

UNESCO CHAIR/UNITWIN NETWORK PROGRESS REPORT FORM

Title of the Chair/Network:	UNESCO Chair in Energy for Sustainable Development
Host Institution:	Politecnico di Milano
Date of establishment of Chair/Network: <i>(mm, yyyy)</i>	03, 2012
Period of activity under report: <i>(mm, yyyy - mm, yyyy)</i>	04, 2012 - 03, 2013
Report established by: <i>(name, position)</i>	Emanuela Colombo, Chair Holder Professor at the Department of Energy Rector's Delegate to Cooperation and Development

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1. Executive Summary:

Major outcomes, results and impact of the Chair, including on national policies, in relation to its objectives as stated in Article 2 of the Chair Agreement (between the Institution and UNESCO)

(Not exceeding 300 words)

The UNESCO Chair in Energy for Sustainable Development has been taken place at Politecnico di Milano since March 2012.

The Chair has given primary attention to teaching and education: curricula upgrading and staff exchanges with DCs have been promoted, aiming at creating new competences towards social responsibility, access to energy and global development global issues. One of the main achievements has been the implementation of a new track within the MSc in Energy Engineering specifically devoted on 'Energy for the Development'.

Research has been addressed to foster distributed generation and enhance the strategy programming for improving access to energy. Optimization of the match Need/Resources and the choice of appropriate technologies are being investigated.

Partnership with universities in DCs has been enforcing: two projects proposal have received the grant (call Tempus and Edulink) by the European Commission, aiming at upgrading higher education system on Sustainable Development, Sustainable Energy strategies and North-South cooperation and two lecturers (from Tanzania and Cameroon) are now developing their PhD research at the Department of Energy, one below the supervision of the Chair holder and another one under the supervision of Prof. Berizzi.

The Chair cooperates with international institution and NGOs, in activities of knowledge sharing and training on issues related to access to energy and sustainable energies strategies. The public-private partnership has been enforced by working with the civil society players and/or public institution on research projects funded by private bodies for supporting local socio-economic growth (for the first year mainly in Mozambique).

2. Activities:

Overview of activities undertaken by the Chair during the reporting period

a) Education/Training/Research

(key education programmes and training delivered and research undertaken by the Chair during the reporting period, target group and geographical coverage)

i) Education (leading to certificate)	<p>In accordance with the deep connection between energy and development, highlighted also by UNDP, the Chair has promoted and made effective the implementation of a new track on Energy for the Development (MSc in Energy Engineering), created to combine engineering fundamentals with the aim of addressing global problems with an holistic approach by using all the tools necessary to assess economic, environmental and social impacts of any technological solution. Studies in this plan aim at preparing a professional figure having a broad knowledge in technical and scientific fields, able to operate in the energy sector at a multi-scale level, including the development of specific technologies and the energy analyses of different scenarios for promoting local sustainability and socio-economic growth.</p> <p><u>Courses currently offered at Politecnico di Milano, in cooperation with the Chair:</u></p> <ul style="list-style-type: none">• Engineering and cooperation for development (8 ECTS) MSc in Energy Engineering – Milano Bovisa <i>Course Program</i> The course aims at introducing students to the theme of development and cooperation as well to the role of scientific research and technology within the field. The main goals are: to provide methodological tools of cooperation and development in order to widen the vision for facing the social challenge, to couple the engineering vision with the whole set of human factors and the principles of ethics, to develop a system of instruments and values that can generate innovation and development in different contexts. Students are involved with a participative approach, analyzing real case proposed by NGOs and delivering a project on a case study.• Energy for sustainable development (6 ECTS) MSc in Environmental and Geomatic Engineering - Como <i>Course program</i> The course aims at introducing basic concepts about energy as a tool for sustainable development. In this perspective, it addresses the following issues: energy and thermodynamic analysis, renewable and nonrenewable energy resources and conversion technologies, local and global emission, Life-Cycle Analysis and environmental impact. Emphasis is also made on political opportunities and legislation (for instance, Kyoto Protocol and Agenda21).
ii) Training (short term)	<p>In line with the strategy of the Chair, several conferences and courses have been organized, aiming at promoting a knowledge sharing network, through capacity building and dissemination towards different actors. Training were addressed to Italian and foreign students, international experts and NGOs.</p> <p><u>Training in collaboration with Universities</u></p> <ul style="list-style-type: none">• Department of Design, Politecnico di Milano, 26th March 2013 Lecturers at the Seminar on “Renewable and Distributed Energy Generation for Sustainable Development in Low-Income Contexts” <i>The seminar was part of the course System Design for Sustainability. The activity comes from an increasing collaboration between the Chair and the Design School, where projects on transcontinental universities cooperation have been in place.</i>

	<p><u>Training in collaboration with International Organizations</u></p> <ul style="list-style-type: none"> • ICS-UNIDO, Trieste, 4th–8th June 2012 Lecturers at the Summer Course on “Renewable energies for decentralized systems: supporting tools and best practices for green energy and sustainable development” • ICS-UNIDO, Tunisi, 8th–12th October 2012 Lecturers at the Training Course on “Options and best practices for renewable energy technologies for productive uses in the Mediterranean region” <i>Lectures presented the issues of access to energy and sustainable development in DCs, focusing mainly on the following subjects: technology trends, potential and selection of renewable energy technologies, low-carbon technologies, renewable energy policies, technology transfer, sustainability and economic growth.</i> • UNIDO Renewable Energies Course (e-learning) <i>This e-learning course is presented by the ICS-UNIDO in joint collaboration with the Politecnico di Milano, the METID Service Area and the Department of Energy. The course covers subjects within a broad frame of renewable energies, specifically solar thermal energy, small-scale hydro power, biomass, and geothermal energy. Each subject is faced in a specific module by considering general basic concepts, technological aspects, economics, environmental issues, and appropriateness in relation with the context. After closure of UNIDO-ICS, the platform is now in the hand of the UNIDO Institute.</i> <p><u>Training in collaboration with Civil Society Organizations</u></p> <ul style="list-style-type: none"> • CeLIM, 13th October 2012 Energy, Environment and Development: challenges in the third millennium <i>Contents of the lectures:</i> <i>Introduction to the concept of energy with a focus on renewable energies and energy strategies; solar photovoltaic, solar thermal and biomass (physical principles, technological aspects, design criteria and case study of a small-scale plant)</i> • AVSI Foundation, 20th November 2012 Lecture in the annual upgrading course for expatriates Access to Energy, Human Promotion and Sustainable Development <i>Contents of the lecture:</i> <i>The linkage between energy and development, access to energy in developing countries (current situation and future challenge), appropriate technologies for access to energy (home systems, distributed generation and mini-grid systems), strategies for access to energy</i>
<p>iii) Research</p>	<p>The activities of the Chair are in line with the vision of the Research Group Blaise Pascal Lab of the Department of Energy: the Group aims at contributing to the shift toward more sustainable and equitable energy systems, able to meet the need of global development. Indeed teaching and research activities are oriented to transfer the achievements to the industrial framework and the social community.</p> <p>Strategies are defined for improving energy access and for the impact evaluation of energy project and systems in order to meet the demanding constrains of economic, environmental and social sustainability.</p> <p><u>Research activity is mainly divided in the following lines:</u></p> <ul style="list-style-type: none"> • Sustainable Strategies planning for improving access to energy <ul style="list-style-type: none"> ○ Needs-Resource math: need assessment and resources analysis ○ Demand side planning in relation to the local framework ○ Multi-criteria, multi-objective and multi-stakeholders evaluation for

	<ul style="list-style-type: none"> ○ selection of strategies in DCs ○ Appropriate technologies and their integration in small scale grid based on renewable sources ● Monitoring & Evaluation of the impact for energy project and systems <ul style="list-style-type: none"> ○ Result Chain Evaluation for the project (OCSE DAC): from input to outcome ○ Evaluation of the Impact over the capitals (environmental, physical, financial, human and social) of the local contest ○ Definition and implementation of a Performance Measurement System (PMS) for Cooperation Project in the Energy field <p><u>The following PhD researches are now active:</u></p> <ul style="list-style-type: none"> ● Optimization of energy systems in rural areas: distributed generation for rural electrification (Italian PhD student supervised by the Chair Holder) ● Energy technologies for efficient cooking in DCs: Improved Cook Stoves, domestic and community biogas systems (PhD student from Cameroon supervised by the Chair Holder) ● Rural Electrification: smart mini grids development and optimization (PhD student from Tanzania supervised by Prof Berizzi)
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<p>b) Conferences/Meetings (key conferences and meetings organized by the Chair or to which its Chairholder contributed)</p>
<p>i) Key conferences and workshops hosted by the Chair</p> <p><u>International conference organized in cooperation with UNIDO and ICS-UNIDO</u> “Sustainable Energy Strategies in Low and Middle-Income Economies” Milan, 22nd-23rd November 2012</p> <p><i>The conference aimed at establishing an international and effective network of experts working worldwide in the field of access to energy and sustainable energy. It served as a high level platform for discussion on sustainable implementation models as part of an integrated approach to global resource management. Three main interlinked topics related to the role of energy for sustainable growth were discussed: technologies to be promoted, business models for new inclusive energy markets, policies and institutions to support new energy systems. During the conference a web based community implemented by Politecnico di Milano was created, giving the opportunity to start a knowledge-sharing platform within the community of experts who attended the conference; access is also available after registration at the following link: http://beep.metid.polimi.it, requiring registration for the “Sustainable energy strategy community”.</i></p> <p>ii) Other conferences/organizational activities undertaken by the Chairholder</p> <p><u>Conference organized by CUCS for the Italian Forum of International Cooperation</u> “The role of universities in cooperation” Milan, 27th September 2012</p> <p><i>The conference is part of the activity of network and knowledge sharing that the Chair leads as coordinator of the Italian CUCS (Coordinamento Universitario per la Cooperazione allo Sviluppo, composed by 27 universities).</i></p> <p>iii) A selection of conference presentations by the Chairholder and other colleagues</p> <p>Energythink V International Conference, Bocconi University, Milan, 21st November 2012 “Sustainable Energy for All, after Rio+20 UN Conference on Sustainable Development”</p> <p>IX International Conference, CeTAmb, Brescia, 21st December 2012 “Research and Cooperation to Development: which synergies?”</p> <p>Accademia di scienza e lettere, Istituto Lombardo, 17th January 2013 “Access to Energy for All beyond 2012”</p>
<p>c) Interuniversity Exchanges/Partnerships</p>

(principal exchanges/partnerships between the Chair and other institutions including UNESCO Chairs/UNITWIN Networks)

- Italian network of UNESCO Chairs
- UNESCO Chair in Hydrological Change and Water Resources Management, RWTH Aachen
- Chaire UNESCO en alimentations du monde, Centre international d'enseignement supérieur en sciences agronomiques, Montpellier SupAgro
- Tempus partners:
 - The American University in Cairo, Egypt
 - Alexandria University, Egypt
 - Aswan University, Egypt
 - Heliopolis University, Egypt
 - Zagazig University, Egypt
 - Technical University of Graz
- Edulink partners:
 - Jimma University, Ethiopia
 - Dar Es Salaam Institute of Technology, Tanzania
 - Technical University of Kenya
 - Technical University of Mombasa, Kenya
- Framework agreement:
 - Catholic University of Bamada, Cameroon
- Existing relationship for previous projects/activities:
 - Ramakumar Research Group, Canada
 - NTNU Trondheim, Norway
 - University of Cairo, Egypt
 - University of Sfax, Tunisia
 - University of Hassan II, Morocco
 - University of Saint Joseph, Lebanon
 - University of Aleppo, Syria
 - Technical University of Delft
- CUCS Network - Formal Protocol signed by 27 Rectors of Italian Universities on Cooperation and Development coordinated by Politecnico di Milano:
 - Università degli Studi di Trento, Università degli Studi di Trieste, Università Cà Foscari – Venezia, Università degli Studi di Padova, Università degli Studi di Ferrara, Università degli Studi di Urbino, Università di Bologna - Alma Mater Studiorum, Università degli Studi di Modena e Reggio Emilia, Università degli Studi di Parma, Università degli Studi di Pavia, Istituto Universitario di Studi Superiori di Pavia, Università degli Studi del Piemonte Orientale "Amedeo Avogadro", Università degli Studi di Torino, Politecnico di Torino, Università della Valle d'Aosta - Università della Vallée d'Aoste, Università degli Studi di Genova, Università degli Studi di Firenze, Università degli Studi di Siena, Università degli Studi di Bergamo, Università degli Studi di Brescia, Università dell'Insubria, Università IULM di Milano, Università degli Studi di Milano, Università degli Studi di Milano Bicocca, Università Commerciale Luigi Bocconi – Milano, Università Cattolica del Sacro Cuore – Milano, Politecnico di Milano

d) Publications/Multimedia Materials

(major publications and teaching/learning materials)

Please tick relevant fields of output and indicate volume of output:

	[tick]	[no.]
Books	<input type="checkbox"/>	
Books (edited)	<input type="checkbox"/>	
Books (chapters)	<input checked="" type="checkbox"/>	1
Monographs	<input type="checkbox"/>	
Research Reports	<input type="checkbox"/>	

	Journal Articles (refereed)	<input type="checkbox"/>
	Conference Proceedings	<input type="checkbox"/>
	Occasional Papers	<input type="checkbox"/>
	Teaching/Learning Materials	<input checked="" type="checkbox"/>
	Multimedia Materials (CD-Rom)	<input type="checkbox"/>
	Multimedia Materials (Video)	<input type="checkbox"/>
	Multimedia Materials (Other)	<input type="checkbox"/>

Give details of major publications and materials including full citations.

i) Theses

- Furlani V., *Stufe migliorate per i paesi in via di sviluppo: stato dell'arte e impatto ambientale in zone rurali (Improved stoves for developing countries: state of the art and environmental impact in rural areas)*

This work consists in an analysis of the state of the art of Improved Cooking Stoves (ICSs) in the context of Developing Countries. A database has been developed in order to assess performances and environmental impact of different kind of stoves. In particular, a case study in Malawi allowed to point out the impact related to the Chitetezo Mbaula stove.
- Manzato A. G., *Exergy Based Evaluation for Energy Projects in Development Cooperation*

The main purpose of this thesis is to provide the Monitoring and Evaluation phase in development cooperation projects with an engineering, exergy-based methodology. The methodology allows to evaluate each project through indicators reflecting the ones used by DAC-OECD (Efficiency, Effectiveness, Relevance, Sustainability).
- Mapelli F., *Feasibility study and CFD modeling of thermoelectric modules coupled with an Improved Cook Stove for developing countries*

Even if Improved Cook Stoves are becoming more and more diffused, there are still some obstacles that prevent them to be well-accepted. One of the main disadvantages is that they do not provide light in the household. In order to improve this aspect, they can be provided with thermoelectric generators, which can feed some LEDs or other electric devices.
- Molina M., Rostoni L., *Caratterizzazione e processo di selezione di tecnologie commerciali per i paesi in via di sviluppo: minieolico e biogas (Process of characterization and selection of commercial technologies for developing countries: small wind and biogas)*, <http://hdl.handle.net/10589/69242>

The work focuses on the study of small wind turbines and on small biodigesters for biogas production. As a matter of facts these technologies can be an appropriate and viable solution to meet the needs of remote areas in developing countries.
- Negri M., *Exploring Nicaragua. Evaluation of small & mini hydropower potential in Costa Caribe*, <http://hdl.handle.net/10589/50121>

The work's main objective was to perform an assessment of natural and technological resources of Nicaragua together with the description of government policies and to individuate strategic resources, with a specific focus on energy. The analysis of the energy market and the investigation of renewable sources revealed a great potential of hydro, geothermal and wind. A European certification procedure was proposed to be adapted to a developing country.
- Romeo F., *Gas flaring reduction: a comprehensive decision model for sustainable alternatives*

The study proposes a comprehensive decision model which allows to choose the most appropriate technology for each specific case when gas flaring occurs: it makes possible to select the feasible alternative which reaches the higher degree of sustainability and acceptance, this having also as a consequence an improvement in access to energy.
- Pesenti S., *Analisi di un impianto solare a concentrazione cogenerativo per applicazione in contesto rurale (Analysis of a co-generative concentrating solar plant for rural contexts)*

The thesis has the goal to assess the feasibility of a concentrating solar power plant coupled with an organic Rankine cycle to be realized in remote rural areas in developing countries. In particular, Tanzania has been taken as the target place. The work that has been done shows the proposed system can be cheaper and more appropriate than conventional technologies in this kind of context.

- Pellizzoli C., *Metodi di ottimizzazione per tecnologie energetiche appropriate in zone remote dei paesi in via di sviluppo : l'opzione Integrated Renewable Energy Systems (IRESs) (Optimization methods for appropriate energy technologies in remote areas of developing countries: the case of Integrated Renewable Energy Systems)*, <http://hdl.handle.net/10589/69101>

The work aimed at studying IRESs for increasing access to energy in remote rural areas of developing countries: after describing some of multi-objective optimization techniques, the design of such an energy system has been done on the basis of capital cost minimization and of exergetic efficiency maximization.

- Redondi A. D. C., Bernardi F., *Mini hydropower for increasing access to energy in Tanzania*, <http://hdl.handle.net/10589/51261>

The thesis aimed at developing a model for mini hydropower plant sizing in the form of the Excel-based software Mini hydro plants simulator. During the time spent in Tanzania by the authors, the model has been tested upon the Madunda power plant, a mini hydro installation built by the Italian NGO ACRA.

ii) Publications

- E. Colombo, S. Mandelli, G. Cassetti, A. Berizzi, C. Bovo. ACCESS TO ENERGY: MINI INTEGRATED RENEWABLE SYSTEMS FOR FACING THE TECHNICAL PROBLEM, Proceeding of the 2012 Tech4Dev International Conference, Lausanne, Switzerland, 29/5/2012-31/5/2012.
- E. Colombo, S. Mandelli. Facts and Figures. A Reasoned Approach. Chapter 1 in the book "Access to Energy. Focus on Africa", ISBN 9788896726082, Ed EDIPLAN, 2012
- P.R. Ortigosa, E. Colombo, Access to Energy. Focus on Africa, ISBN 9788896726082, Ed EDIPLAN, 2012
- "Accesso all'energia e Cibo: dalla competizione alla cooperazione", Extra Expo Tempi, January 2013

e) Cooperation with UNESCO Headquarters, Field Offices

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f) Other

(any other activities to report)

1. PROJECT

The Chair aims at promoting international university partnership with developing and emerging countries, supporting the upgrading of higher education in the target countries, promoting joint research and staff exchange. Currently the most effective collaborations have been in place with the MENA Region and with some Sub-Saharan Countries. Indeed Politecnico di Milano, under the flag of UNESCO Chair, is coordinating the following European Grants.

Tempus IV TEMPUS-530611-2012-IT-JPCR

GIEP - Green Innovation and Entrepreneurship Programme

The project aims at making Sustainable Development and Green Economy the new entrepreneurial frontier and business in Egypt. The objective of the project consist in developing a joint/double MSc program on "Green Innovation and Entrepreneurship" with the cooperation of 3 European universities and 4 Egyptian Universities. The program will create a whole new generation of business and social entrepreneurs with skills allowing them to start-up green businesses, launch innovative ventures and products, and put in place public policy and social entrepreneurship innovations.

ACP-EU Co-operation Programme in Higher Education EDULINK II

ENERGISE - Enlarged Network in Education and Research for a Growing Impact of Sustainable Energy

Engineering on Local Development

The project has the objective to develop high quality, market-driven curricula in Energy Engineering focused on sustainability, innovative technologies and modern renewable energies relevant to the energy asset within the countries of Ethiopia, Kenya and Tanzania. The project involves 4 local universities and will count on the cooperation of local enterprises, NGOs, ministerial department and rural agencies working at different level on access to energy.

2. ADVISORY

The activity of the Chair also includes advisory to NGOs and private companies. To improve the effectiveness and sustainability of cooperation projects, the Chair is convinced in the complementarity of all interested actors and in the need for partnership. The role of university focuses on research and is oriented towards innovative solution, by improving methodologies and assessing most appropriate technologies for specific contexts.

Pre-feasibility study: access to energy in north Mozambique, Cabo Delgado Province

The study was carried out for the Italian NGO AVSI. It allowed to state the actual situation of the energy sector in Mozambique, in particular in two focus areas in Cabo Delgado Province. Problems related to energy have been investigated thanks to both the analysis of policies, programmes and projects, and an on-field assessment of the actual situation of access to energy in the target areas. A preliminary identification of the problems and opportunities at the target level allowed to define some main actions to be considered in order to enhance access to energy in compliance with the principles of sustainable development.

Pre-feasibility study: Improved Cook Stoves and Thermoelectric Modules for domestic usage in Mozambique

The study was carried out as advisory service for the Italian company Eni SpA. The analysis of the context of Mozambique and the study of the household needs within this study underlined the massive use of traditional biomass and the problems coming from the traditional cooking devices. Since transition to modern fuels and technologies results unfeasible in the short term, a good intermediate solution is the use of "Improved stoves", which have a good thermal efficiency of combustion, relatively low emissions and offer the possibility of integration with TE modules for island household electric generation.

3. Future Plans and Development Prospects

Outline of action plan for the next biennium and short/medium and long-term development prospects.

Please do not hesitate to refer to difficulties that the Chair has experienced
(Not exceeding 300 words)

The Chair aims at fostering the activity of knowledge sharing within the network that it has been created. In line with this objective:

- The UNESCO Chair website will be implemented, to disseminate the results and have an interactive platform to support the joint activities of the community
- A conference, in cooperation with private Italian utilities and public institutions, has been already planned for December 2013 oriented to International Cooperation for Sustainable Energy Strategies, Energy Access and Nexus with Water, Food and Land.

The activity of capacity building and dissemination will be implemented with a publication of a book published by Springer within the year 2013. The book (tentative title: "Renewable Energy for Unleashing Sustainable Development") will base its contents on the conference held in November 2012 and propose a whole elaboration of the discussed subjects with the contribution of high level experts. The Chair will also organize a PhD School in cooperation with UNIDO in February 2014.

The activity of the Chair will be particularly addressed to Mediterranean and MENA Regions, with the aim at promoting cooperation, joint research and staff exchange for creating an integrated area of knowledge. In line with this objective, under the last call of Tempus Programme (closed in March 2013), the Chair submitted a proposal for tackling a strategic priority in Egypt: the Water-Energy-Food Nexus.

In long-term the idea of the Chair is to strengthen the knowledge sharing between partners and enforce the networking activity. Joint researches with universities and lecturers coming from DCs attending Politecnico di Milano as PhD students will be supported. The Chair will intent to work on the creation of a remote access system to the Library Network Platform of Politecnico di Milano and on an open knowledge system for free on line training to increase access to global scientific knowledge.