M&V for energy-efficiency projects

Anneline du Preez

South Africa's energy crisis has brought about several research initiatives in the quest for an effective long-term solution to the problem. At the University of Pretoria, the South African National Energy Development Institute (SANEDI) National Hub for Energy Efficiency and Demand-side Management (EEDSM) focuses on producing high-quality master's and doctoral graduates to meet the needs of an expanding and sustainable energy industry.

The SANEDI Energy Hub was established in 2008, and is a joint initiative between the University, and the national Department of Science and Technology and the former Department of Minerals and Energy. Prof Xiaohua Xia, an A-rated researcher in the Department of Electrical, Electronic and Computer Engineering at the University of Pretoria, is the Director of the Hub.

In recent years, Prof Xia's research group has made continuous contributions to the National EEDSM programme by conducting research activities on measurement and verification (M&V), energy system modelling, and management and optimisation. M&V is the process of using measurement to reliably determine actual savings created within an individual facility by an energy management programme. As the M&V activities offer continuous and informative feedback from EEDSM projects, the energy regulation utility is able to manage energy budgets and enhance the financing for energy efficiency projects.

An article entitled "Mathematical description for the measurement and verification of energy efficiency improvement", developed by Prof Xia and his colleague, Prof Jiangfeng Zhang, has recently been published in an international peer-reviewed energy journal. This was the world's first paper to present a mathematical description of the energy efficiency M&V problem and bring the basic M&V concepts, propositions, techniques and methodology into a scientific framework. In this paper, the mathematical definitions for baseline and baseline adjustment are given. In addition, the M&V plan development is formulated as an M&V modelling problem.

This approach provides a fruitful source of research problems by which an optimal M&V plan under various practical constraints can be determined.

As a case study of developing an optimal M&V plan, another article, entitled "Optimal sampling plan for clean development mechanism energy efficiency lighting projects", has also been published by Prof Xia, Prof Zhang and a PhD candidate, Mr Xianming Ye. This work proposes metering cost minimisation models for handling the M&V uncertainties with minimal metering costs under the case study of energy-efficient lighting projects.

By using the proposed optimisation model, the overall accuracy of the project can be maintained by sacrificing the confidence/precision criteria of the groups with high uncertainty, while improving the accuracy in the groups with low uncertainty. The metering costs are then minimised by optimising the sample size of each group. The proposed model largely reduces the metering costs of the sampling, while still maintaining the accuracy requirements of the project.

The research on this topic ultimately culminated in the publication of a book, *Energy efficiency measurement & verification practices*. This M&V case study book summarises the success stories and also lessons learnt in M&V best practice in South Africa during the past 10 years. The book is a collection of papers on various energy efficiency M&V projects. It was written by the most experienced M&V professionals in South African and was edited by Prof Xia and Prof Zhang.