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Knowledge management mapping and gap analysis in renewable energy: Towards a sustainable framework in developing countries

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ABSTRACT

This paper presents a mapping of knowledge management in renewable energy (RE) promoted through international and regional organizations with emphasis on gap analysis for the purpose of increasing RE deployment in developing countries. The knowledge mapping showed that most efforts are focused on RE information sharing and awareness raising, followed by policy assistance and technology transfer. Priorities seem vague with minimal close implementation, coordination, and evaluation whereby technology transfer and capacity building efforts do not always cater to the needs of benefiting countries with a lack of specialized RE financial mechanisms that provide incentives for countries to invest in RE. Equally significant, limited efforts are discerned about joint research initiatives with a slow progress towards standardization and certification of RE technologies. A general framework is proposed with a definition of short, medium and long-term undertakings towards increased RE penetration in developing countries. The profile of well-positioned organizations to adopt such a framework is identified on the basis of a SWOT analysis.

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1. Introduction

Renewable energy (RE) has had its uprising concurrently with rising concerns about climate change and associated implications. Much effort to substitute or supplement current energy trends with sustainable RE resources can be readily discerned through the implementation of various RE related projects [1–4]. Recent estimates indicate that RE provided ~12.9% of the total primary energy supply in 2008 [5] and accounted for ~16% of the world final energy consumption in 2010 [6] with a potential that can rise to 50% of the global energy demand by 2050 [7]. Low to middle income developing countries are equally attempting to deploy RE technologies and exploit associated environmental and economic benefits [8–12]. Many of these countries, however, are faced with a series of barriers that preclude RE from market penetration including a lack of information sharing and awareness, a lack of regulatory frameworks, a restricted access to RE technologies, a high up-front investment cost or a lack of access to capitals, a lack of standards and certification, a lack of skilled professionals and training facilities as well as trade barriers and unstable macro-economic environments [13–18]. As these

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barriers are 'rooted in or can be explained by knowledge barriers' [19,20], organizations of knowledge facilitation and exchange ought to play an important role in easing these constraints. Such entities contribute to RE knowledge exchange and technology deployment in developing countries through information dissemination, technology transfer and policy assistance for the facilitation and promotion of enabling environments for RE market penetration. While research on RE knowledge, resources, potential and barriers is plentiful at the local and national levels [19,8,21,2,11,12], limited work has assessed the role of international, regional, and at times national organizations in tackling RE knowledge barriers. This paper reviews the scope and scale of knowledge disclosure and dissemination by major players in the RE sector through a comprehensive mapping of their worldwide related activities. It brings forward an analysis of gaps in the international, regional, and local systems for the enhancement of RE collaboration, accessibility, and deployment particularly in developing countries. The paper concludes with a general framework that can assist in setting the future road map for RE knowledge management followed by a SWOT (strengths, weaknesses, opportunities and threats) analysis to define the type and role of organizations to adopt such a framework.

2. Methodology

A comprehensive critical review was conducted to identify active entities in the RE sector at various levels. The resulting data and information were synthesized and critically examined to establish who the main entities in RE knowledge creation are, what type of knowledge is being shared and through what forms and means. Nine indicators (Table 1) were defined to assess and map RE knowledge and how it is being managed as well as to analyze existing gaps. The knowledge mapping and gap analysis were used to develop a general framework of short, medium and long-term tasks to enhance RE penetration. A SWOT analysis was then performed to identify the relevant profile of an international body to assume the leading role in advancing this framework. The SWOT consisted of (1) short listing potential organizations or types of organizations with required scope and scale of work, (2) assessing the performance of these entities identifying strengths and weaknesses, and (3) defining the optimal organization profile for leading efforts towards enhanced RE deployment in developing countries.

3. Results and discussion

3.1. Knowledge mapping

Based on its source and application, RE knowledge can be classified under three levels: global, regional and country. Accordingly, the main entities in RE include a wide range of governmental organizations, networks and partnerships, financial and research institutions, regional organizations and initiatives, and private sector representatives. While these classifications are used to facilitate the approach and discussion of RE knowledge mapping, the three levels are intertwined and practically inseparable. Global knowledge is transferred regionally and locally through awareness raising, information sharing and exchange, capacity building efforts as well as technology transfer to be acquired, understood, adapted and used at the local level where it becomes localized. In parallel, local knowledge becomes globalized when it is published or made accessible through information technology. The contribution of the main RE entities in producing, building, sharing and exchanging knowledge related to RE at the various levels is summarized in Table 2.

Mapping of RE knowledge generation and exchange among regional and international key players reveals that nearly half of identified organizations are significant contributors to RE knowledge (Fig. 1), although by far, knowledge exchange efforts are concentrated on information sharing and awareness raising. While most information sharing is related to available technologies and examples of best practices and to a lesser extent on policies and incentives, there are specialized networks whose main mandate is to collect, analyze, update and disseminate RE related information, knowledge and practices (i.e. REEP; REN21; UN Energy; IRENA). The majority (90%) of these organizations allow public access to their information consisting mainly of reports, newsletters, policy briefs, guides, and manuals etc. While the sharing of such tools, contribute indirectly to capacity building (CB), key actors exert also direct efforts towards CB in the form of workshops, training, and education (i.e. Global Renewable Energy Education and Training Program). Concurrently, focused training, technical assistance, dissemination of best practices and lessons' learnt, as well as the funding of sustainable energy pilot and demonstration projects constitute the main forms of promoting technology transfer and enhancing local competence in and uptake of RE technologies. Financial institutions fund projects through multiple financing instruments particularly available to

Table 1
Indicators used for knowledge mapping and gap analysis.

Indicator		Refers to
A	Information sharing and awareness raising:	Collection, analysis and dissemination of RE related information and knowledge and awareness raising on benefits and potential of RE
A1	- Policies	
A2	- Technologies	
A3	- Best operational practices	
B	Policy advice and assistance	Policy advice, policy assessment and review; policy assistance; international exchange on RE policy
C	Technology transfer	Transfer of technology through demonstration projects, funding, pilot projects, grants
D	Capacity building	Training, workshops, educative material, expert support, exchange visits
E	Financing mechanisms	Financial support for RE investment, deployment, and use
F	Research and Development	Joint research and cooperation
G	Technical standards, certifications	National and international codes
H	Global agreements (Kyoto, etc.)	Involvement in RE related agreements
I	Regions of action	Africa, Af; Asia, A; Asia-Pacific, AP; Balkans, B; Latin America, LA; Caribbean, C; Pacific, P; Europe, E; Island states, SIS; Economies in transition, T; Member states, M; Middle East North Africa, MENA