SAHARA TRADE WINDS TO HYDROGEN: APPLIED RESEARCH FOR SUSTAINABLE ENERGY SYSTEMS

WIND RESOURCE ASSESSMENT IN MOROCCO

First Follow-up meeting
Al Akhawayn University of Ifrane February 12-13, 2009
Khalid Benhamou - PPD (Morocco)
Fundamentals of Wind Resource Assessment program

Equipment is relatively inexpensive:
• Anemometers (~100 €) & data loggers (~500 €)

Main costs:
• How to put instruments at 40-50 meters height?
• Data collection
• Protect equipment from vandalism (remote sites)
Costs of Wind Resource Assessment program

Mast tower costs 5~15 000 €/unit (40 meters +)
+ Transportation costs (bulky equipment)
+ Erection costs (mast + guy wires etc…)

Wind Resource Programs Available in Morocco (CDER)
50 k€ for 1 year of wind measurement per site at 40m.
Wind Measurements

Area of Tarfaya
SfP-982620 is End-User Driven Project

Identify ‘Industry’ Disposing of Masts Tower infrastructures
• Telecom companies
  • GSM Repeater infrastructures:
    • Spread throughout the country (every 15 km)
• Security & Defense
  • Illegal immigration surveillance network South of Morocco
    • High towers (80 meters)
    • Tower Every 30 km
    • Along coastline (best wind regimes)
Potential End-User interests

• Telecom companies
  • Need to power their GSM Repeater infrastructures
    • Expensive refueling logistics (generators)
    • Clean autonomous stand alone system is ideal
• Security & Defense
  • Existing Military to NATO cooperation
  • Military to civil partnership under NATO Science for Peace program possibly interesting (sustainable energy & development of upstream solutions to illegal immigration)
• Environmental security
Example of a ‘Science for Peace’ Project (4/4)


Morocco, Mauritania, USA, France, Germany, Turkey;
Awarded June 2007
Complementarities within Applied Research Objectives

• Engage End-Users & Develop Effective Collaborative Protocols
  o Instrumentation (100% SfP Funded)
    o No quality compromise (integrity of Data)
    o Integrate site specific measurements constraints
  ✓ Equipment Installation/deployment (Co-funded)
    o On-site Supervision (SfP Team)
      ✓ Installation & access to infrastructures (End User)
  ✓ Data collection (Co-funded)
    o Data download (SfP Team)
      ✓ Access to infrastructures (End User)
  o Data Processing/Academia (Co-funded)
    o Software design (SfP Participants)
    o Equipment & Software purchases (SfP Funded)
Wind Monitoring

• Ensuring Quality Measurements
  o Duplicating Measurements
    o Duplication of Calibrated Instruments
    o Additional non-calibrated on-site instrument deployed
    o Wind Measurements Vertical Profiling
  o Calibrated Instrumentation
    o EU Standards
    o Data used as collateral for Financing of Wind Parks
      o Commercial value & End User interests
      o Develop Commercial Protocols for Data Processing
        o Build expertise locally
        o Sales of Services
        o Sales of Processed Data (value added service)
Wind Data Collection

- Autonomous Data logger Based
  - Totally Independent from tower infrastructure
  - Independent power supply (Battery) & manual data collection (PC)
  - Good follow-up & visual system verification

- Integrated power & Data transmission options
  - GSM based system
  - Direct data link using telecom network

- Initial approach is to use Autonomous systems

- Integrated systems subsequently tested with wind-powered supply of Telecom towers, for on-line system verification & performance checks.
  - System initially tested at University
  - Site specific deployment
NATO SfP-982620 PROJECT OBJECTIVES
Build Synergies with Industry

Wind Resource Assessment:
Partnership Between University of Nouakchott and Mauritel / Maroc Telecom
Wind Data Collection data loggers

Site specific equipment: data loggers
Highly accurate & reliable
Wind Measurement Anemometer cups

Anemometer-calibration in wind tunnel (MEASNET)
NATO SfP-982620 PROJECT OBJECTIVES
End-User Driven Applied Research Program

✓ Wind resources assessment program
  ✓ Wind Measurements
  ✓ Data Collection
  ✓ Data Processing

• Small Wind Turbine systems
• Intermittent energy storage
• Hydrogen Sustainable Energy Systems
NATO SF-982620 PROJECT PARTNERS

NATO MEDITERRANEAN DIALOGUE PARTNERS

MOROCCO:
- SAHARA WIND INC. (PPD)
- AL AKHAWAYN UNIVERSITY OF IFRANE
- ENSAM - ECOLE NATIONALE SUPÉRIEURE DES ARTS ET MÉTIERS
- EMI - ECOLE MOHAMMEDIA DES INGENIEURS
- FST – FACULTÉ DES SCIENCES DE TETOUAN
- FSTM - FACULTÉ DES SCIENCES ET TECHNOLOGIES DE MOHAMMEDIA
- CERPHOS: CENTRE D’ÉTUDES ET DE RECHERCHES DES PHOSPHATES MINÉRAUX
- ONEP - OFFICE NATIONAL DE L’EAU POTABLE

MAURITANIA:
- UNIVERSITE DE NOUAKCHOTT - FACULTE DES SCIENCES ET TECHNIQUES
- CRAER – CENTRE DE RECHERCHE APPLIQUE ENERGIES RENOUVELABLES
- ISET ROSSO – INSTITUT SUPERIEUR D’ENSEIGNEMENT TECHNOLOGIQUE
- MAURITEL MOBILE – MAURITEL S.A.
- APAUS – AGENCE DE PROMOTION POUR L’ACCES UNIVERSEL AUX SERVICES
- SNDE – SOCIETE NATIONALE DE L’EAU
- SNIM – SOCIETE NATIONALE INDUSTRIELLE ET MINIERES
- SAFÀ – SOCIETE ARABE DES FERS ET D’ACIERS.
- ANEPA – AGENCE NATIONALE DE L’EAU POTABLE ET D’ASSAINISSEMENT

NATO COUNTRIES PARTNERS

UNITED STATES: (NPD)
- U.S DEPARTMENT OF STATE - OFFICE OF GLOBAL CHANGE – BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS (OES)

FRANCE:
- COMMISSARIAT A L’ENERGIE ATOMIQUE CEA

GERMANY:
- MINISTRY OF ECONOMIC AFFAIRS AND ENERGY OF THE STATE OF NORTH RHINE-WESPHALIA - M.NRW

TURKEY:
- UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION – INTERNATIONAL CENTRE FOR HYDROGEN ENERGY TECHNOLOGIES UNIDO-ICHET