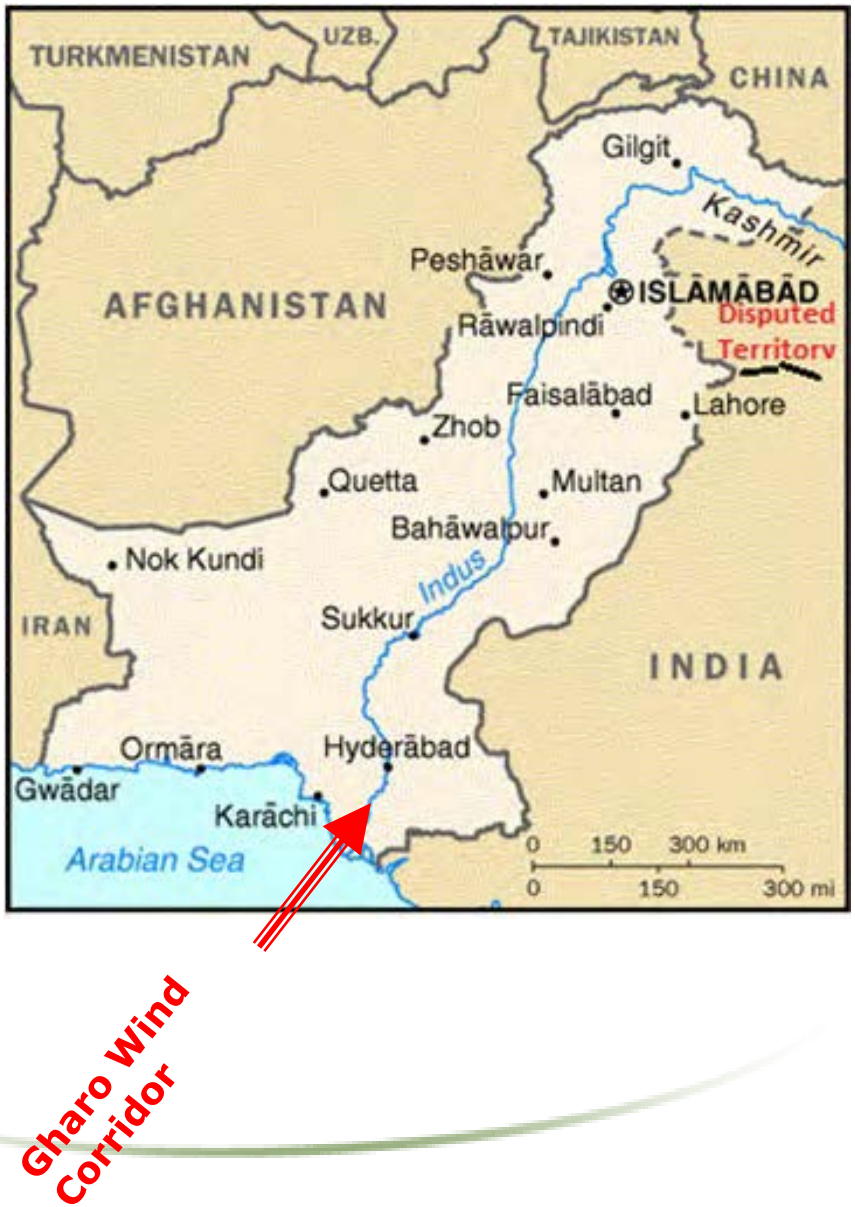
- One Window for all Alternative Energy Investments in Pakistan.
- Implement policies, programs and projects through private sector in the field of Alternative Energy
- Assist and facilitate development and generation of Alternative Energy to achieve sustainable economic growth
- Encourage transfer of technology and develop indigenous manufacturing base for ARE Technology
- Promote provision of energy services that are based on Alternative energy resources
- Setting up ARE projects on its own or through joint venture or partnerships with public or private entities.

Salient Features of Renewable Energy Policy

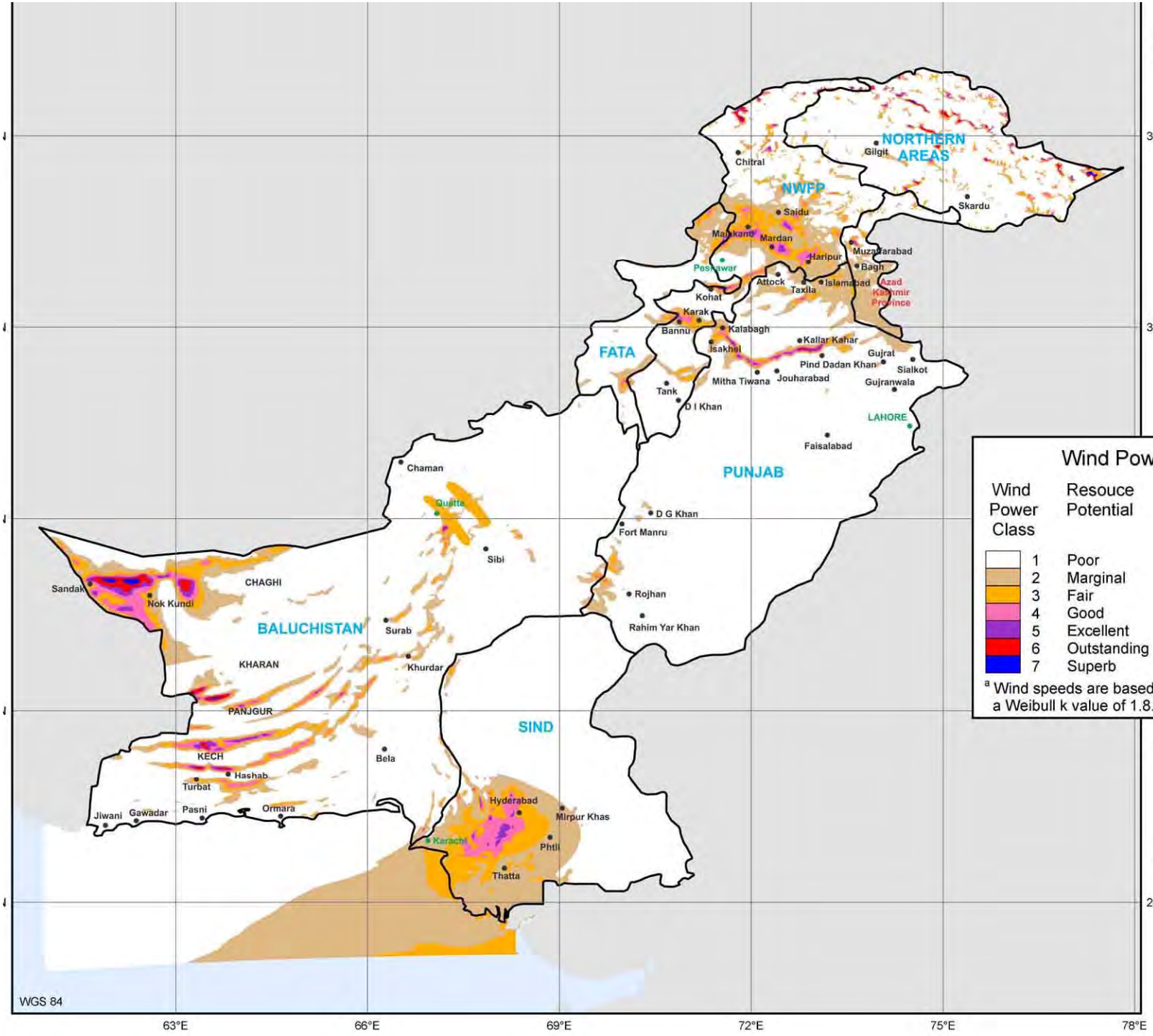
- Guaranteed electricity purchase
- Grid provision is the responsibility of the purchaser
- Protection against political risk & change in law
- Attractive Tariff – Cost Plus and Upfront
- Return on investment is between 17% to 18%
- Upfront Tariff of US Cents 13.52/kWh for Wind and US Cents 17.1 per kWh for Solar PV announced by the Regulator.
- No Import Duties on RE Equipment
- Zero Sales Tax
- No Income Tax / withholding tax / turnover tax
- Repatriation of equity along with dividends freely allowed
- Convertibility of PKR into USD

RE Resource Potential – Wind Energy Potential

- National Renewable Energy Lab (NREL) under USAID Program – Rolled Out Wind and Solar Atlas of Pakistan (based on available data and data collected through satellite)
- **350,000 MW** theoretical National Potential of Wind Energy (according to NREL Study)
- **50,000 MW** in province of Sindh (Gharo – Keti Bandur Wind Corridor)
- Pakistan has more than 300 sunny days and has one of best solar resource



Pakistan
50 m Wind Pow



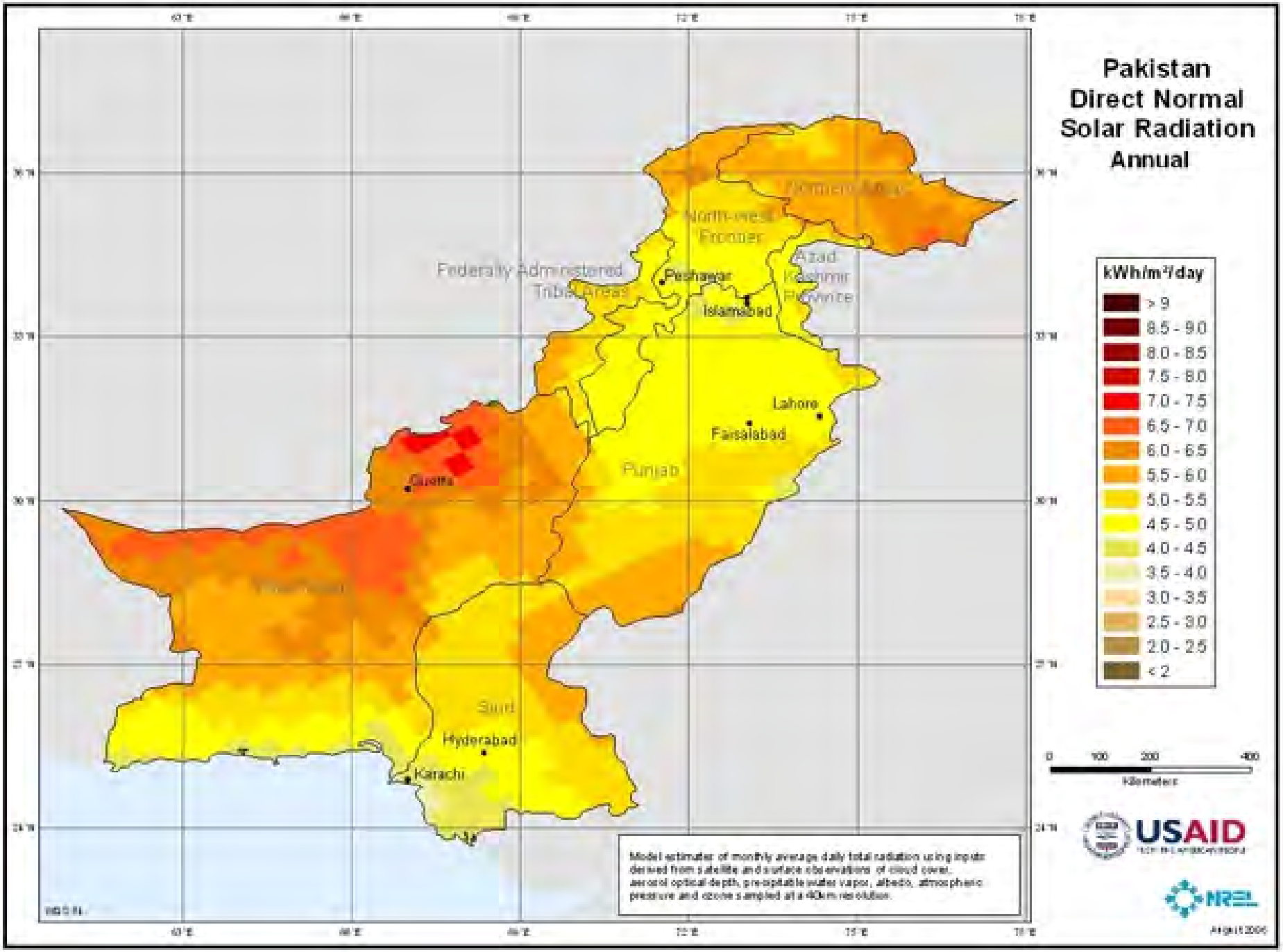
Wind Power Classification

Wind Power Class		Resouce Potential	Wind Power Density at 50m W/m^2	Wind Speed[a] at 50 m m/s
	1	Poor	0 - 200	0.0 - 5.4
	2	Marginal	200 - 300	5.4 - 6.2
	3	Fair	300 - 400	6.2 - 6.9
	4	Good	400 - 500	6.9 - 7.4
	5	Excellent	500 - 600	7.4 - 7.8
	6	Outstanding	600 - 800	7.8 - 8.6
	7	Superb	> 800	> 8.6

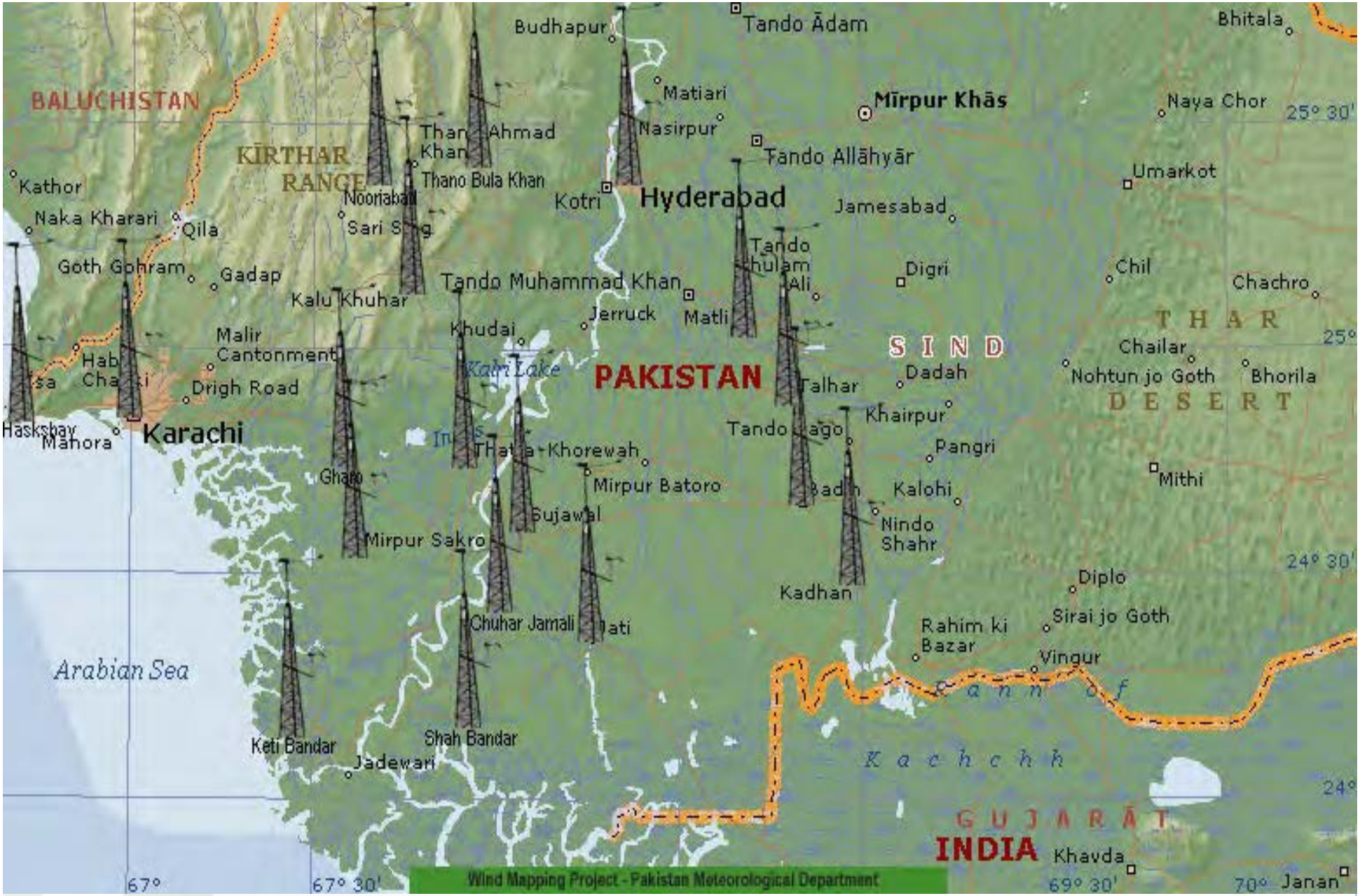
[a] Wind speeds are based on an elevation of 500 m and a Weibull k value of 1.8.

0 100 200
Kilometers

UNDP/GEF WIND ENERGY PROJECT PAKISTAN
AEDB
USAID
FROM THE AMERICAN PEOPLE


Pakistan
Direct Normal
Solar Radiation
Annual
kWh/m²/day
> 9
8.5 - 9.0
8.0 - 8.5
7.5 - 8.0
7.0 - 7.5
6.5 - 7.0
6.0 - 6.5
5.5 - 6.0
5.0 - 5.5
4.5 - 5.0
4.0 - 4.5
3.5 - 4.0
3.0 - 3.5
2.5 - 3.0
2.0 - 2.5
< 2
Federally Administered Tribal Areas
North-west Frontier
Azad Kashmir
Peshawar
Islamabad
Lahore
Faisalabad
Punjab
Quetta
Sindh
Hyderabad
Karachi
0 100 200 400
Kilometers
USAID
Model estimates of monthly average daily total radiation using inputs derived from satellite and surface observations of cloud cover, aerosol optical depth, pre-cipitable water vapor, albedo, atmospheric pressure and ozone sampled at a 40km resolution.

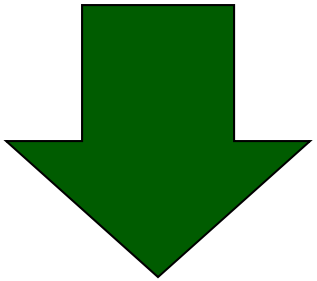
Meteorological Department Wind Measuring - Baluchistan



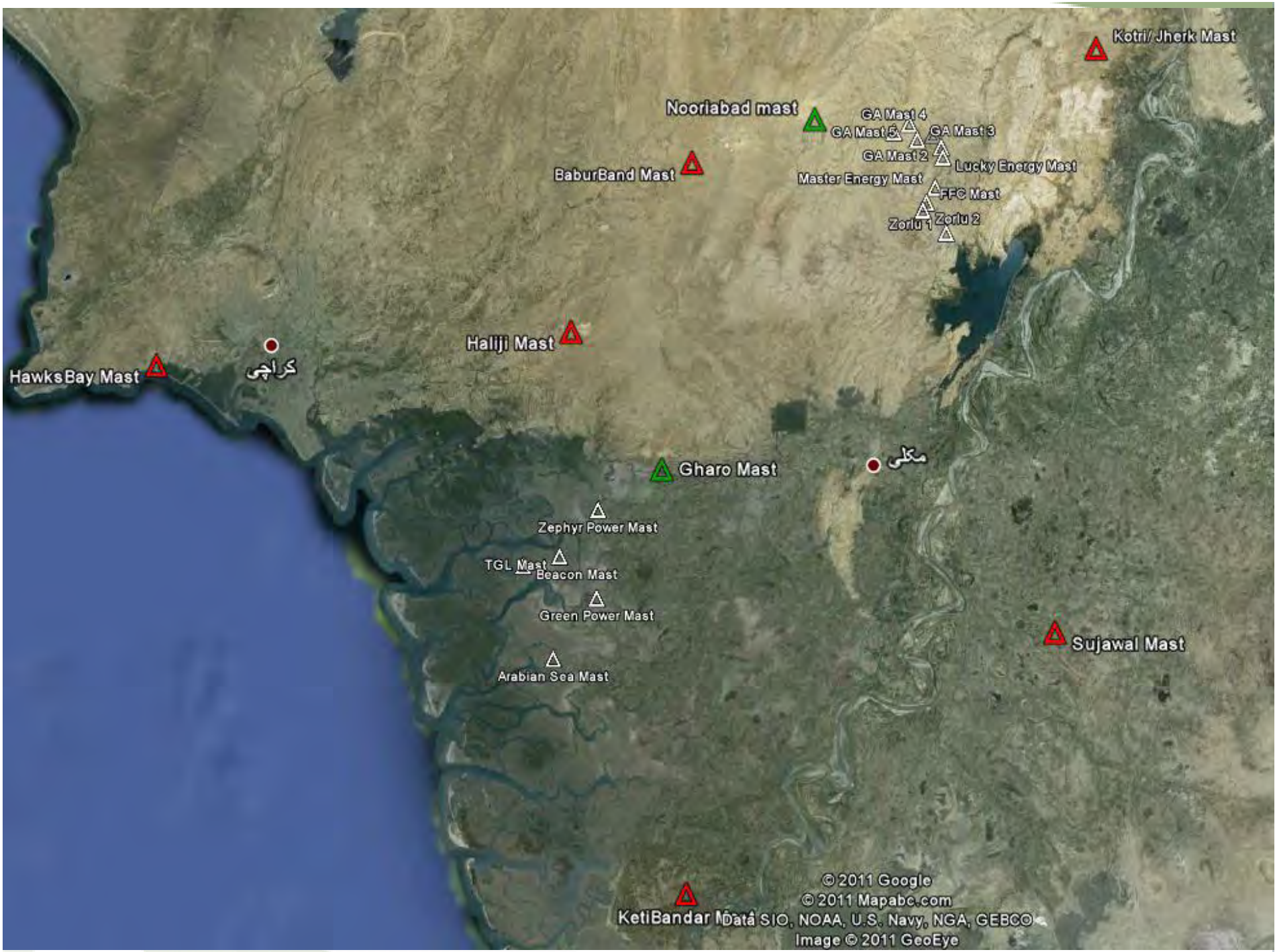
Meteorological Department Wind Measuring - Sindh

Rational for RE Resource Mapping

- Masts installed previously were not in compliance with IEC standards
- No proper calibrations
- Data recoded at 10 and 30 m only
- Interrupted wind data due to poor O&M



- Data available was not bankable
- Government had to introduce ‘wind-risk’ concept (risk of variability of wind speed was covered by the Government)
- IPPs / investors had to install their own masts to gather bankable data - gestation period increased delaying wind power development


Kotri/ Jherk Mast
Nooriabad mast
GA Mast 4
GA Mast 5
GA Mast 3
GA Mast 2
Lucky Energy Mast
BaburBand Mast
Master Energy Mast
FFC Mast
Zorlu 1
Zorlu 2
Haliji Mast
HawksBay Mast
کراچی
Gharo Mast
مکلی
Zephyr Power Mast
TGL Mast
Beacon Mast
Green Power Mast
Sujawal Mast
Arabian Sea Mast
KetiBandar Mast
© 2011 Google
© 2011 Mapabc.com
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2011 GeoEye

Current Status of Different Renewable Energy Projects in Pakistan

- RE power projects - thru. IPP mode.

Wind Power

2013: 106 MW – Operational
2014: 150 MW
2015: 380 MW
2016: 500 MW
2017: 789 MW

1925 MW

Solar PV

24 IPPs for 792.99 MW Solar PV in different stages of development.

- **Biomass: 34 MW Projects** using Bagasse to Energy- Operational in Sugar Mills. Government plans to generate 1500-2000 MW from sugar mills using bagasse in next 3-4 years.
- **Biogas:** 14000 Household Biogas Plants being Constructed through Rural Support Program Network (RSPN) with Dutch Government Funding
- **Off Grid Projects-** Solar Home Systems in different areas, wind mills
- **Hydro Power Projects**: Potential of 50,000MW Hydro Projects in Northern Areas

Need for Detailed Resource Mapping

- Detailed resource data is required for;
  - Determination of RE share in energy mix by 2020 and 2030
  - Analysis of impact of RE tariffs /rate on basket price
  - Setting definite targets for different technologies
  - Identification of potential areas for development of utility scale RE projects
  - Grid extension plans for evacuation of RE power

WB Initiative - Wind/Solar/Biomass Resource Mapping

- Based on request from Government of Pakistan, World Bank initiated- RE Resource Mapping Project covering wind, solar and biomass resource mapping
- Project will be based on earlier work done by UNDP and NREL
- Minimum 8 wind masts and solar data collection equipment will be installed at promising sites
- AEDB has requested for minimum 25 wind and solar masts owing to large windy areas and interests of IPPs in wind/solar sector
- Additional funding being secured
- Project will help in;
  - identification of additional wind farm areas and bankable resource data
  - Increase investors' confidence
  - Resolving current energy crisis
  - Reduce GHG Emissions, Reduce Global Warming

Scope of RE Mapping

- **Solar and Wind**
  - Ground-based data collection through installation of solar and wind stations at strategic locations across the country
  - In case of wind, build on measurements that Pakistan already has, mainly in the very south of the country
  - Combine the ground-based data satellite and other data to produce validated resource atlases for the whole country

- **Biomass**
  - Field-based biomass resource mapping will be limited to Punjab province. Will assess the quality and quantity of available biomass and agricultural waste and study the most appropriate and competitive technologies to utilize available biomass for energy production.
  - A literature/desk-based review will be done for other provinces, based on the data generated by various federal and provincial ministries, departments, NGOs, and private sector organizations

Coordinate with other donor-funded programs

Collect and generate geospatial data

Initial outputs inform WB-Client policy dialogue

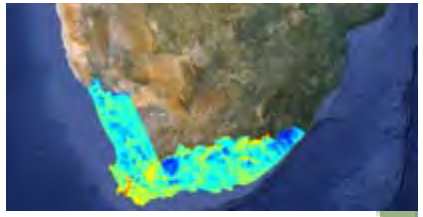
Provide training and capacity building

Build country and global partnerships

Disseminate via open data repository and GIS

Phase 1

Scoping and preliminary mapping output based on satellite and global atmospheric and meteorological data

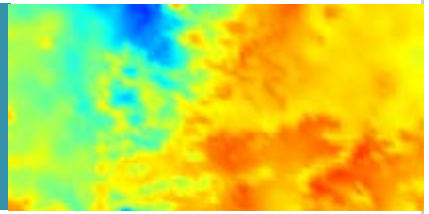


Phase 2

Ground-based data collection
(12-24 months)

Phase 3

Production of validated resource atlas based on satellite and ground-based data

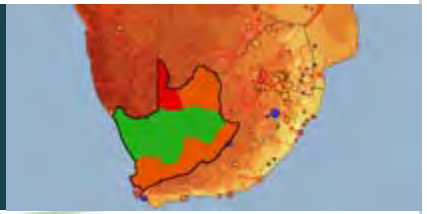


Phase 4

Geospatial planning (GIS) and strategic environmental assessment

Phase 5

Develop and agree policy framework to support investment



Snapshot of Wind Farm in Pakistan

RE Mapping Pakistan - Status

Resource	Status	Timeline
Solar	Contract signed with DLR Germany Project inception	• February 2014: Project begins; inception mission • June 2014: Site Selection Mission • July-September 2014: Phase 1 workshop • October-December 2014: Start of Phase 2 • March-April 2017: Phase 3 workshop
Wind	Procurement ongoing	• Launch delayed due to lack of response to RFPs • March 2014: Fresh EOI, New RFP issued • May 2014: Expect to sign contract • June 2014: Inception mission • Nov-Dec 2014: Phase 1 workshop • Jan 2015: Launch of Phase 2 • March-April 2017: Phase 3 workshop
Biomass	FAO partnership Contract Signed	• May 2014: Inception mission planned • December 2014: Phase 1 outputs • Jan 2015: Launch of Phase 2

Questions for Group Discussions

- What are the reasons for carrying out RE mapping?
- What benefits would accrue from RE mapping?
- Does RE mapping help in gird planning?
- Does detailed resource mapping help in prioritizing RE technologies?
- Can private investors play any role in RE mapping?

Thank You