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ScienceDirect

Energy Procedia 121 (2017) 158–165

Energy Procedia

www.elsevier.com/locate/procedia

International Conference on Improving Residential Energy Efficiency, IREE 2017

Dealing with energy efficiency data

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Abstract

The collection of detailed data for undertaking research into the area of residential energy efficiency has become common and yet many pitfalls and issues can arise during the collection process that can either result in loss of data, incorrect data or no data at all. The LIEEP program saw many projects collecting data in the field or from third parties that was crucial in the evaluation of the effectiveness of their project. However, many suffered from data issues that then lead to difficulties at the analysis stage of their project.

This paper explores various issues around data collection, particularly focusing on data that is used for assessing the energy efficiency performance of residential dwellings. It will draw upon the experiences from one LIEEP project that collected a large amount of data including electricity and gas consumption data, temperature data, energy utility data and survey data. Determining what to collect, how to collect, maintenance and monitoring of equipment and the final storage and analysis of data will be discussed.

Finally, the paper will look at how the data collected can be used. This includes linking the various data sets, visualising the data and providing analysis of the data back to clients and volunteer households themselves.

Collection of data is critical to many research projects, but issues with data are almost inevitable. Trying to minimise these issues through careful planning and collection of data should also be a critical part of the research agenda.

Peer-review under responsibility of the scientific committee of the International Conference on Improving Residential Energy Efficiency.

Keywords: energy efficiency; energy data; data collection; data visualisation

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1876-6102
Peer-review under responsibility of the scientific committee of the International Conference on Improving Residential Energy Efficiency.
10.1016/j.egypro.2017.08.013

1. Introduction

The collection of detailed data for undertaking research into the area of residential energy efficiency has become common and yet many pitfalls and issues can arise during the collection process that can either result in loss of data, incorrect data or no data at all. Traditionally, estimating the energy consumption of residential households relied on macro level analysis of energy utility data [1] or on billing data at the individual house level [2] [3]. Both have their strengths and weaknesses. Macro level utility data is excellent at providing an overview of "typical" residential energy use [4] and will reveal daily and seasonal use patterns, but it cannot easily tell how usage patterns vary amongst different household types. Billing data from an individual household is good at showing energy use for different household types, but the coarseness of the data usually means that daily use patterns cannot be determined and only seasonal variation is possible to determine. Some studies have relied on data from self-reporting surveys, but comparison of self reporting data to actual consumption data has revealed errors of almost 30% [5].
Collection of detailed energy consumption data for individual households has been undertaken for many years, but has usually involved the installing of expensive monitoring and data logging equipment [6] [7] [8]. Consequently, most studies have been restricted in the number of houses that can be monitored and thus the data collected is often not broad enough to allow a statistically valid conclusion to be made about general residential energy consumption. More recently with the adoption of smart meters and the reduction in cost of energy monitoring equipment it has been possible to undertake studies with more extensive datasets and greater number of houses being included. Although this is good news for researchers, it does bring with it a range of challenges and pitfalls that can result in the data gathered being of limited use. As with all research projects, it is important to develop a robust and defendable methodology for the collection of household data.
A recent series of research projects undertaken in Australia focused on energy efficiency in low income households. The Low Income Energy Efficiency Program (LIEEP) had 20 funded projects awarded to a range of groups made up of government, business and community organisations with the aim of trailing approaches to improve energy efficiency of low income households and enable them to better manage their energy use. A key objective of the program was to "*capture and analyse data and information to inform future energy efficiency policy and program approaches*" [9]. Consequently, for all projects data gathering and analysis was a core component of their research methodology. Many of the project teams had experienced researchers as participants, but some project teams had never undertaken such a data gathering exercise and consequently, some teams struggled to collect the data required which in turn hampered their analysis process. This paper explores the various issues with collecting and analysing household data and examines some of the experiences from one LIEEP project.
The Energy Saver Study (ESS) was one of the twenty successful LIEEP projects and recruited 320 households in the south eastern area of Melbourne [10]. Households were randomly, but evenly assigned to one of four groups. Group A received house improvements/retrofits, Group B received energy action information and support, Group C received both the improvements and the energy action information, while Group D acted as a control group and did not receive anything until after the study was completed. This project was one of the larger LIEEP projects and included building assessment and rating, household surveys and interviews and energy and temperature monitoring. The large amounts of data collected along with the different techniques that were employed means the project serves as a good case study into the difficulties of data gathering.

2. Types of data

To undertake a residential energy efficiency study will usually involve a range of data being collected and a range a data collection techniques being employed. For the LIEEP projects much of the data that was to be collected was outlined in the program guidelines. This included the following:

- Household physical characteristics such as size, building type and material, roof type and material and star rating (if applicable)
- Information relating to hot water systems and space heating and cooling
- Lighting and appliances used within the household and property