

Ecole Nationale Supérieure d'Arts et Métiers - ENSAM

Al Akhawayn University

Université de Nouakchott - Faculté des Sciences et Technologies

Sahara Wind Energy Development Company

NATO 'Science for Peace'

SfP-982620

# Sahara Trade Winds to Hydrogen: Applied Research for Sustainable Energy Systems

Follow-up meeting

Al Akhawayn University of Ifrane February 12-13, 2009

Khalid Benhamou - PPD (Morocco)



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## NATO : Network of Cooperation

### – NATO Countries (26)

Belgium, Bulgaria, Canada, Czech Republic, Denmark, Estonia, **France**, **Germany**, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, **Turkey**, United Kingdom, **United States**.

### – Partner Countries (23)

Albania, Armenia, Austria, Azerbaijan, Belarus, Bosnia & Herzegovina, Croatia, Finland, Georgia, Ireland, Kazakhstan, Kyrgyz Republic, Moldova, Montenegro, Russia, Serbia, Sweden, Switzerland, Tajikistan, the former Yugoslav Republic of Macedonia(\*), Turkmenistan, Ukraine, Uzbekistan.

### – Mediterranean Dialogue Countries (7)

Algeria, Egypt, Israel, Jordan, **Mauritania**, **Morocco**, Tunisia.

### – Total: 56 countries



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## NATO SfP-982620 PROJECT OBJECTIVES

- Applied research capacity building around common strategy
  - Sustainable Energy
  - Technology integration through industrial Synergies
  - Leverage human resources
- Reinforce role of education and research in national energy decision choices
- Develop competence in (renewable) energy branches of the future, through integrated applications (centralized and distributed)



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## NATO SfP-982620 PROJECT OBJECTIVES

- Complementary Working Teams through a Science for Peace Project Platform on a regional level (Academic and Industrial network) in Morocco and Mauritania.
- This Partnership can benefit from other Mediterranean Partnership dialogue countries of NATO, and contributions of NATO member Countries (Europe and North America)
- Success measured not only in terms of intellectual property production, number of patents, etc. but also in terms of relevant partnerships essential in all applied research activities.

Technology – University/R&D Platform - Industry



# PROJECT PROGRESS

## Wind Resource Assessment

- Wind Resource Assessment of the Trade Winds
  - ✓ Instruments Acquisition
  - ✓ Installation of Instruments
  - Data Collection
  - Data Processing / Wind Mapping

---Status 2/5



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## PROJECT PROGRESS

### Small Wind Turbine Deployment Program

- Assessment of Small Wind Turbine Technologies --- Status 2/5
  - ✓ Identify type of Equipment (Small Wind Turbine)
    - ✓ Technology used and reliability
    - ✓ Quality materials and design
    - ✓ Costs
  - Visit Equipment Manufacturers
    - Availability
    - Collaboration interests/potential
  - ✓ Establish Manufacturer agreement
  - Equipment Procurement
    - ✓ Competitive bidding
    - Thorough Evaluation
  - Installation of wind turbines in test benches
  - Systems integration
  - Deployment (Maroc Telecom & ONE-PERG / MAURITEL & APAUS)



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# PROJECT PROGRESS

## Wind Energy Industrial Applications

- Wind Energy Industrial Applications --- Status 2/5
  - Centralized
    - Power production (CERPHOS, SNIM, SONELEC)
    - ✓ Desalination (CERPHOS, ONEP, SNDE)
    - Electrolysis (CERPHOS, SNIM)
  - Distributed
    - Telecom infrastructures (MAURITEL-MAROC TELECOM)
    - ✓ Remote electricity access (APAUS)
    - Desalination (ONEP-SNDE)
    - Electrolysis (ONEP-SNDE)



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# PROJECT PROGRESS

## Hydrogen Applied Research

- Hydrogen Applied Research --- Status 1/5
  - ✓ Hydrogen Integrated Production
    - ✓ PEM, Alkaline, Hypochlorite & Chlor-Alkali Electrolysis
  - Hydrogen Storage
    - Pressurized Hydrogen tanks (all uses)
    - Metal Hydrides (distributed energy only)
  - Hydrogen Utilization
    - Energy
      - Fuel Cells (Maroc Telecom, Mauritel)
      - Internal Combustion Engines (CERPHOS, SNIM)
    - Non-Energy
      - Phosphate processing (CERPHOS)
      - Iron-Ore processing (SNIM)



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## PROJECT PROGRESS

### Criteria for Success Table

• Wind Resource Assessment of the Trade Winds	---	Status 2/5	
• Small Wind Turbine Program Deployment	---	Status 2/5	
• Wind Energy Industrial applications	---	Status 2/5	
• Intermittent Energy Storage alternatives	---	Status 1/5	
• Hydrogen Applied Research	---	Status 1/5	
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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

FSR - FACULTE DES SCIENCES DE  
RABAT

FSTM - FACULTÉ DES SCIENCES ET  
TECHNOLOGIES DE MOHAMMADIA

FST – FACULTÉ DES SCIENCES DE  
KENITRA

CERPHOS: OCP GROUP

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.

APAUS – AGENCE DE PROMOTION POUR  
L'ACCES UNIVERSEL AUX SERVICES

SNDE – SOCIETE NATIONALE DE L'EAU

ANEPA – AGENCE NATIONALE DE L'EAU  
POTABLE ET D'ASSAINISSEMENT

SNIM – SOCIETE NATIONALE  
INDUSTRIELLE ET MINIERES

SAFA – SOCIETE ARABE DES FERS ET  
D'ACIERS.

## 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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