

IEEE Working Group on Sustainable Energy Systems for Developing Communities

Its Role and Approach: A Position Paper

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Introduction

IEEE Sustainable Energy Systems Working Group (SESDC) aims to raise awareness to the technical community, governments, policymakers, and other organizations about the challenge to provide universal access to modern energy systems, including electricity and the related issues in developing communities around the world.

Respecting social norms, traditions, and cultures, the Working Group collaborates with stakeholders to provide practical recommendations to facilitate environmentally-safe, measurable, and cost-effective sustainable energy system technologies and solutions to enhance economic and social viability, standard of living, and quality of life of people living in developing communities.

The purpose of this position paper is to describe the vision for SESDC and to mark its activities and approach.

Context

Currently, over two billion people in developing countries lack modern fuels for cooking and heating, and about 1.2 billion people do not have access to electricity. Another one billion have only access to unreliable and low-quality power services. Most of these energy poor live in rural and remote areas.

In 2000 the Millennium Development Goals (MDGs) [2] were adopted by the international community: a set of goals for fighting poverty, hunger, diseases, gender inequality and local environmental concerns. The availability of appropriate and affordable energy services, including electricity, is a major requisite to reach the MDGs, to improve the living conditions, and to support socio-economic development of rural and remote communities.

The sustainability of the delivery of electricity services to these areas is determined by a variety of parameters. Related issues are the needs and affordability of the customer base, the long-term availability of local energy resources, the local environment, availability of human resources, the technical choices, the financial, social/cultural and institutional conditions, and many others. Their impact on sustainability can be different for grid-based and off-grid power supply.

A few years ago, the United Nation's Sustainable Energy for All Initiative (SE4ALL) set the year 2030 as a target date for universal access to modern and sustainable energy services, including electricity [1]. However, with a "business-as-usual" approach as many as 1.4 billion people will still lack access to electricity in 2030. This is why the UN called for the acceleration of the world-wide transfer of best practices. The IEA predicts a requirement of nearly USD \$1 trillion to realize universal electricity access by 2030 [3]. Universal access would be achieved through expansion of main grid supply to power all urban centres and 40% of the rural areas, while the remainder is split between mini-grids (75%) and stand-alone off-grid installations (25%)[5].

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There is a substantial repository of electrification experiences since the 1920s, yet recent progress for today’s developing community remains painfully slow. Many electrification initiatives are underway by a variety of actors – government, utilities, local communities, and NGOs. The SE4ALL vision for universal access recognizes that significant engagement by all these actors (see Figure 1) is required on multiple levels and across many stakeholder groups: from policy support and regulations to encouraging working business models and investment environments. Whatever the specific arrangements, as a system, it is clear that all the various institutions supporting the vision must, individually, succeed in their efforts or risk derailing the ultimate goal of universal access.

	Host Countries	Donors	Private Sector	Civil Society
National Policies	Best practice: Implementation	Technical support Professional Exchange	Professional Exchange	Transparency Accountability
Grid Based Business Models	Best practice Regulation	Technical support, Feasibility studies, Training	Investment, Technology, Good & Services	Environmental impact monitoring
Unconventional Business Models				
Global Capital Markets	Regulation	Finance, Guarantees, Insurance	Capital	Non-bank services, Capital
National Banks and Financial Institutions				
Intermediaries, Users & Consumers	Standards Regulation	Standards Training	Services Training	Services, Distribution, Quality
Institutional Capacity and Finance	Capacity development and incentives	Technical support	Capital support and technology development	Advocacy, monitoring and local market development

Figure 1- UN SE4ALL Framework - Roles for achieving universal access [6]

There is a need to provide a platform for synthesis of learning and dissemination of results to stakeholders to guarantee realization of electrification goals. SESDC views each actor, with added emphasis on the communities themselves, as both inputs to our Working Group direction, and as a potential user of its outputs. Attention will be placed on avoiding related or potentially duplicative work from like organizations.

SESDC Rationale

The motivation of SESDC is well aligned with the goals of SE4ALL and other likeminded initiatives to achieve universal access to sustainable energy sources for the world’s unserved communities. The Working Group is a multidisciplinary and global network of IEEE members with relevant expertise, diverse backgrounds, and experiences to provide input to national and multinational decision makers, practitioners, researchers, and communities. The WG forum and resources of members allows for the following general contributions:

Stimulate a Community of Experts. The Working Group seeks to be relevant to pressing needs for developing communities, inclusive of differing perspectives and experiences, and cognizant of the legacy of research already completed and new critical topical areas. Organization of activities will reflect this desire utilizing the full IEEE PES forum: setup of task forces to look into knowledge gaps or priority research areas, proposing IEEE Panel Sessions, and identification of publication opportunities.

Raise Awareness. SESDC will seek to raise the awareness of the engineering community on key issues, learning, and best practices for sustainable energy development, with a focus on sharing experiences, causes, and solutions.

Provide Recommendations. Where appropriate, recommendations and position papers will be generated by the Working Group to stakeholder groups, for example to users, communities, practitioners, entrepreneurs and decision makers.

Organize of Research Initiatives. When key research needs are identified and within the remit of the Working Group, collaborative research initiatives, funding support, methodology guidance, and organization of Working Group resources will be encouraged. This will be carried out by actively networking with sustainable energy initiatives, identifying member expertise areas, and coordinating opportunities with working group members.

Disseminate useful knowledge. It is recognized that establishing effective channels for the dissemination of knowledge is an equally important factor to achieve impact as conducting and synthesizing research. To complement the typical dissemination modes, special emphasis will be placed on the preparation of publications suitable for all potential users.

Working Group activities, inputs, and desired outputs are shown graphically (see Figure 2).

INPUTS		ACTIVITIES	OUTPUTS
	Examples		
International Initiatives	SE4ALL	Task Forces	Publications
		Addresses key issues identified by WG members or other inputs	
Rural Electrification Initiatives	ARE	IEEE Panel Sessions	Reports
	National Elec. Programs		
		Organized to provide a forum for research, learning, recommendations provided by WG	
Humanitarian Initiatives	NGOs	Collaborative Research Initiatives	Research Results
	IEEE Humanitarian Groups		
Academic-led Initiatives	Student/Research Projects	Utilizes unique expertise and global footprint of WG members	
Grassroots Initiatives	Local Entrepreneurs	Networking	Recommendations
	Community Based Orgs	Identifies key needs of stakeholders: policy makers, practitioners, and communities	
Development Sector/Best Practice	World Bank	Education/Training	Education Provided
	UNDP	Identifies education/training needs and coordinate training activities or development of educational resources	
	Practical Action		
Other Technical Groups	IEEE Technical WGs	Outreach	User-oriented materials
	CIGRE	Informs and communicates WG results. Establishes new relationships with affiliated groups	

Figure 2- Principle SESDC Reference of Activities

Aim of Working Group

The aim of the Working Group is to address the various dimensions of and concerns regarding the provision of energy services for rural and remote areas, synthesize knowledge and experiences, and to provide recommendations for decision makers and user-groups.

The Working Group will draw inspiration and guidance on priorities from the key issues defined by thought leaders in the field such as UN Sustainable Energy for All, World Bank / GEF, ESMAP, the Alliance for Rural Electrification and CIGRÉ. Humanitarian-led groups such as NGOs, Academic led projects, as well as grass

roots initiatives provide important perspectives for research needs but also serve as audiences that can benefit from Working Group outputs. Finally, intra-IEEE collaborations with other technical working groups will be encouraged in order to utilize various areas of expertise to develop innovative energy system solutions for rural and remote communities.

The scope of activities of SESDC allow for a flexible organization of its resources (namely members) to meet critical research needs. Areas of interest that are identified will form the basis for establishing Task Forces to investigate further. SESDC has a goal of proposing panel sessions biennially at the IEEE Power and Energy Society General Meeting to disseminate outputs and provide a forum for Member contributions. By leveraging member expertise and their global footprint, the Working Group will identify collaborative research initiatives between its members and with external connections.

Group representation and networking activities are pursued at many levels, for example through liaising and knowledge exchange with thought leaders and forging connections to initiatives (both new and established). One goal of the WG is to link interested and qualified members together and nurture a network of related research and learning.

One of the major problems encountered with small power systems in rural and remote areas is the long-term sustainability of the services. Therefore the focal point of the activities of the working group will be on sustainability dimensions of both grid-connected and off-grid systems. Against the background of currently available renewable energy technologies, opportunities for providing services based on such technologies will also receive particular attention. The working group will identify and assess relevant developments and trends, and look ahead for opportunities for electricity supply to rural and remote areas in the developing world.

While “sustainability” and “appropriate technology for developing communities” are common themes of research for the Working Group, any related and relevant research topic can be proposed. SESDC Working Group leadership has proposed an initial list of interests shown below.

Initial Areas of Interest

1. Off-grid energy project sustainability indicators
2. Impact of institutional arrangements on the electrification of rural and remote areas in the developing world
3. Upscaling energy interventions in developing countries
4. Framework for the application of smart grid technologies for rural electrical systems in developing countries
5. Educational needs for NGO-led energy interventions
6. Electricity and non-electric solutions: evaluation of appropriateness for the need; gender issues; electricity for productive uses.
7. High tech prototyping in developing communities
8. Sustainability of end-of-grid applications
9. Successful business models for rural and peri-urban electricity service
10. Rural energy services leap-frogging opportunities and challenges
11. Technical Capacity building for sustainable rural electrification
12. Entrepreneurship training for sustainable electrification
13. Community based business models in rural electrification
14. Templates for integrated rural development
15. Safe end of life disposal and management of batteries
16. Engagement of local communities in rural electrification
17. Sustainable total energy solutions for rural communities
18. PV based electricity supply for electrification of remote rural communities
19. Assessing the viability of mini/micro-grids in developing countries
20. Geo-spatial electricity distribution planning in developing countries

Organization of Task Forces

Task Forces are the primary means for investigation, analysis, and production of outputs.

A proposal for the formation of a Task Force on the impact of various institutional arrangements on the electrification of rural and remote areas in the developing world is shown below.

Task Force: “Impact of institutional arrangements on the electrification of rural and remote areas in the developing world”

Outline of Proposal

The following tasks will be undertaken:

- **Task 1** – Identification and description of the various dimensions of sustainability of electricity services for rural and remote areas in the developing world.
- **Task 2** - Critical review of world-wide Rural Electrification (RE) experiences, with particular reference to the impact of power sector reform and resulting institutional arrangements on the sustainability of electricity service in developing countries. This task will identify sample countries that will form the base cases for detailed study. The regions of focus are Africa, Latin America, the Caribbean, and Asia.

Methodology

The method of gathering data will be through literature search and stakeholder surveys in selected countries. This will require development of a suitable questionnaire for information collection. Where feasible, interviews with policy makers and other stakeholders will be encouraged.

- **Task 3** - Comparative analysis of country reports from Task 1.

This task is primarily a desk study of reports. It may involve further literature review and additional conversations with stakeholders. The task will aim to formulate a coherent and consistent framework for assessing the impact of power sector institutional arrangements on the sustainable delivery of electricity services in rural and remote areas.

- **Task 4** – Development of options and approaches to maximise long-term sustainability of electrification. The development of these options and approaches will involve a process of brainstorming and analysis of outputs of Task 2.

Outputs and deliverables

The main deliverables of this working group will be:

- A. Report with options and approaches to maximize long-term sustainability of power supply to rural and remote areas.
- B. Organization of IEEE panel sessions on the topic
- C. Preparation of relevant papers/articles
- D. Publication of Research Results
- E. Provision of education / training and other user-oriented materials

Collaboration

The Working Group will initiate and maintain linkages with stakeholders and other organisations involved in the electrification of rural and remote areas. These organizations include the World Bank, ESMAP, UN organizations, Alliance for Rural Electrification (ARE), NGOs and others. The collaboration with CIGRÉ’s Advisory Group on Electricity Supply to rural and Remote Areas will continue.

References

- [1] Sustainable Energy For All. [online] Available at: <http://www.sustainableenergyforall.org>
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- [3] International Energy Agency. *World energy outlook 2012*. [Online] Available at: <http://www.worldenergyoutlook.org/>

- [4] World Bank. *Independent Evaluation Group, ed. The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits: an IEG Impact Evaluation*. World Bank Publications, 2008.
- [5] Zomers, A, "Remote Access: Context, Challenges, and Obstacles in Rural Electrification," *Power and Energy Magazine, IEEE* , vol.12, no.4, pp.26,34, July-Aug. 2014
- [6] Sustainable Energy For All. *Technical Report of Task Force 1 in Support of the Objective to Achieve Universal Access to Modern Energy Services by 2013*. April 2012.