MONITORING AND EVALUATION OF PV PROGRAMS IN RURAL AREAS IN THE ASIA-PACIFIC REGION

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ABSTRACT

An estimated 1 billion people living in rural areas in the Asia-Pacific region do not have access to modern energy and the basic services it provides. Photovoltaic (PV) programs have been implemented in many countries in the region to address this need. International experience has shown that the continued operation of PV systems in rural areas largely depends upon institutional factors such as program design, maintenance and training. Therefore, monitoring and evaluation of PV programs along institutional and technical dimensions are essential for improving the performance of existing PV systems and future programs. This paper will discuss the monitoring and evaluation methods used for PV programs, with a special focus on comparative work in the Asia-Pacific.

INTRODUCTION

Of the 2 billion people worldwide who do not have access to modern energy services, such as electricity, over half live in the Asia Pacific region and most live in rural areas. Energy is an essential for achieving the Millennium Development Goals (UN-Energy, 2005). At the same time, countries in the Asia- Pacific region are experiencing rapid increase in energy demand due to population and economic growth (p 6-12, ESDD, 2005). Most of the demand for electricity is being met by fossil fuels which contribute to global warming, local air pollution and pose energy security issues for developing countries (ESDD, 2005). Photovoltaic (PV) systems hold the promise of providing electricity for development in rural areas at the lowest financial and environmental cost (for example, Byrne et al., 1998). For these reasons, PV systems have been installed by governments and donors in rural areas in the Asia-Pacific region from 1960's onwards (Bhattacharya and Kumar, 1997). As of 2004, an estimated 3.4 million households worldwide have PV systems installed in their homes, this is equivalent to a mere 2% of households without access to the electricity grid. Only two thirds of the PV systems installed are working well (Nieuwenhout et al., 2004). Clearly, PV systems have not made a large-scale impact on rural communities in developing countries – including those in the Asia-Pacific region. As Herbert Wade asks in the title of his paper, "Photovoltaics for rural electrification – what happened to the promises?" (Wade, 1997). Why has PV not been widely adopted? And why do a sizable proportion of those installed not function properly? These questions must be answered if PV systems are to make a substantial contribution to sustainable development in the Asia-Pacific and around the world.

The earliest implementations of PV systems in the 1970's and 1980's in rural areas of developing countries "focussed on technical demonstrations or on projects that were narrowly self-sustaining but could not be replicated. Many projects were considered failures because of poor technical performance, and poor suitability to user needs and local conditions" (p 313, Martinot et al., 2002). It has since been acknowledged that institutional factors are crucial to the success of PV projects (GNESD, 2007, Nieuwenhout et al., 2004, IEA-PVPS, 2003). These factors include financing to address the high upfront cost of the systems, awareness raising and capacity building at all levels, viable maintenance and repair arrangements, quality assurance mechanisms and integration with other polices. Many aid-funded PV project now take a market-oriented approach to systematically address these 'barriers' to sustainable PV markets in developing countries.

Focusing on development needs and outcomes rather than exclusively on hardware has also proven to be important for the success of PV projects. The productive uses of PV systems can be in the areas of agriculture, water pumping, telecommunications and microenterprises (GEF-FAO, 2002). As previously mentioned, all of the Millennium Development goals depend upon access to modern forms of energy (DFID, 2002). However, the implementation of PV projects in rural areas does not automatically lead to increased production or development. Access to electricity must be combined with other ingredients (such as education, transportation and machinery) for development to occur. In addition, gender sensitive and participatory approaches have been used for PV project design to help facilitate development. Despite these efforts, the causal chain between PV projects and development outcomes remains unclear, partly due to the complex and long-term nature of development (Adams et al., 2006).

Monitoring and evaluation of PV projects form an important learning cycle so that we can continue to improve the technical performance of PV systems, as well as the development outcomes of these projects. The terms 'monitoring and evaluation' are often used to mean tracking of project objectives during implementation and periodic assessments of the project by project implementers, donors and governments. Wider evaluations which compare between different PV projects in different countries are especially important in order to find out what the common factors for project success are and which type of project might be most successful in different contexts. This paper will first review the monitoring and evaluation methods being used for PV projects worldwide. Then, the monitoring and evaluation methods used to compare projects specifically in the Asia-Pacific region will be examined. The last section will include a discussion and suggest further work in this area.

MONITORING AND EVALUATION METHODS WORLDWIDE

Although monitoring and evaluation is a well established practice in governments and aid agencies, Wendy Annecke notes that the energy for development sector is still establishing monitoring and evaluation processes. She notes that "the number of rigorous impact and evaluation studies, and in particular those open to peer review and scrutiny, constitutes only a fraction of the nominally implemented energy projects" in

developing countries (Annecke, 2008). The lack of quality project evaluations is an impediment to improving and scaling up the use of PV systems in rural communities. This section will discuss recent attempts to standardise and improve monitoring and evaluation processes for PV and other renewable energy rural electrification projects.

PV projects in developing countries are diverse -with differing goals, project designs, hardware specifications and contexts. Monitoring and evaluation methods for individual projects are as diverse as the projects themselves, with different stakeholders having different monitoring and evaluation objectives and, ways of measuring project success. This diversity presents difficulties when we wish to compare between PV projects from existing data. Elizabeth Ilskog (Ilskog, 2008) suggests that one way of comparing "apples and pears" is to use a standardised set of 39 sustainability indicators across technical, economic, social/ethical, environmental and institutional dimensions to assess the effects of rural electrification on development. However, these standard indicators will need to be supplemented by case-specific indicators (Ilskog, 2008) to account for the different contexts in which each project is being implemented and the reporting needs of each organisation.

Recent exchanges between various agencies that are part of the Monitoring and Evaluation for Energy Projects have led to the publication of two step-by-step guides on the subject. The *Guide to Monitoring and Evaluation for Energy Projects* (Adams et al., 2006) uses a logic model which sets out the inputs, activities, output, outcomes and impacts of a project. The guide also provides a detailed discussion and suggest indicators for different types of projects – from rural electrification to institutional support. The *Monitoring and Evaluation of the Impact of Renewable Energy Programmes* (Rai, 2005) provides various methods for engaging the community in monitoring and evaluation of projects with respect to the Millennium Development Goals. These guides could be used to evaluate the success of individual PV projects, but further work is needed in order to make comparisons between projects.

MONITORING AND EVALUATION METHODS IN THE ASIA-PACIFIC

This section will examine the monitoring and evaluation methods that have recently been used to compare PV systems in the Asia-Pacific region.

Technical

The Renewable Energy Technologies in Asia Regional Research and Dissemination Programme at the Asian Institute of Technology (AIT) has monitored and evaluated 180 demonstration PV systems (totalling 10.7 kW) of different types in five countries in Asia. Data was collected on the technical performance, maintenance procedures, usage, payment, user satisfaction and dissemination impact. The focus of the AIT's monitoring and evaluation of PV systems has been on technical modes of systems failure linked with component quality and usage issues (Kumar et al., 2005). Under the same project, AIT has developed several 'packages' of renewable energy technology which are suitable for use in Asia, with an emphasis on quality hardware components.

Project Sustainability

The sustainability of PV projects in the Asia-Pacific region has been the subject of several evaluations. In a review of PV lighting systems in Tonga, Tevita Tukunga highlights issues of environmental, economic, technological and institutional sustainability (Tukunga et al., 2002). A comparative case study of PV projects in Bangladesh and Fiji categorised these issues into economic; legal and regulatory; and financial and institutional (Urmee et al.). Drawing on case studies in Indonesia, Maria Retnanestri proposes the Implementation, Accessibility, Availability, Acceptability (I3A) framework for evaluating the sustainability and equity of PV projects (Retnanestri, 2007). Retnanestri uses the I3A framework to compare three different PV projects in Indonesia. This framework could also be used to examine projects in other countries. The emphasis of all the afore mentioned studies is on non-hardware related factors.

Impact on Development

The World Bank has implemented 65 projects involving renewable energy worldwide, with 8 involving PV systems in the Asia-Pacific region (World Bank, 2006). Although the World Bank has published emerging lessons learnt from its projects and integrated them into its design of new projects (see Martinot, 2001, Martinot et al., 2001, World Bank, 2006), the Bank's own review of its renewable energy investments revealed that the monitoring and evaluation on these projects were inadequate (World Bank, 2006). In fact, this lack of data meant that the review could not evaluate the impact of the World Bank's renewable energy projects on poverty alleviation and the environment. Recently, the Energy Sector Management Assistance Program (ESMAP) and the Asia Alternative Energy Program (ASTAE) within the World Bank have developed methods for assessing the socioeconomic impact of PV projects. Newer World Bank PV projects have included more substantial monitoring and evaluation components. Of special interest are the monitoring and evaluation methods developed as a part of the Energy, Poverty, and Gender project (run jointly by ESMAP and ASTAE) which were trailed under the World Bank's Cambodia Rural Electrification Project (Ramani and Heijndermans, 2003). The Energy, Poverty and Gender project evaluated the impact of rural electrification on poverty alleviation in several Asian countries and emphasised gender dimensions of poverty and participatory approaches to conducting research.

DISCUSSION & FURTHER WORK

Monitoring and evaluation methods for PV projects in the Asia-Pacific region are in line with worldwide trends. The evaluations of PV project sustainability presented in this paper mirror the acknowledgement in the wider literature that non-technical factors are important for PV project success. At the same time, the quality of hardware components remains an important issue in the Asia-Pacific region. Unfortunately, the most marked trend in the Asia-Pacific and worldwide is that there are few PV projects which have publically accessible monitoring and evaluation processes in place and there are even fewer comparative studies. This lack of information is especially severe for the impact of PV projects on development outcomes. Steps are already being taken to improve the monitoring and evaluation, but these studies need to be made publically available with an appropriate means of comparison so that lessons learnt can help to improve PV projects everywhere.

While more monitoring and evaluation is needed for PV projects, making use of the lessons learnt is also important. The World Bank has already integrated some of the lessons that it has learnt into its newer projects in the Asia-Pacific, which seem to be more successful than projects that it has already completed. There are also indications that PV projects in China are benefiting from monitoring and evaluation work – with an extensive review of the Township Electrification Program forming an important input into the design of the Village Electrification Program. A study of the *relationships* and the *history* of interactions in the institutional structure that supports or hinders PV use in rural areas would be useful for understanding how these institutions could best be approached to absorb the lessons learnt.

In 2009, I will undertake monitoring and evaluation of PV and micro-hydro systems in a remote area in Nepal and assist a local non-government organisation in improving its renewable energy projects.

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BRIEF BIOGRAPHY OF PRESENTER

Long Seng To commenced her PhD research in 2007, she is doing an inter-disciplinary PhD on PV in rural areas of Asia under the supervision of Dr Muriel Watt (School of Photovoltaic & Renewable Energy Engineering) and Dr Stephen Healy (School of History and Philosophy). The aim of the research project is identify the institutional factors that enable the successful implementation of PV systems in remote communities, using China, Nepal and Indonesia as case studies. Long Seng has previously conducted research on PV in remote Indigenous communities in Australia and has worked as a consultant on sustainable energy policy.