ALTERNATIVE ENERGY SECTOR IN PAKISTAN

Presentation by

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SEQUENCE

- Government of Pakistan's Vision
- Alternative Energy Development Board
- Mid-Term Development Framework
- Renewable Energy Policy 2006
- Wind Energy in Pakistan
- Solar Energy in Pakistan
- Status and Potential of Other Renewable Energy Technologies in Pakistan
- Institute of Renewable Energy Technologies (IRET)
- International Collaboration

Government of Pakistan's Vision

- Meet Increased Demand of Electricity
- Energy Security
- CO_2 Reduction
- Reduce Deforestation
- Human Resource Development
- Poverty Alleviation

Alternative Energy Development Board

- AEDB was established in May 2003
- Mandated by the Government of Pakistan to:-
  - Develop Polices for Renewable Energies
  - Facilitate private sector to invest in RE Sector
  - Facilitate transfer of technology

Composition - Alternative Energy Development Board

- Chairman Air Marshal (Retd) Shahid Hamid
- Public Sector Members
  - **Advisor to PM on Energy**
  - **Federal Secretary or his nominee not below the level of Additional Secretary**
    - **Water & Power Division**
    - **Finance Division**
    - **Planning Commission**
    - **M/o Petroleum & Natural Resources**
    - **M/o Science & Technology**
    - **M/o Environment**
- Six Members From Private Sector
- One Co-opted Member each from provinces of Sindh & Balochistan

Mid-Term Development Framework

- Development of wind and solar energy to meet at least 5% of total installed capacity through RE resources by 2030 (i.e. 9700 MW)
- AEDB to facilitate installation of 700 MW of Wind Energy near Gharo, Sindh by 2010.
- Development of solar products like solar lights, solar fans, solar cooker, solar geyser etc. through private sector
- Laws and taxes designed to encourage self energy generation by domestic sector

Policy for Development of Renewable Energy in Pakistan 2006

- Prepared by AEDB / Ministry of Water & Power, incorporating inputs of all Stakeholders
- Approved by the Economic Coordination Committee (ECC) of the Federal Cabinet
- Provides unprecedented incentives for Private Sector Investment in the ARE Technologies

UNIQUE FEATURES OF POLICY

1. Wind Risk / Hydro Risk
2. Guaranteed Electricity purchase
3. Grid provision is the responsibility of the purchaser
4. Attractive Tariff
5. No Import Duties on Equipment
6. Zero Sales Tax
7. Net Metering
8. Banking of Electricity
9. Wheeling Provisions
10. Grid Spill Over Concept introduced

POTENTIAL OF RENEWABLE ENERGIES IN PAKISTAN

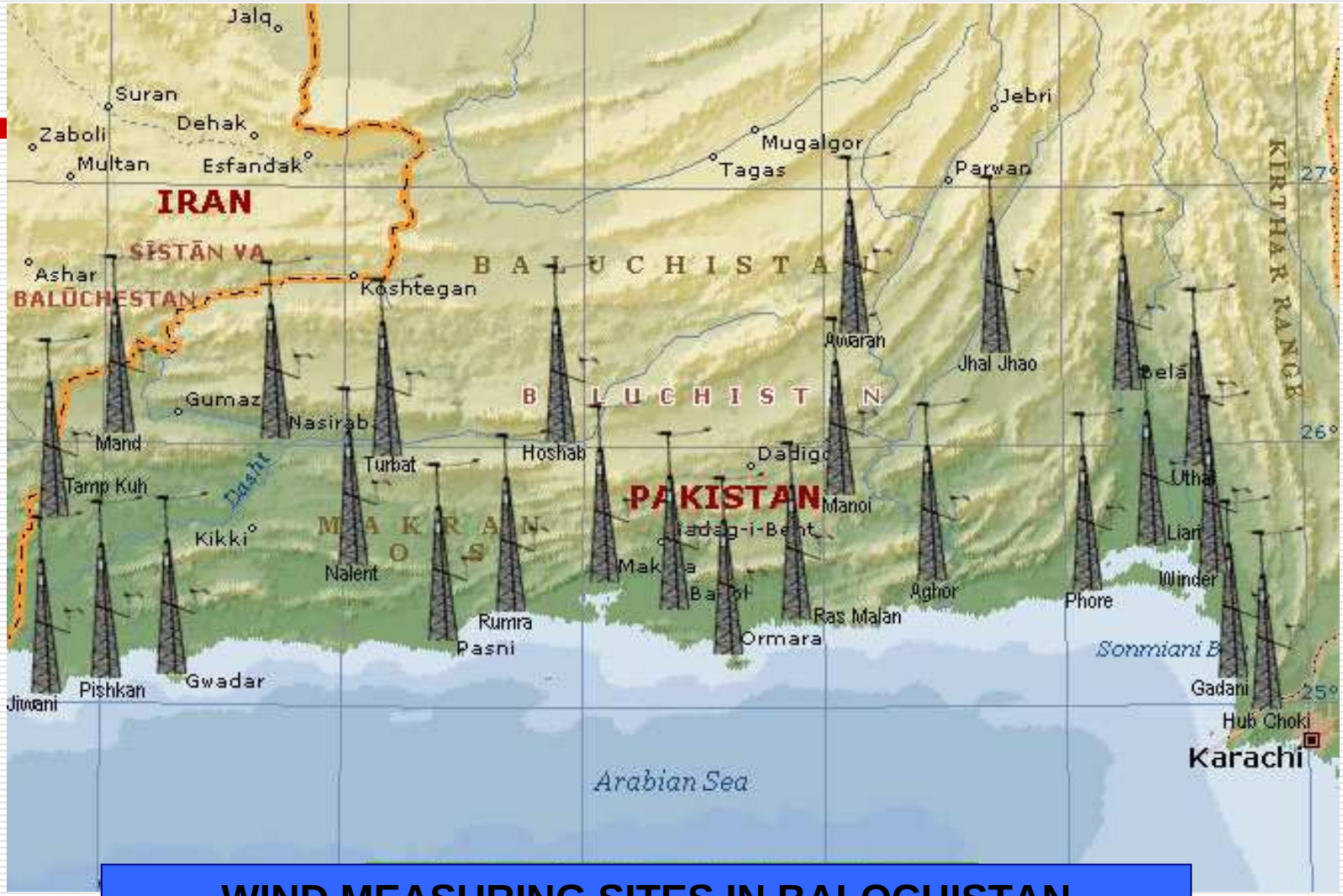
- On-Grid Power Generation

- Off-Grid Village Electrification

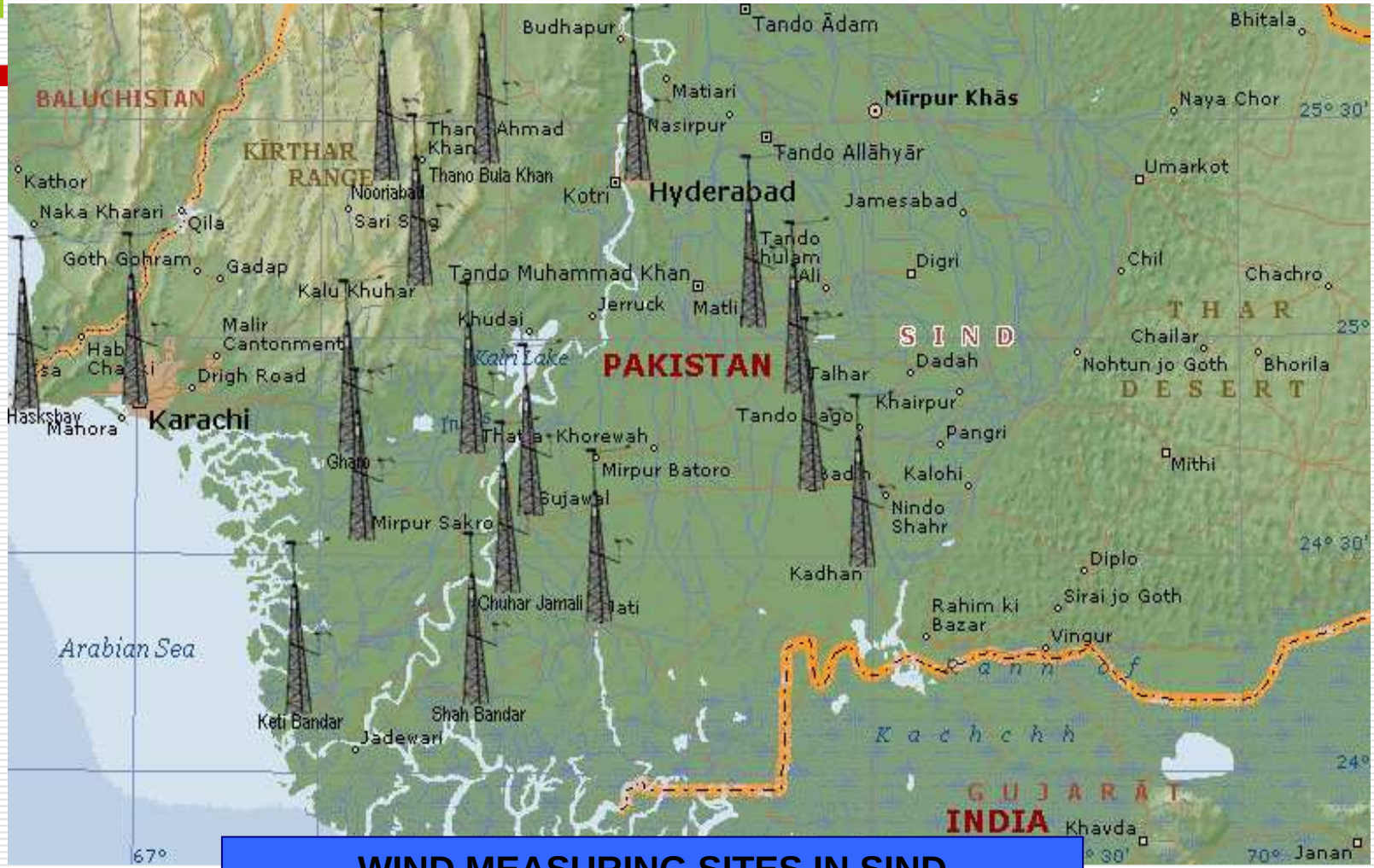
Wind Energy : On-grid

Wind Resource in Pakistan

- Pakistan has a 1,046 Km coastline in the South
- Average wind speed more than 7 m/s in Gharo Wind Corridor
- Estimated wind potential more than 50,000 MW
- Other sites in Balochistan, Punjab and Northern Areas being identified



WIND MEASURING SITES IN BALOCHISTAN



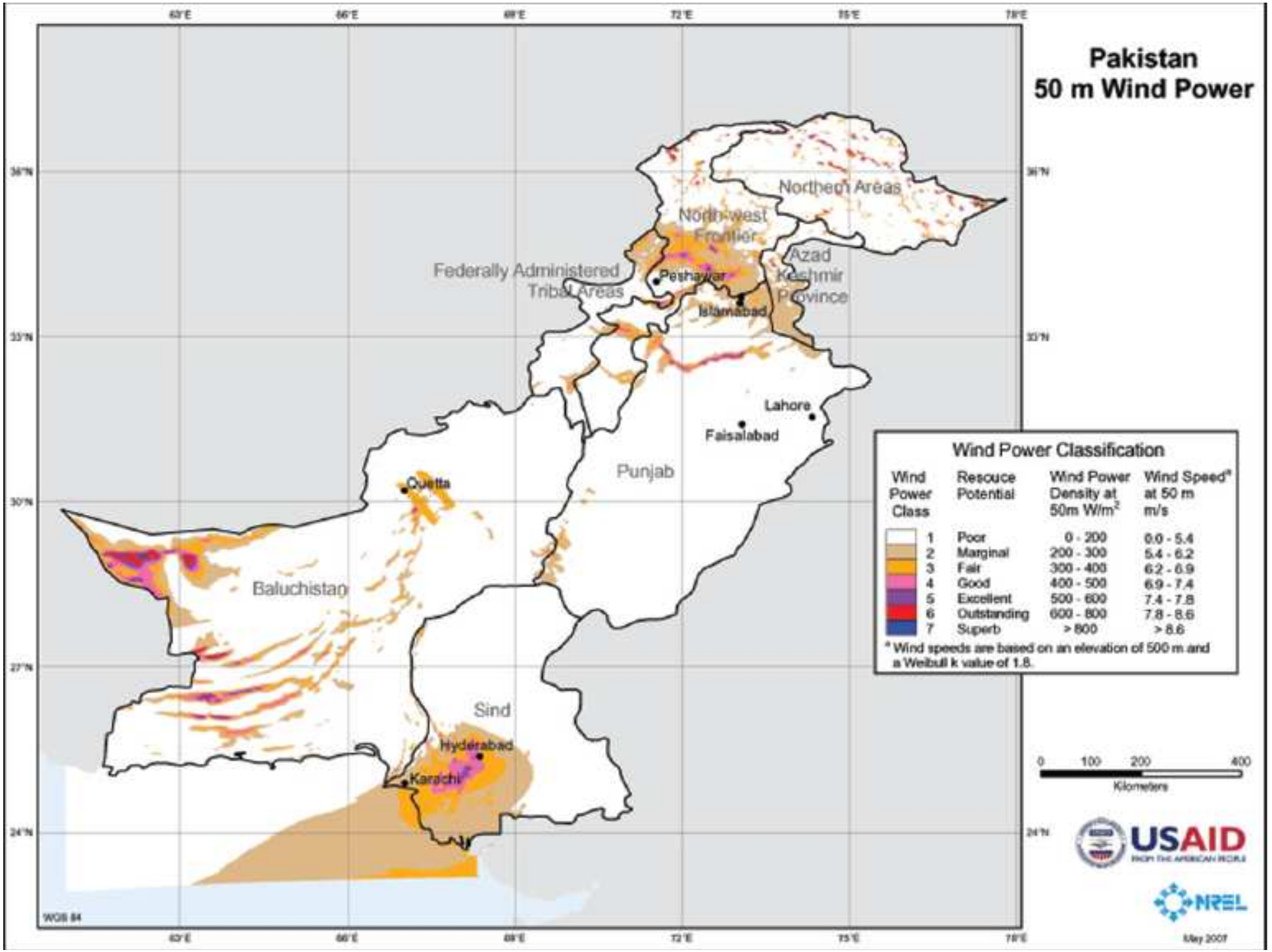
WIND MEASURING SITES IN SIND

USAID WIND / SOLAR MAPPING

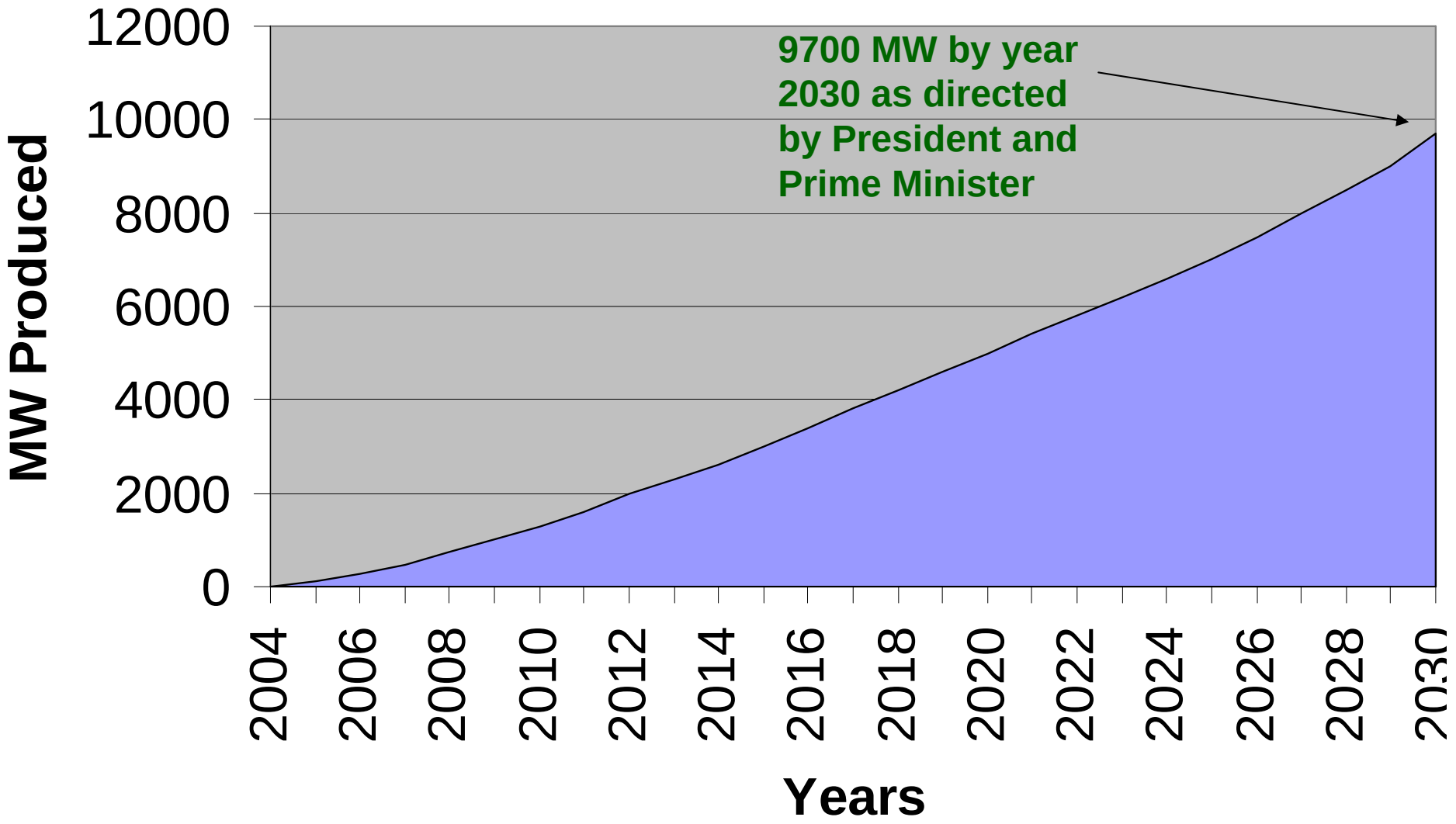
- USAID / SARI, on AEDB's initiative, has conducted Wind & Solar Resource Assessment of Pakistan through NREL, USA
- USAID officially launched these Wind & Solar Maps for Pakistan (and Afghanistan) at a Conference on 25-26 June 2007 in Islamabad
- Estimated potential for power generation:

  Wind: 346,000 MW

  Solar: 2.9 Million MW
- These Resource Maps & GIS data products would be instrumental in identifying & developing optimal wind & solar energy sites in Pakistan


Pakistan
50 m Wind Power
Northern Areas
North-west Frontier
Federally Administered Tribal Areas
Azad Kashmir
Province
Peshawar
Islamabad
Lahore
Faisalabad
Punjab
Quetta
Baluchistan
Sind
Hyderabad
Karachi
Wind Power Classification
Wind Power Class
Resouce Potential
Wind Power Density at 50m W/m²
Wind Speed* 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
* Wind speeds are based on an elevation of 500 m and a Weibull k value of 1.8.
0 100 200 400
Kilometers
USAID
NREL
May 2007
WGS 84

Wind Energy Development Plan



Government Incentives for Wind Farm Investors

- Attractive cost of land for wind energy projects (€7 per acre per year)
- Pre-Feasibility has been done by AEDB
- Wind data measured, analyzed
- Wind Risk taken by Government
- Wind data currently being validated by Risøe National Laboratory of Denmark
- Policy Guidelines for Tariff Determination approved by the Federal Cabinet
- Upfront Tariff of US cents 9.5 / kWh offered by National Electric Power Regulatory Authority (NEPRA)
- 15% Return on Equity (ROE) guaranteed as per NEPRA guidelines

Current Status of Wind Projects

STAKEHOLDERS

- Ministry of Water and Power
  - WAPDA / NTDC
  - HESCO
  - KESC
- NEPRA
- Government of Sindh
- Private Investors

AEDB

Present Status of Wind Projects

- **Letter of Intent (LoI)**
  Issued to ninety (90) investors so far for setting up wind farms of 50 MW each

- **LAND ACQUISITION / DISTRIBUTION**
  23, 646 acres of land allocated to fifteen (15) investors in the general wind corridor
  Survey & Demarcation of another 16,024 acres in process

- **GENERATION LICENSE**
  Issued to Five Companies for 50 MW each

- **POWER PURCHASE AGREEMENT**
  Approved by M/o Water & Power

Present Status of Wind Projects

TARIFF

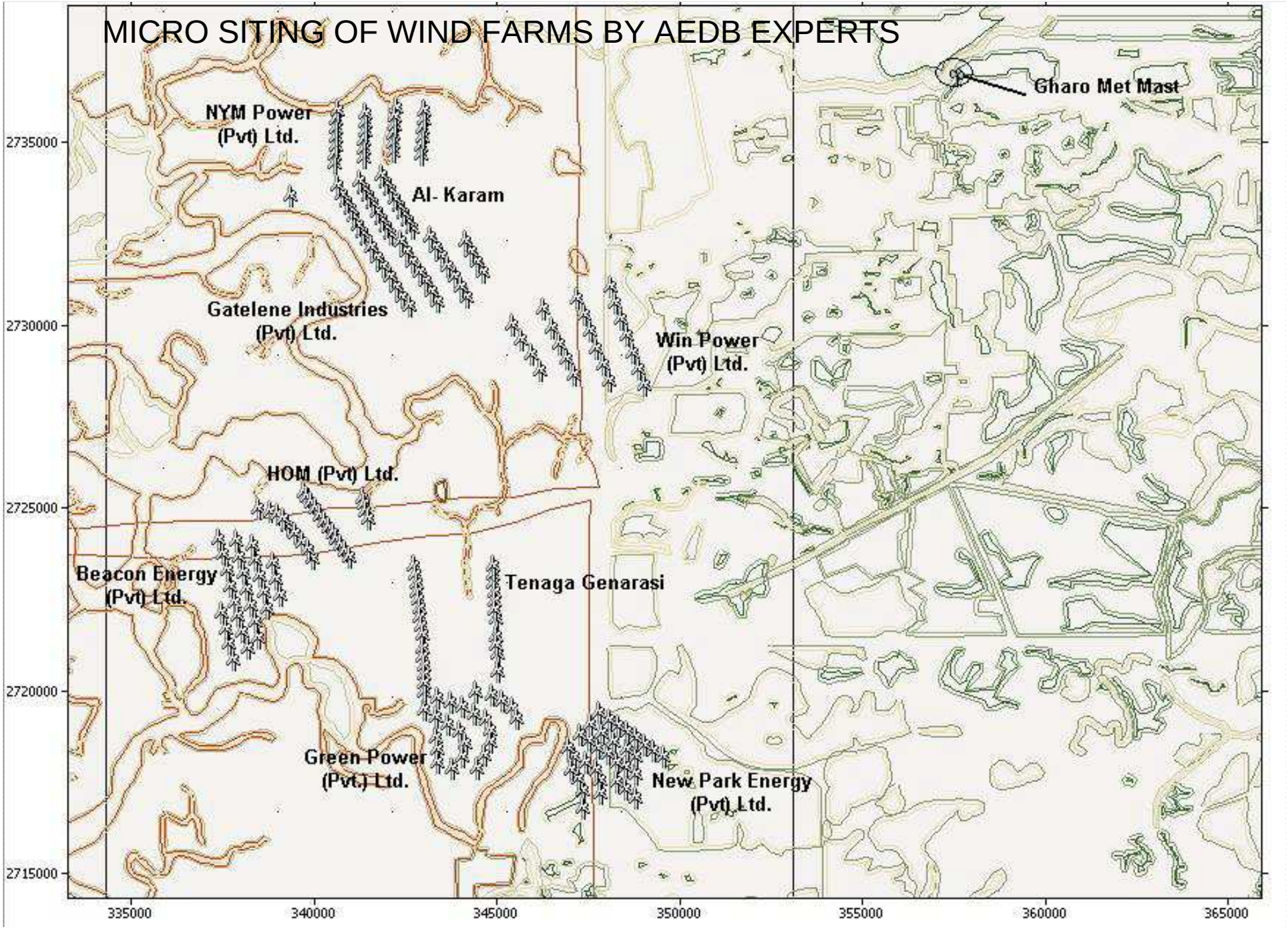
- **Upfront tariff of 9.5 US cents has been given by NEPRA**

- **Negotiated tariff of more than 10.5 US Cents has also been given to two companies considering their project requirements**

ON SITE DATA COLLECTION

- Seven wind measuring masts installed by private sector (@ 50 m, 80 m & 85 m height)


Bhanbhore Sites
KuttiKun Sites
Gharo
Mirpur Sakro
Grid Station
Mirpur Sakro
N
W
E
S
© 2006 Europa Technologies
Image © 2006 TerraMetrics
©2005 Google
Pointer 24°37'28.34" N 67°31'11.28" E elev 10 ft
Streaming 100%
Eye alt 24.47 mi


MICRO SITING OF WIND FARMS BY AEDB EXPERTS
Gharo Met Mast
NYM Power
(Pvt) Ltd.
Al- Karam
Gatelene Industries
(Pvt) Ltd.
Win Power
(Pvt) Ltd.
HOM (Pvt) Ltd.
Beacon Energy
(Pvt) Ltd.
Tenaga Genarasi
Green Power
(Pvt.) Ltd.
New Park Energy
(Pvt) Ltd.
2735000
2730000
2725000
2720000
2715000
335000
340000
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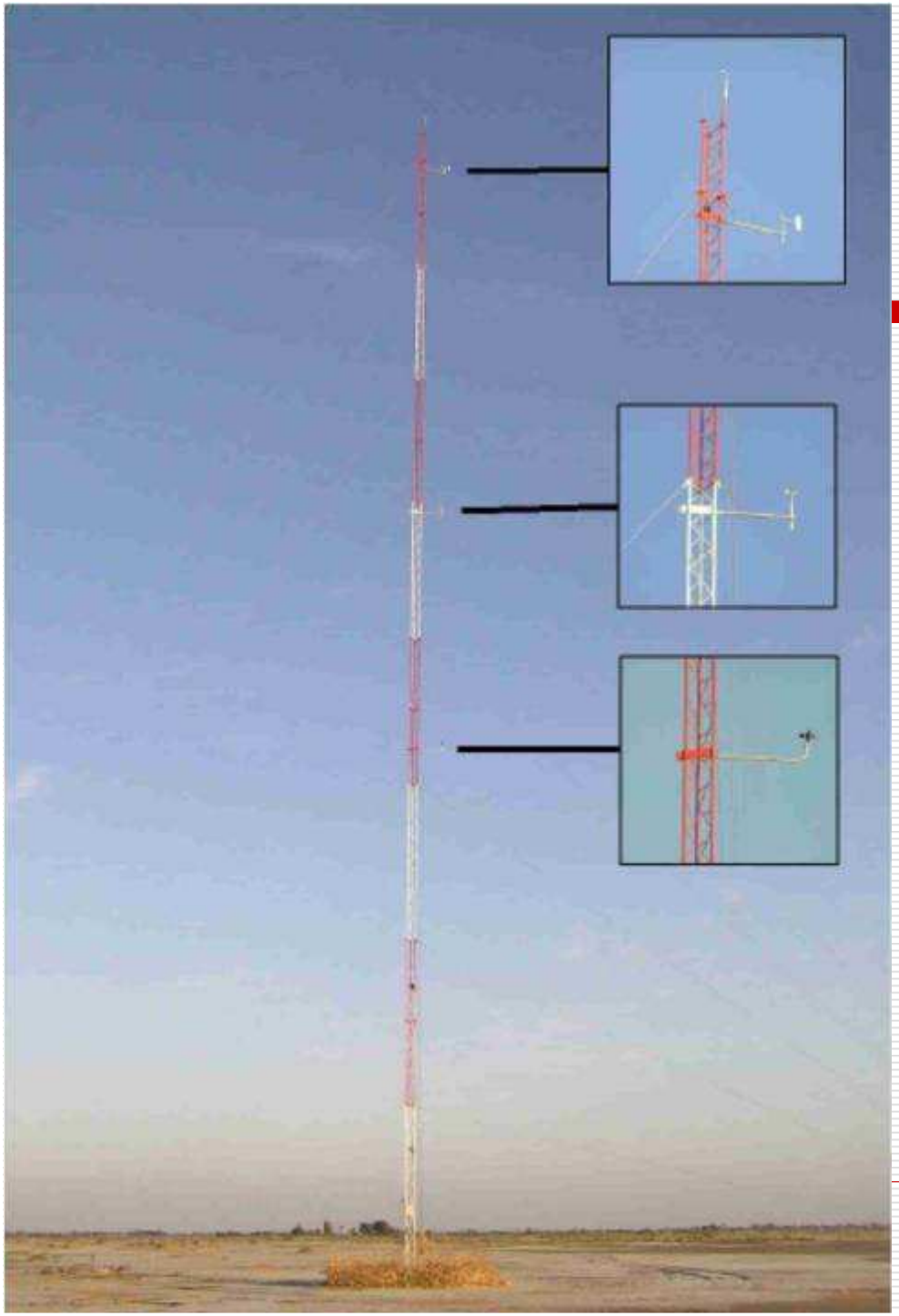
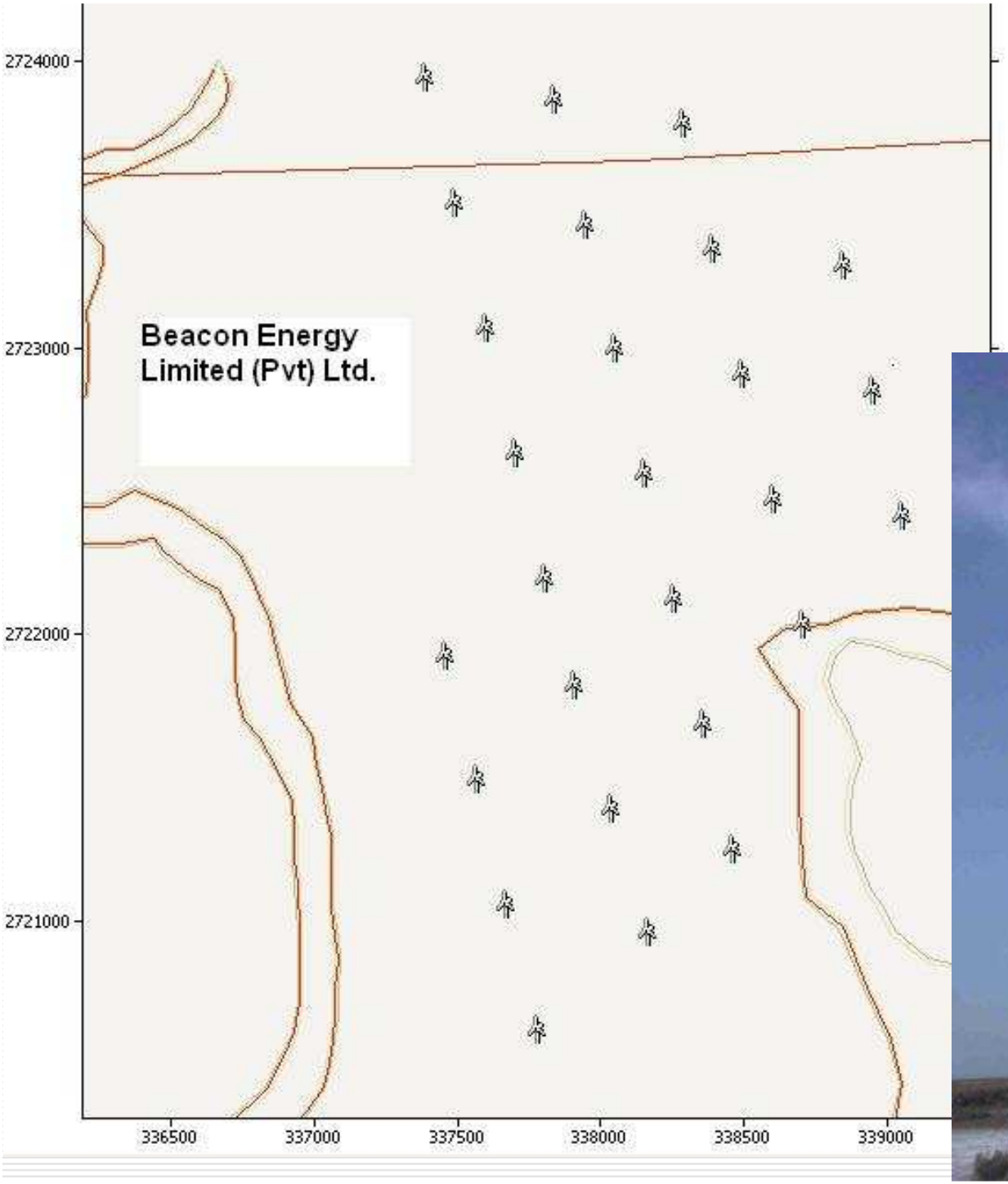
365000



50m Wind Mast –Zephyr Power

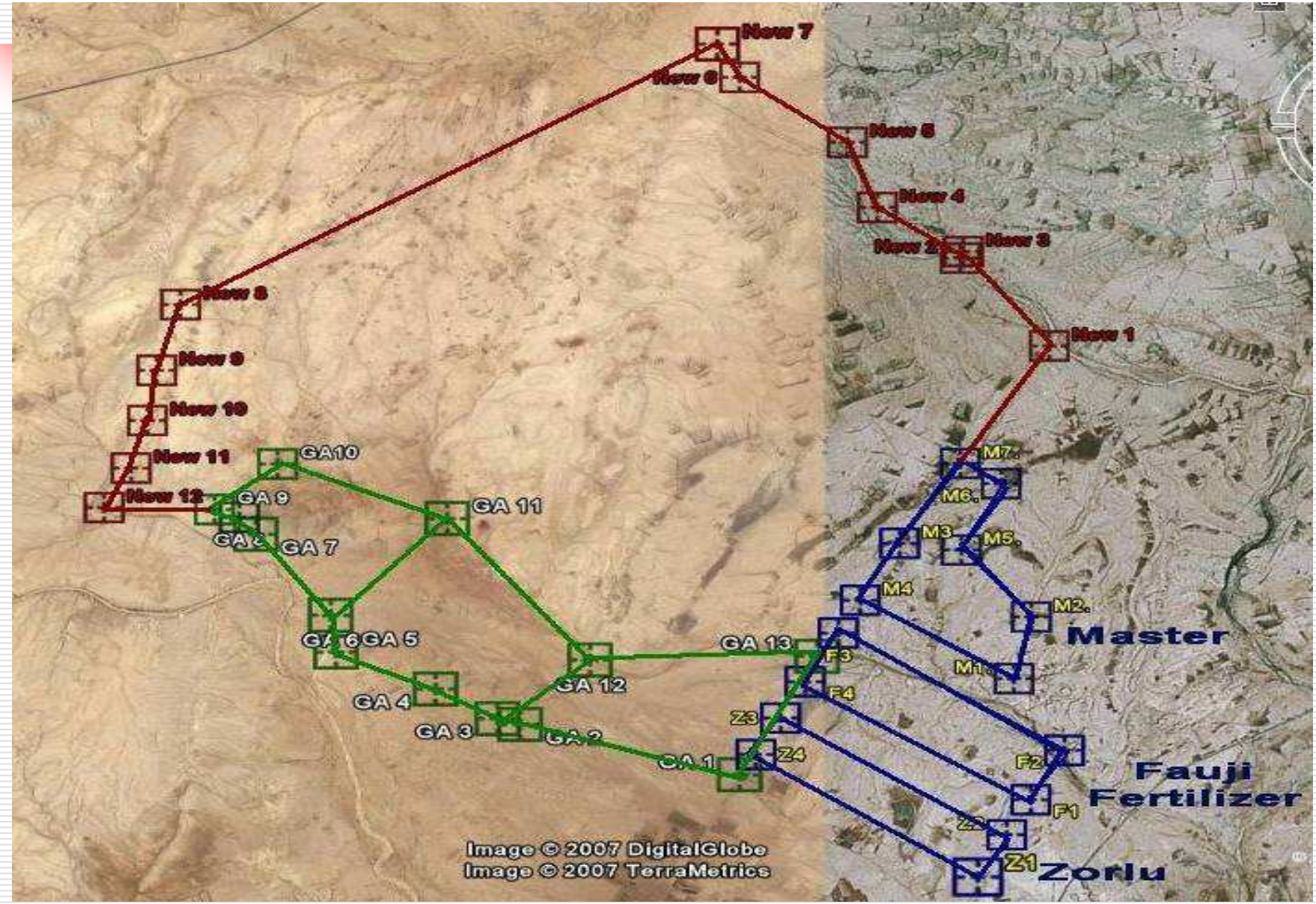
80m Wind Measuring Mast- BEL



60m Wind Measuring Mast- NPE

First **60m** Wind Measuring mast in Pakistan

(www.KonDen.com)



LAND IN JHIMPIR, THATTA DISTRICT, SINDH

85m Wind Measuring Mast- Masterwind

85m Wind Measuring Mast- Zorlu

Renewable Energy Resource

Micro Wind – Off Grid

- Pilot Project for Development and Installation of Micro Wind Turbines completed
- 140 Micro Wind Turbines installed in Sindh & Balochistan
- Providing electricity to 691 homes.

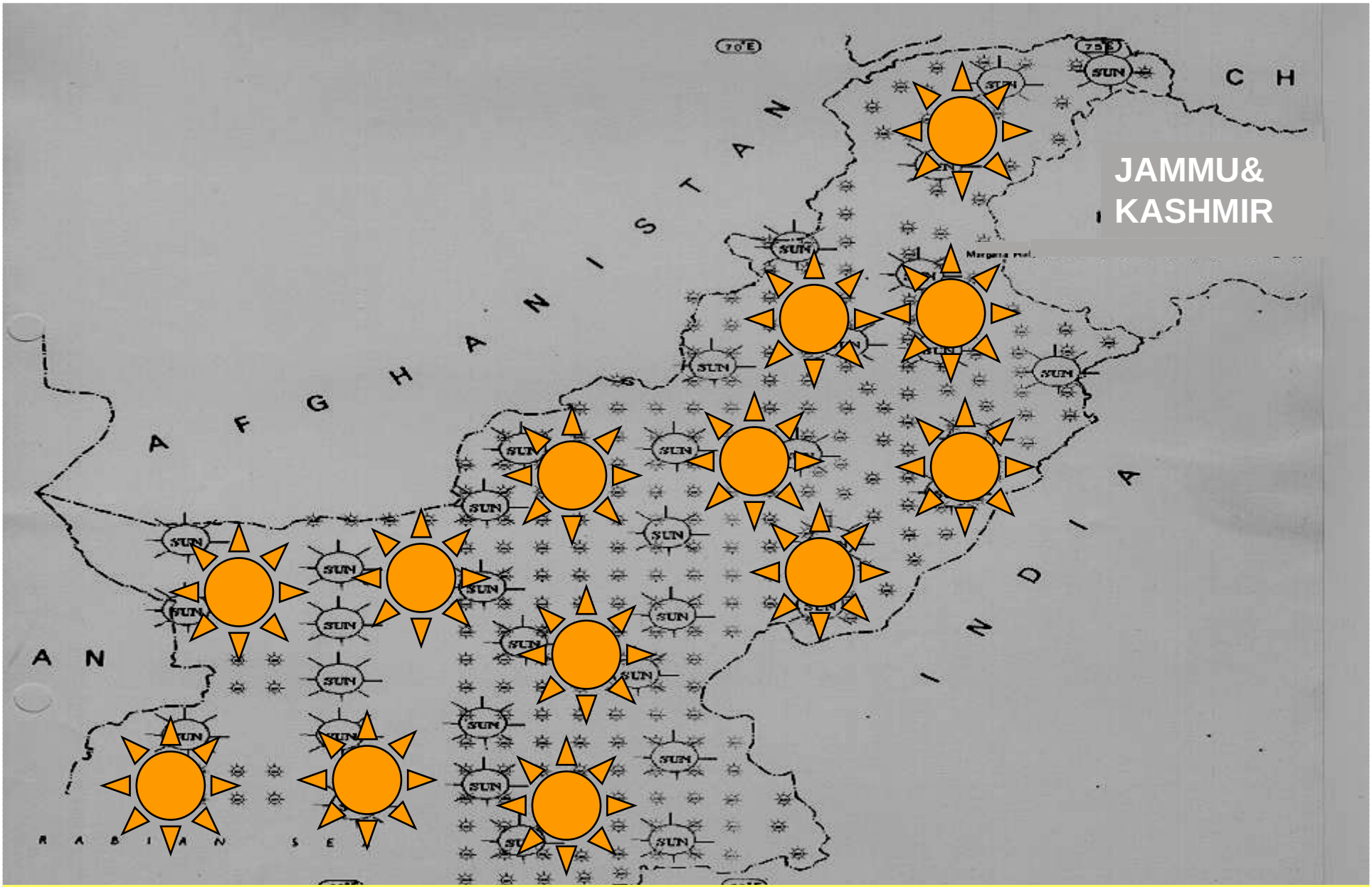

500 WATTS MICRO WIND TURBINE
AT KUND MALIR, BALOCHISTAN


Micro wind turbines installed at
Village Dandari, Ghora Bari, Thatta Sindh

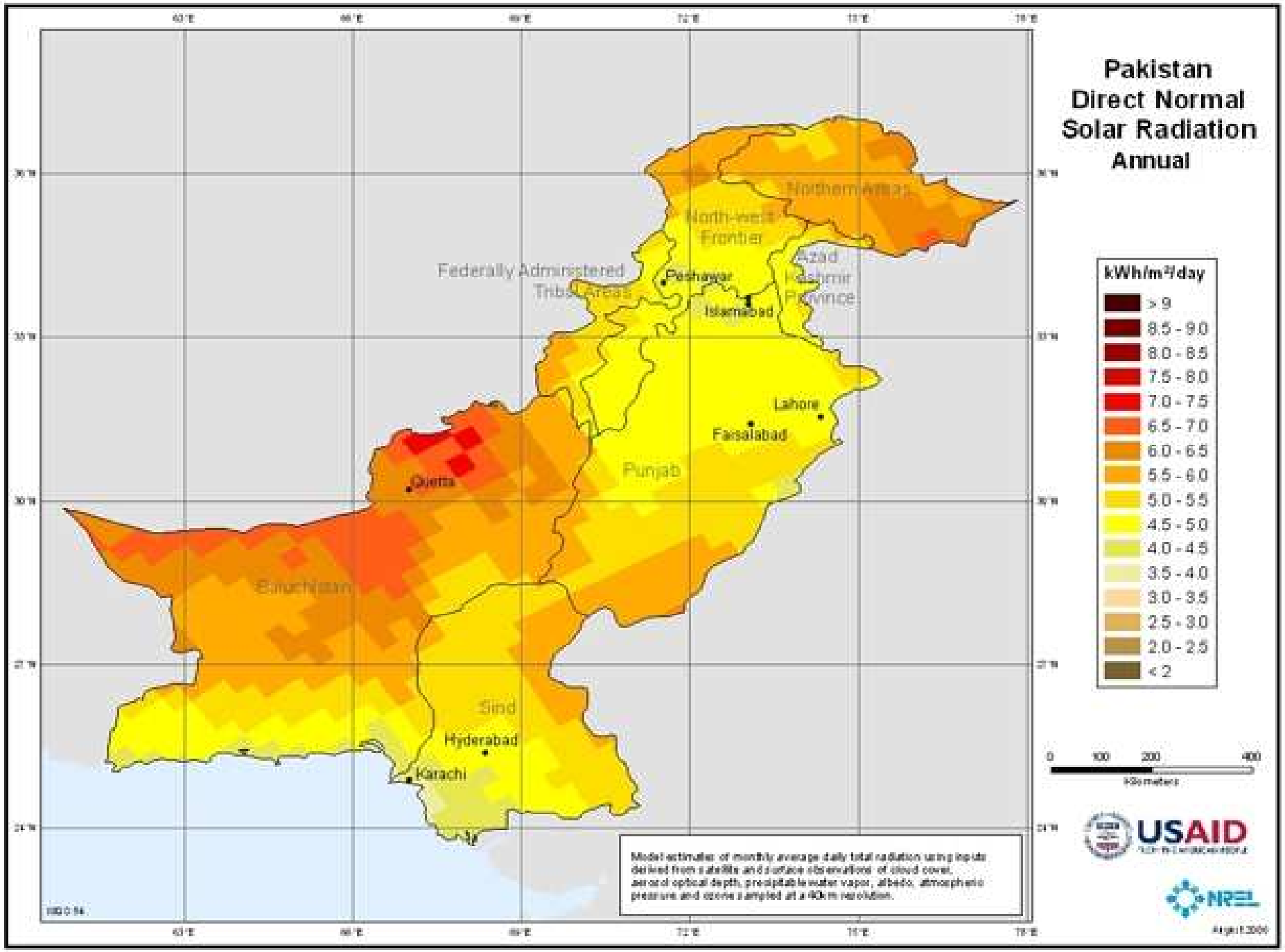
Renewable Energy Resource

Solar

- Pakistan is located in the "sun belt" and offers ideal solar energy options
- Pakistan receives one of the maximum solar radiations in the world

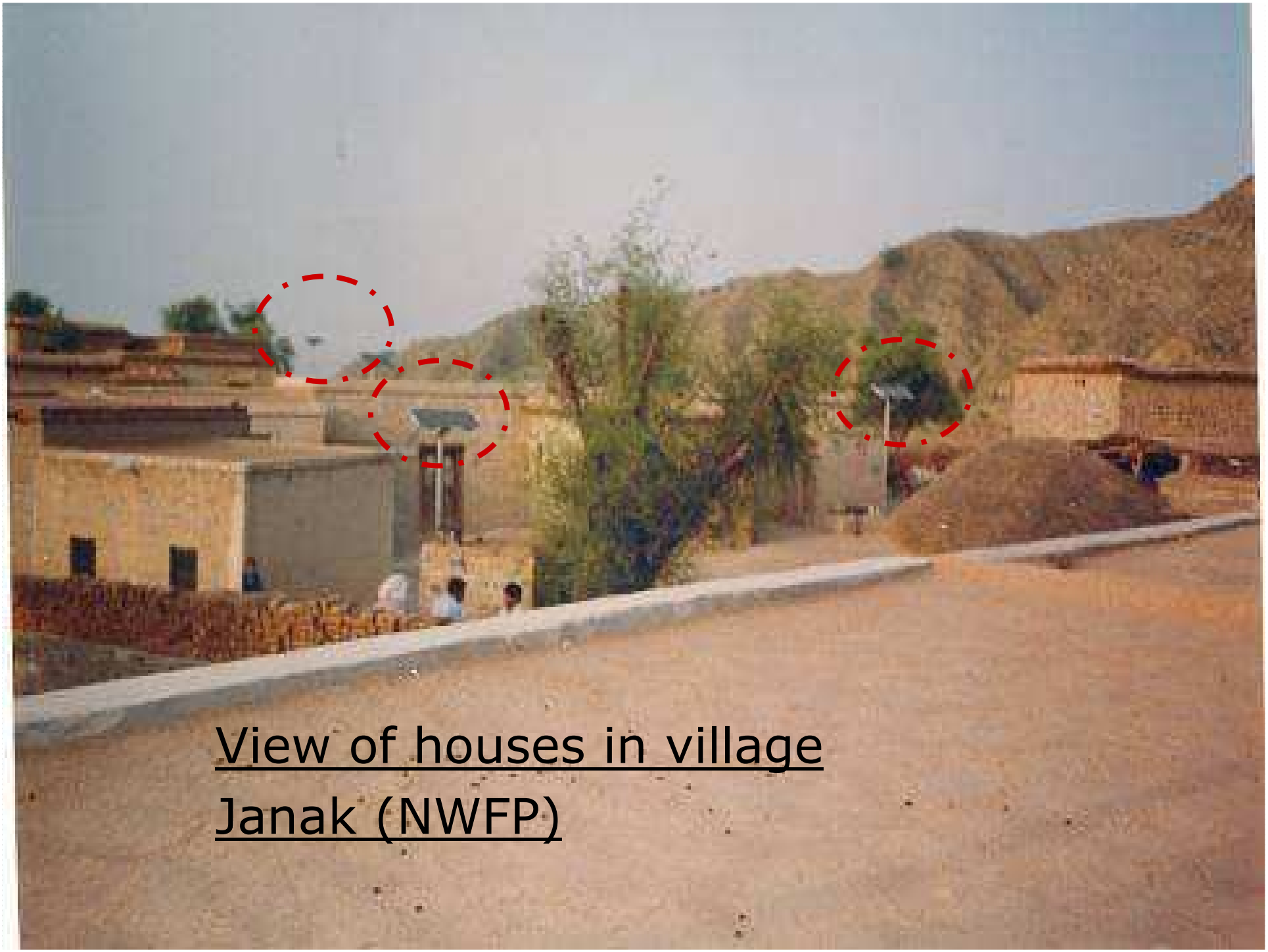


AVAILABILTY OF SOLAR ENERGY IN POPULATION CENTERS IN PAKISTAN

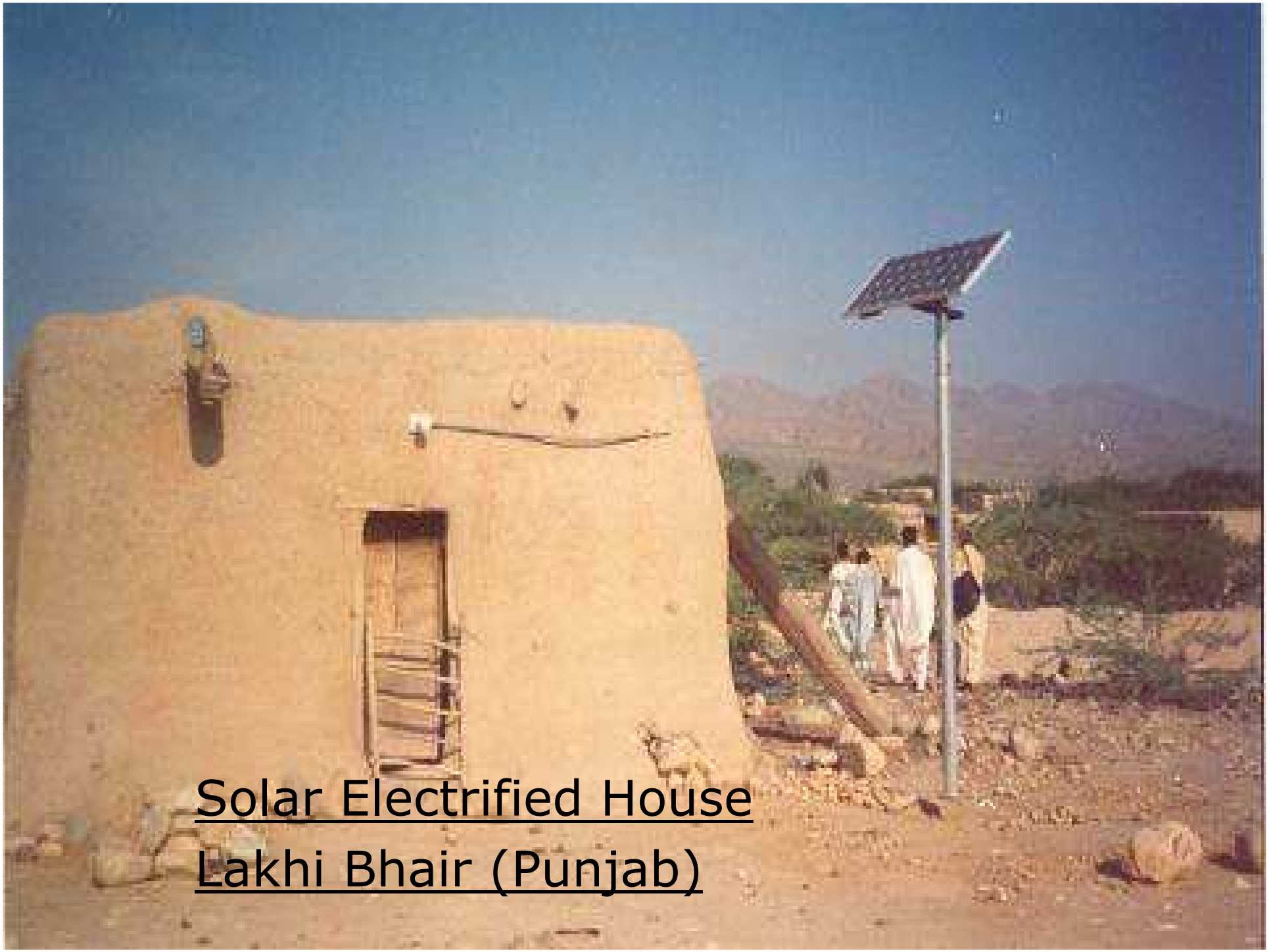

Pakistan
Direct Normal
Solar Radiation
Annual
kWh/m²/day
> 9
8.5 - 9.0
8.0 - 8.5
7.5 - 8.0
7.0 - 7.5
6.5 - 7.0
6.0 - 6.5
5.5 - 6.0
5.0 - 5.5
4.5 - 5.0
4.0 - 4.5
3.5 - 4.0
3.0 - 3.5
2.5 - 3.0
2.0 - 2.5
< 2
Northern Areas
North-west Frontier
Federally Administered Tribal Areas
Azad Kashmir
Province
Peshawar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

Remote Village Electrification

- Almost 40,000 villages without electricity
- Approx. 10,000 villages situated more than 20 Km from 11 KVA grid
- Mostly in Balochistan and Sindh Province
- Pilot project of 100 solar homes in each province completed.
- 7,874 off-grid villages to be electrified by AEDB
- 400 solar villages program has been initiated
- 100 villages in Sindh and 300 in Balochistan



View of houses in village Janak (NWFP)

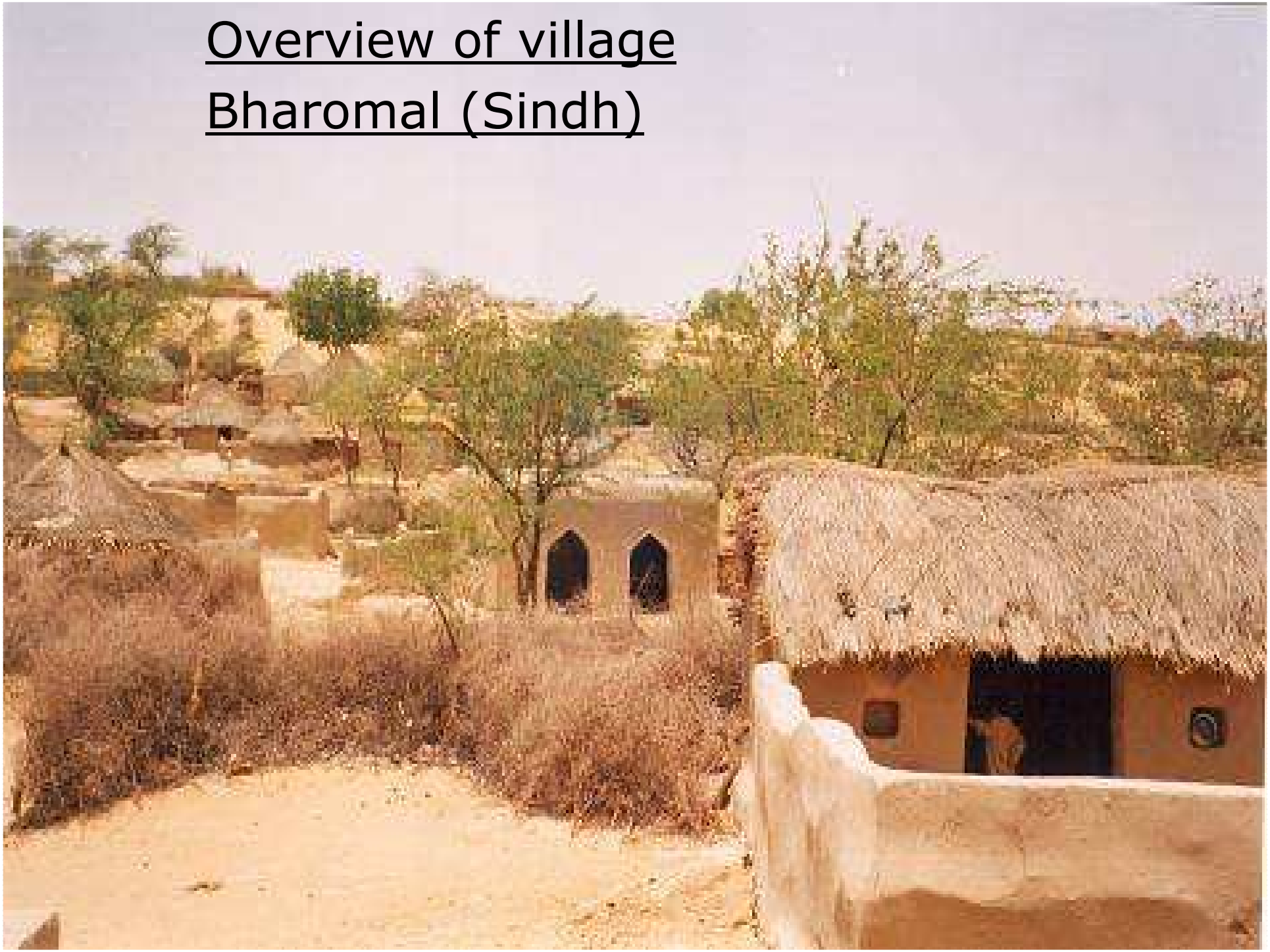


Solar Electrified House

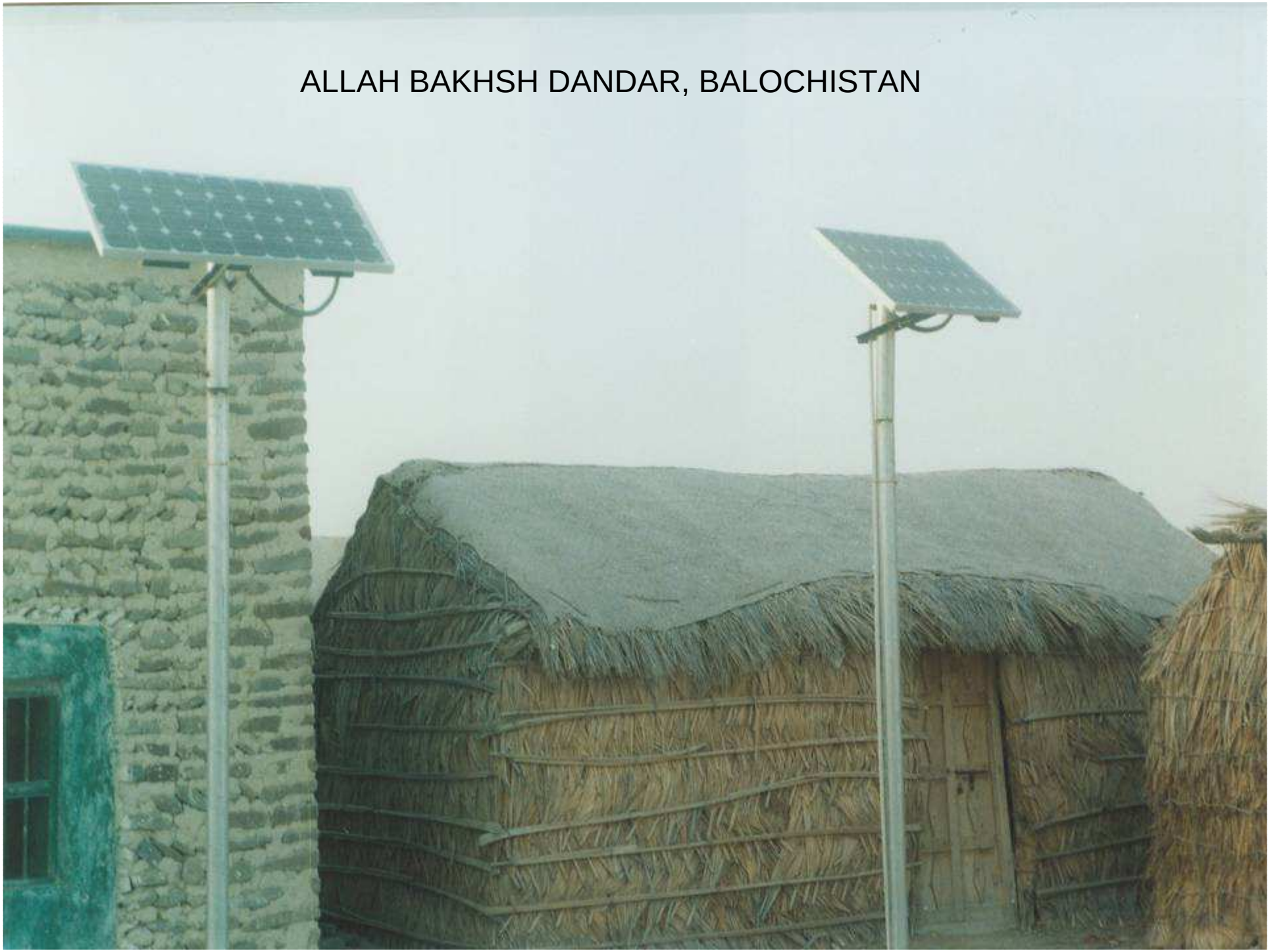
Lakhi Bhair (Punjab)

LED Light at village
Janak (NWFP)

Overview of village Bharomal (Sindh)



ALLAH BAKHSH DANDAR, BALOCHISTAN



Micro Hydro Power

- **Micro Hydro Power resources**
  - Overall micro hydro potential is over 2700 MW
  - North of Pakistan has immediate exploitable potential of more than 300 MW
  - Canal Network in Punjab has exploitable potential of more than 350 MW

REDSIP by Asian Development Bank

NWFP		**$80 M**
(a)	Ranolia	(11.5 MW)
(b)	Daral Khwar	(35 MW)
(c)	Machai	(3.5 MW)
Punjab		**$ 65 M**
(a)	UCC Main Lower near Gujranwala	(4.8 MW)
(b)	Deg Fall Sheikhpura	(5.5 MW)
(c)	Pakpattan Canal	(3.3 MW)
(d)	LBDC Okara	(5 MW)
(e)	UCCM Marala	(11.5 MW)
	TOTAL	**$ 145 M**

AEDB working for development of Kaplan turbine through private sector


14 18:34

Bio-Mass / Waste to Power Potential

- Bio-mass has a huge potential
  - Sugar industry has a potential of at least 400 MW additional power using Bagasse during sugar season
  - Waste to Energy
    - 06 LoIs issued for 275 MW from Waste to Power Generation
    - Every major city has an estimated potential of more than 200 MW
    - AEDB currently carrying out Feasibility Study for determining Waste to Energy potential in 10 major cities

Emerging Technologies

- Ethanol
- Bio-diesel
- Wave/Tidal
- OTEC
- Hydrogen Fuel Cell
- Geo Thermal
- Geo-Magmatic

Biodiesel power house in the center of Goth UmarDin Arain, Sindh Pakistan

BOIDIESEL OPERATED CAR UNDER TEST

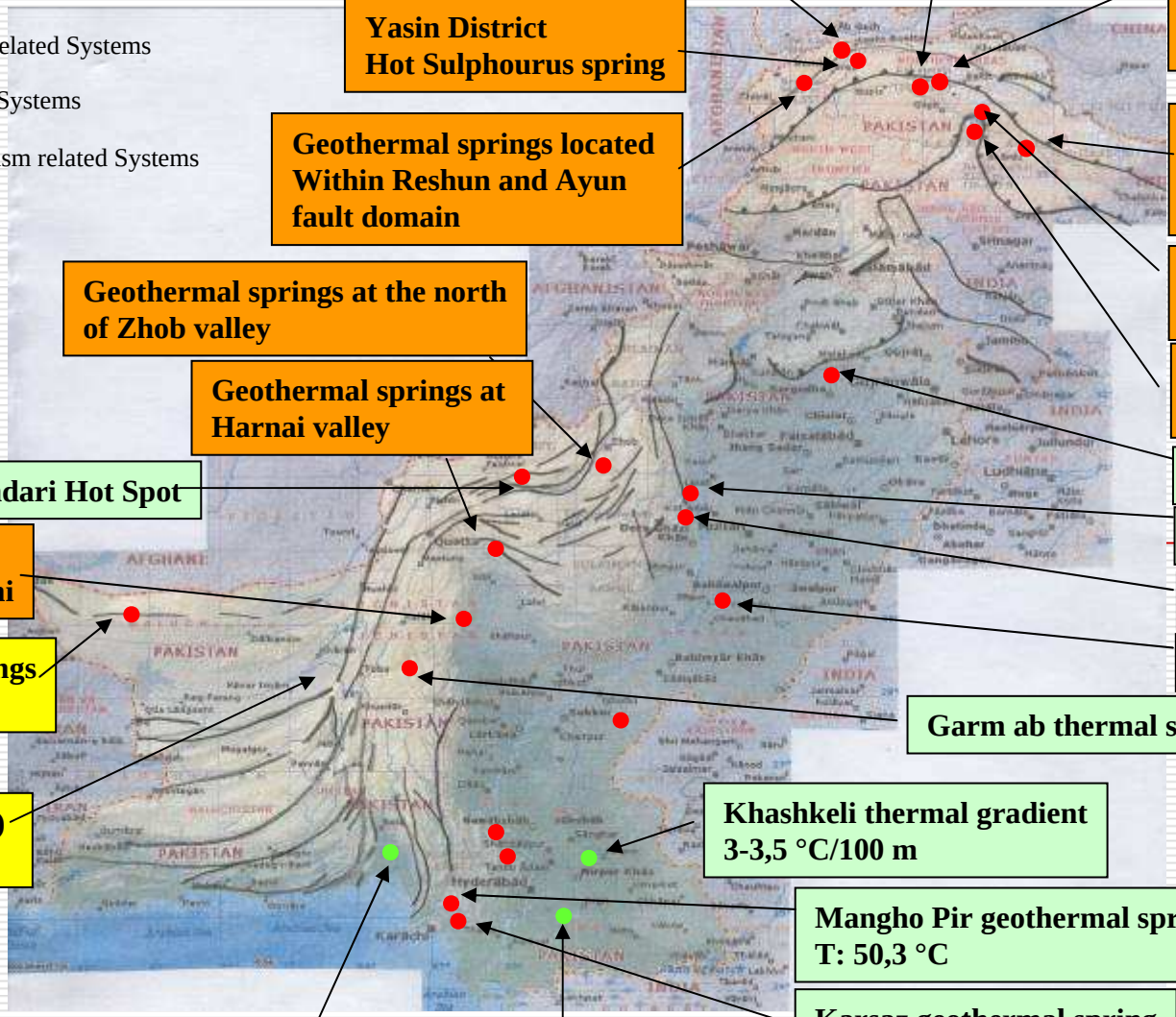
FUEL CELL VEHICLE

GEOTHERMAL SPRINGS OF PAKISTAN

Seismo-Tectonic & Suture Related Systems

Geopressured Geothermal Systems

Neogene-Quaternary volcanism related Systems



Geothermal spring Near the snout of Pechus Glacier

Budelas Geothermal springs T: 36 - 46°C

Murtazabad Geothermal springs T: 26 - 92°C

Yasin District Hot Sulphourus spring

Geothermal springs located Within Reshun and Ayun fault domain

Dassu area Skardu di Geothermal springs T: max: 71 °C

Mushkin geothermal T: 57 °C

Geothermal springs at the north of Zhob valley

Tatta Pani geotherma T: 65,5 - 83 °C

Geothermal springs at Harnai valley

Bakkur thermal spri

Giandari Hot Spot

Taunsa thermal spri

Geothermal springs at West of Dhadar, near Sanni

Zinda Pir thermal sp

Koh-e Sultan thermal springs T: 25,6 – 34,8 °C

Uch thermal spring

Garm ab thermal spring

Kharan region (potential) geothermal system

Khashkeli thermal gradient 3-3,5 °C/100 m

Mangho Pir geothermal spring T: 50,3 °C

Karsaz geothermal spring T: 39 °C

Lakhra thermal gradient 3,3 °C/100 m

Talhar thermal gradient 3-3,5 °C/100 m

Prepared by ORME Jeotermal Inc., September 2006

INSTITUTE OF RENEWABLE ENERGY TECHNOLOGIES (IRET)

- Institute of Renewable Energy Technologies
  - Degree Programs
  - Vocational Trainings
  - User Level Trainings at village level
  - Training of Trainers
  - International Collaborative Research

International Collaboration

- **German Agency for Technical Cooperation (GTZ)**
  Promotion of Renewable Energy & Energy Efficiency
- **EU Asia Invest Program**
  Business to Business match making and Capacity Building
- **Asian Development Bank (ADB)**
  Development of Renewable Energy in Pakistan
- **GEF / UNDP**
  Sustainable Development of Wind Power Production
  Productive use of Renewable energy through micro-hydel projects
- **UNESCO**
  Support to Education in Renewable Energy and Energy Conservation
- **USAID**
  Cooperation in rural education and social uplift projects
  Wind and Solar Resource Assessment
- **World Wind Energy Association (WWEA)**
  Pakistan co-opted member of Board of Directors
- **International Solar Energy Society (ISES)**
  AEDB is Chair of Pakistan Section
- **South Asian Association for Regional Cooperation (SAARC)**
  AEDB focal point for Renewable Energy in Pakistan

WORLD WIND ENERGY CONFERENCE & EXHIBITION 2008

- The WWEC 2008 has been awarded to Pakistan
- WWEC is the premiere annual event in the global wind energy sector
- Honour was bestowed upon Pakistan following AEDB's presentation in WWEA's recent Board Meeting in Turkey
- Turkey, Brazil, Egypt and South Korea were also among the candidates for hosting the prestigious event

REASONS TO INVEST IN PAKISTAN'S ALTERNATIVE ENERGY SECTOR

- Extremely attractive / investor-friendly RE Policy 2006
  - Wind Risk Coverage
  - Buy Back Guarantee
  - Liberal Political Risk Coverage
  - Liberal Fiscal / Financial Incentives
  - Attractive IRR
- Facilitation for procurement / lease of land for wind farms provided by AEDB (unheard of in other territories around the world)
- Extremely cheap rates offered for Land for wind farms (Euro 7/- only per acre per year)
- Environmental Issues dealt with by AEDB on behalf of investors (incl. EIA and relevant Government permissions)
- Attractive Tariff Offered
- Availability of infrastructure for setting up manufacturing facilities


Thank you