Bridging the Energy Performance Gap: Improving building energy efficiency and comfort performance through innovative technologies supporting Energy Performance Contracting (EPC)

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Abstract

In an era of environmental awareness and concerted action toward sustainable energy management, energy efficiency is a key challenge. In conjunction with carbon reduction and renewable policies, the European Union’s Energy Efficiency aims to reduce greenhouse gas emissions to 80–95% below levels by 2050. Taking that into account, several energy efficiency measures in buildings are required during Building life-cycle concept. However, once the building operates, it shows the existence of mismatch between the predicted and the real energy consumption, which is known as “Energy Performance Gap”. This gap is a serious stumbling block towards realizing EU targets.

To bridge these performance gaps, this proposed research will review the state of the art and will develop robust model based integrated innovative decision support system to improve: 1) the business model of energy performance contracting (EPC) .2 energy efficiency measures; 3) comfort performance for the occupants (according to the ASHRAE 55 standard) and;

EPC is a form of ‘creative financing’ for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement an external organisation (ESCO) implements a project to deliver energy efficiency, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment.

EPC has shown to be successful towards a low-carbon economy, realizing significant energy savings in the existing building stock. It can be a powerful approach in reducing the performance gap. In addition to this a novel application of Building and Energy systems to support EPC and thermal comfort of the occupants.

Case studies using Irish dwelling types (University, Manufacturing, Houses) will serve as a real-life test-bed for the proposed methodology. Furthermore, it will enable the development and implementation of innovative business models for EPC.

1. Introduction

The discrepancy between predicted design intents and actual energy performance during the operation of buildings, the so-called ‘performance gap’, has been widely addressed and discussed in the literature [1-4]. Key findings from the studied literature [5-6] shows the potential causes of energy performance gap are due to the poor assumption, inaccuracy of the design model in the design stage and the building occupant’s behavior and their misconduct once the building is in operation. Building Energy Simulation Programs (BESP) such as TRNSYS, Energy Plus, and Design Builder, are utilized for such predictions [8-11]. Direct usage of BESP for evaluating the energy performance indices for building energy systems under study is complex and can sometimes; lead to an over or under estimation of building energy consumption. To investigate developed control strategies to building energy systems, a sufficiently accurate energy model with reduced order is necessary [7].

2. Methodology

In this proposed research, we will develop reduced order (RO) models for simulation using
International Energy Agency Annexe 60 project activities and furthermore use these models for the business model of EPC. EPC has shown to be successful towards the development of a low-carbon economy, realizing significant energy savings in the existing building stock of most European countries [12]. EPC can be a powerful approach in reducing the performance gap, but the gap is also attributed as a significant barrier for large scale implementation of EPC. This study will also investigate the consequences that the gap in energy performance has or conducting energy performance contracts. The research novelty lies in EPC business model and its effect on occupant’s thermal comfort.

Figure 1: Approach to develop RO models for the research

3. References