Badr Altrahuni et al., Expert Opin Environ Biol 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2325-9655.C1.012

Predicting residential energy savings using known energy characteristics and historical energy consumption

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Upgrading and replacing inefficient energy-consuming equipment in both the residential and commercial building sectors offers a great investment opportunity, with significant impacts on economic, climate, and employment. Cost effective retrofits could yield savings of approximately 30 percent of the annual electricity spent in the United States. Energy-saving investments will lead to reduce greenhouse gas emissions in the US Energy. Further, investment in energy efficiency can create millions direct and indirect jobs throughout the economy for manufacturers and service providers that supply the building industry. Unfortunately, the prediction in savings, which has been generally based upon energy models, has been circumspect, with energy savings typically over-predicted. Investor confidence as a result can degrade. The objective of this study is to use an expanded set of building characteristic data to predict savings from the adoption of individual measures based upon actual building data but not on energy models. Key to this study will be the use of a large number of buildings/residences for which all energy characteristics are known and for which there is reasonable variation in input parameters. The specific case considered addresses of hundreds of student residences owned by the University of Dayton. The housing stock includes houses generally constructed in the early 1900s. Energy saving upgrades has been adopted on many of these houses, but not in a coherent way; thus, this housing set offers a diverse set of energy characteristics. In this study, these energy characteristics have been documented for each house. Historical energy consumption (gas and electric) data for each residence has also been collected. A machine-learning approach is used to correlate energy consumption to the energy characteristics and to account for residential variation. The resulting neural net is used to predict savings associated with a small subset of houses in the study which have already been upgraded from a variety of measures. The estimated savings are compared to the actual savings realized. The results show that the predicted savings match the actual savings within 2.5 percent of the actual savings for most of the measures considered. These results show the potential for establishing larger public databases of building energy characteristics in order to strategically implement energy reduction strategies for greatest energy savings per cost to implement.

Biography

Badr Altrahuni is a PhD student at the University of Dayton (Mechanical and Aerospace Engineering/Renewable and Clean Energy) with his dissertation titled, “Measuring the effectiveness of a home energy reduction program for national deployment”. The objective of this research is to use an expanded set of building characteristic data to predict savings from the adoption of individual measures-based upon actual building data-not on energy models. He also has a Master’s degree in Mechanical Design from University of Tripoli, Tripoli-Libya. He has worked as an Assistant Lecturer at the University of Zawia, Libya.

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