

Renewable Energy Technologies Morocco

Moroccan American Bridges
June 25, 2010
Casablanca

Association of Moroccan Professionals in America
In Partnership with
Al Akhawayn University

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KED Group



Agenda



- Affiliation
- About Us
- Utility Scale Projects
- Local Systems
- Transmission
- Smart Grid Tech
- Distributed Systems
- Interconnection

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About Us



The KED Group, LLC, based in Columbia, South Carolina specializes in infrastructure and trade development projects worldwide with expertise in transportation, renewable energy, finance and design. **KED** offers a full spectrum of services for the assessment, development, implementation and financing of projects, including:

**Master Plans
Feasibility Studies
Economic Impact Studies
Demand Forecasting**

**Privatization and PPPs
Environmental Review
Market Research**

On certain energy projects, KED partners with Electric Power Engineers (EPE). Founded in 1968, EPE provides engineering consulting and management services for Transmission, Distribution, Industrial and Generation clients.

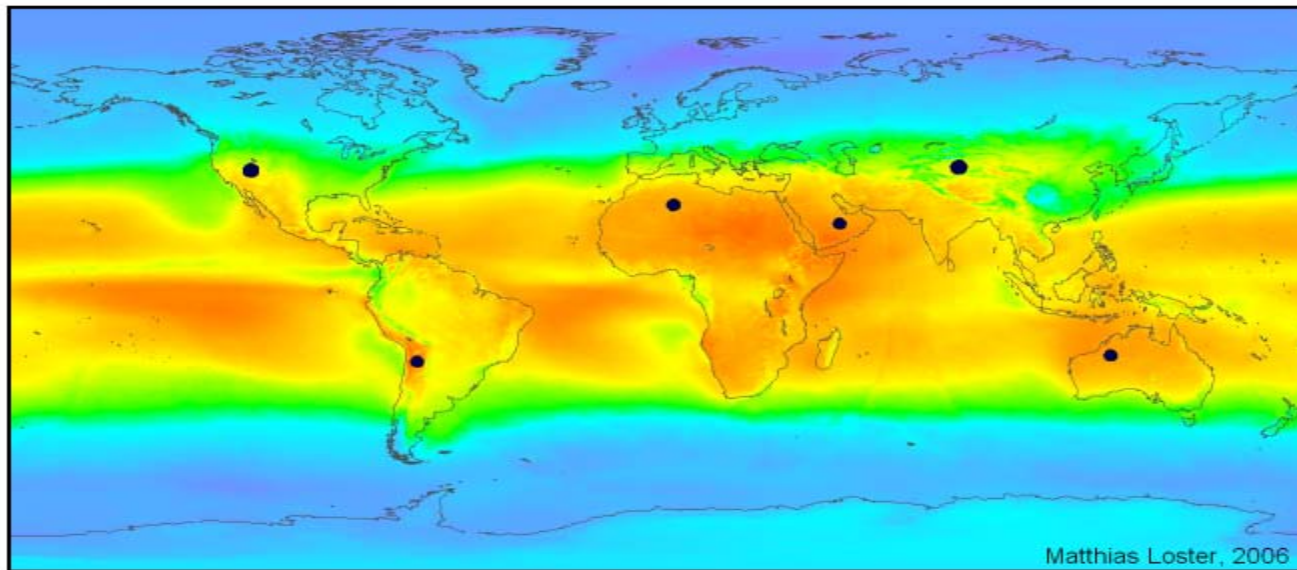


Utility Scale Projects



- Outstanding Solar Resources
- Compare Globally...

Author Mlino76, 22Mar2006



0 50 100 150 200 250 300 350 W/m²

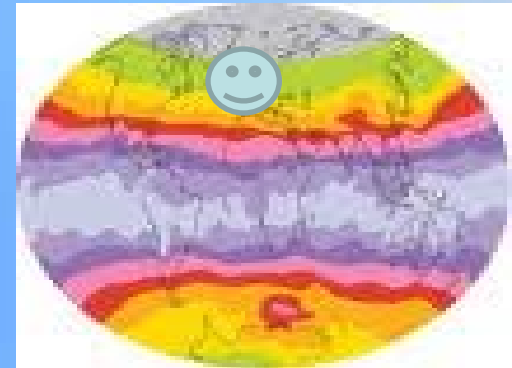
$\Sigma \bullet = 18 \text{ TWe}$



Utility Scale Projects



- Solar/Insolation Resource Map



- Excellent Solar potential with 4.7 – 5.7 kWh/day (2,800 hours/yr in North, and over 3,000 hours/yr in South Morocco).
- Tracking systems (PV and CSP)

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Utility Scale - PV



- Photovoltaic (PV) technology is widespread
 - Rapidly developing
 - Cost effectiveness is rapidly improving
 - Numerous , competitive suppliers
 - Perhaps the most easily scaled tech for electric power

Strengths

Easily Scalable from residential -> utility scale

Weaknesses

Developing technology
Intermittent

Opportunities

**Vast Area to Deploy
Training & Employment**

Threats

Price Fluctuation
Cost Factor





Utility Scale - CSP



CSP Power Tower

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CSP Solar Thermal



eSolar's 5 MW Sierra SunTower facility-Lancaster, CA, USA Arrays of heliostats (mirrors tracking) concentrate sunlight on a central receiver at the top of a tower.



Parabolic troughs are more common, over dishes, used to concentrate insolation, to heat oil, to exchange to steam, and ultimately, generate electricity.

Strengths Promising	Opportunities Training Employment
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Weaknesses Rapidly Developing Technology - Intermittent	Threats Unknown Track Record Extreme Temps @ Tower
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Strengths Proven Tech	Opportunities Training Employment
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Weaknesses Oil Base Heat Transfer Intermittent	Threats Oil Leak
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Utility Scale - Wind



- Wind: Offshore vs. Onshore



- **Installed** production capacity: **482 MW** and **855 MW** under **construction**. Potential:
 - North (average annual between 8 m/s & 11 m/s)
 - South (between 7 m/s & 8.5 m/s)

Strengths

Proven Technology
Global Acceptance/Growth

Opportunities

Good wind North and South,
especially coastal

Weaknesses

Utility-scale wind farms must
have access to transmission
lines to transport energy

Threats

Environmental Impact
Visual Impact
Requires Vast Space



Utility Scale Hydro



- Traditional Hydro Power Generation
- Pumped storage systems
 - Excellent resources at rivers, lakes, dams
 - Natural and man-made

Strengths On-demand thru storage Proven Technology	Opportunities Pumped Storage
Weaknesses Dams impact topography Requires natural waterway	Threats Environmental Impact Drought



Utility Scale - WTE



- Waste to Energy
 - Fully dispatchable resource – 24/7 availability

Strengths Fuel source near demand	Opportunities Reduce Landfill size/gas Training & Employment
Weaknesses Requires Infrastructure and investment to collect, sort and transport fuel AND build plant	Threats Infancy stage developing technologies (i.e., plasma) may significantly alter plant design



Utility Scale - Biomass



Biomass

-Fully dispatchable IN SEASON

Strengths

Similar tech to WTE
Reduces Ag waste

Opportunities

Combine/Co-gen with
traditional, renewable or
WTE fuels

Weaknesses

Requires Infrastructure and
investment to collect and
transport fuel AND build plant

Threats

Requires Fuel (impacted
by drought conditions)



Utility Scale - Storage



- Energy Storage Systems
 - Hydro – pumped storage
 - Battery Systems
 - Mechanical Kinetic Systems

Strengths Balance Peak Demand	Opportunities Increase Productivity
Weaknesses Costly	Threats Environmental



Utility Scale Projects



- Wave and Tidal
 - Wave capture
 - Tidal float Systems
- Underwater ‘river’ currents
 - Type of Traditional Hydro – Very Powerful

Strengths Extreme potential	Opportunities Training & Employment Other - TBD
Weaknesses Underdeveloped Technology	Threats Significant Investment Risk Harsh environment



Utility Scale Projects



- Transmission and Distribution
- Grid Interconnection:
 - a critical element for development
- Morocco 2020 requires in depth network studies
 - Optimize location and size of projects
- Study result will superimpose Wind and Solar resources on transmission grid

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Utility Scale Projects



Interconnection: Texas Lessons Learned

- 2673 miles of 345 kv line must be built
 - 18 GW from West Texas to Load centers.
 - Some wind transmission > 1,000 km
- Transmission upgrade began 2001
 - in-service ETA 2013
- Major tech studies required to determine reactive power due specific frequency and voltage conditions of wind generation



Local System Projects



- Local Systems aka “Distributed Technology”
 - Solar PV
 - Lighting, Power, for residents and remote equipment
 - Solar Thermal
 - Heating, Cooling, Lighting
 - Wind
 - A single 0.5 MW Turbine can power a farm

Strengths

Easy Installation and integration

Weaknesses

Costly without incentives

Opportunities

Significant reduction on utility scale production

Threats

Lack of public interest



Efficiency Projects



- Conservation = Reduced Consumption
 - Energy Efficiency Programs
 - Commercial, Industrial, Residential
- Reduce, Reuse, Recycle Programs

Strengths Widely Accepted, Proven and Ready Technology	Opportunities Huge Potential ROI
Weaknesses Requires Infrastructure, Training Education and Consumer Commitment	Threats Poor Results after significant investment of time, money and talent



Efficiency Projects



- Massive Potential
- Reduced demand same as increased production
- Building efficiency (i.e., lighting, heating/cooling)
 - applies to residential, commercial, industrial
- Industrial Controls (i.e., electronic motor drives)

Strengths

ROI often < 2 years

Opportunities

**“Low Hanging Fruit”
Often Incentivized
Training & Employment**

Weaknesses

**Difficult to launch and
develop public interest**

Threats

Re-training / cultural

Renewable Energy Technologies Morocco



- Closing Remarks
- Q & A
- Thank you



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