

Sahara Wind Energy Development Company

NATO 'Science for Peace'  
SfP-982620

**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)



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is supported by:*

The NATO Science for Peace  
and Security Programme

## 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)



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## 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.



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## Wind Measurements



Area of Tarfaya



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## 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)



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## 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



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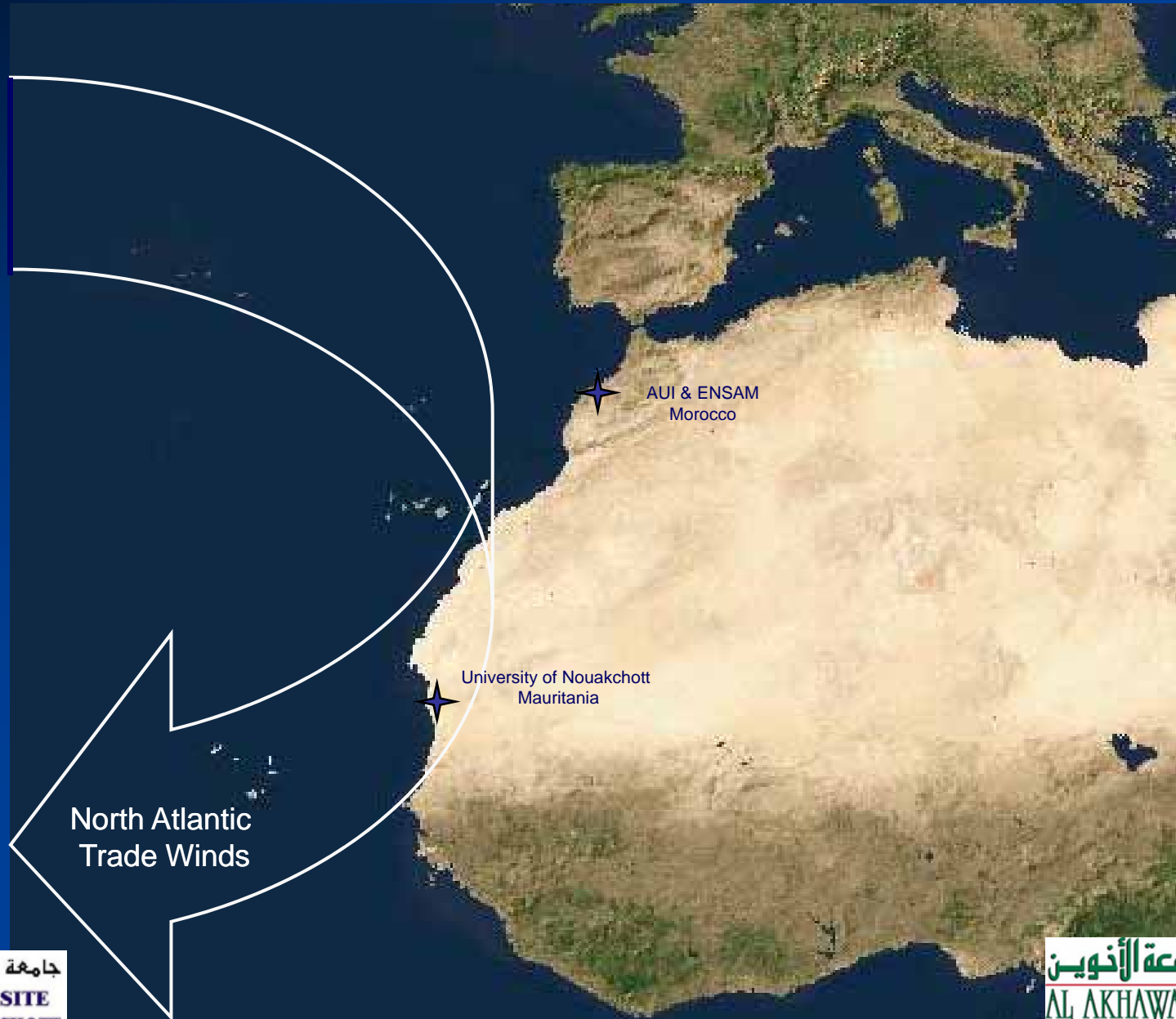
# Example of a 'Science for Peace' Project (4/4)



**“Sahara Trade Winds  
to Hydrogen: Applied  
Research for  
Sustainable Energy  
Systems”**

**Morocco, Mauritania,  
USA, France, Germany,  
Turkey;**

**Awarded June 2007**





## Complementarities within Applied Research Objectives

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



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## Wind Monitoring

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



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## 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



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# NATO SfP-982620 PROJECT OBJECTIVES

## Build Synergies with Industry



Wind Resource Assessment:  
Partnership Between University of Nouakchott and Mauritel / Maroc Telecom



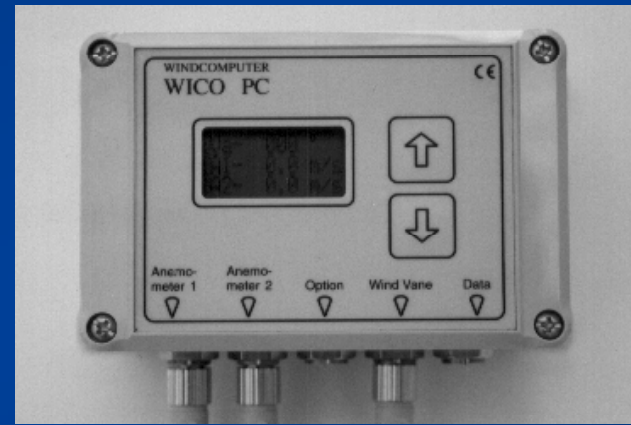
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## Wind Data Collection data loggers



Site specific equipment: data loggers  
Highly accurate & reliable



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## Wind Measurement Anemometer cups



Anemometer-calibration in wind tunnel (MEASNET )



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## 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



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## NATO SfP-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

ENSET-ECOLE NORMALE SUPERIEURE  
DE L'ENSEIGNEMENT TECHNIQUE  
MOHAMMEDIA

FST – FACULTÉ DES SCIENCES DE  
TETOUAN

FSTM - FACULTÉ DES SCIENCES ET  
TECHNOLOGIES DE MOHAMMADIA

FST – FACULTÉ DES SCIENCES DE  
KENITRA

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

ISSET ROSSO – INSTITUT SUPERIEUR  
D'ENSEIGNEMENT TECHNOLOGIQUE

MAURITEL MOBILE – MAURITEL S.A.

AP AUS – AGENCE DE PROMOTION POUR  
L'ACCES UNIVERSEL AUX SERVICES

SNDE – SOCIETE NATIONALE DE L'EAU

SNIM – SOCIETE NATIONALE  
INDUSTRIELLE ET MINIERES

SAFA – 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



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