Accepted Manuscript

Assessment of primary energy consumption, carbon dioxide emissions, and peak electric load for a residential fuel cell using empirical natural gas and electricity use profiles

Kazunori Nagasawa, Joshua D. Rhodes, Michael E. Webber

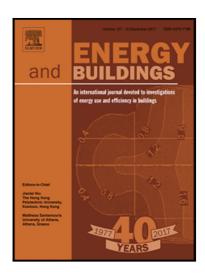
PII: S0378-7788(18)31013-2

DOI: https://doi.org/10.1016/j.enbuild.2018.07.057

Reference: ENB 8728

To appear in: Energy & Buildings

Received date: 29 March 2018 Revised date: 14 June 2018 Accepted date: 25 July 2018



Please cite this article as: Kazunori Nagasawa, Joshua D. Rhodes, Michael E. Webber, Assessment of primary energy consumption, carbon dioxide emissions, and peak electric load for a residential fuel cell using empirical natural gas and electricity use profiles, *Energy & Buildings* (2018), doi: https://doi.org/10.1016/j.enbuild.2018.07.057

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Assessment of primary energy consumption, carbon dioxide emissions, and peak electric load for a residential fuel cell using empirical natural gas and electricity use profiles

Kazunori Nagasawa^{a,*}, Joshua D. Rhodes^{a,b}, Michael E. Webber^{a,b,**}

Abstract

This analysis uses empirical data for 20 single-family homes from a smart grid demonstration project in Austin, Texas to create intra-day natural gas and electricity use profiles on one-minute intervals based on cooling and heating degree days. Combining these intra-day energy use profiles with emissions factors and a linear programming model, temporal energy use profiles were evaluated to quantify primary energy consumption, CO₂ emissions, and peak electric load for a house with a residential fuel cell used as on-site power generation versus being connected to the electric grid. Results showed that natural gas use primarily peaked in the morning, while electricity use peaked in the afternoon. For fuel cell capacities of 0-3.0 kWe and efficiency of 40%, total CO2 emissions, including the fuel cell for the cooling day, were 1.7-1.9 times higher than the heating day. For a fuel cell capacity of 1.0 kWe and efficiency of 40%, peak electric load decreased during on-peak hours (14:00-20:00) for the cooling and heating days by 60% and 44%, respectively. Effects of fuel cell capacity and efficiency on total primary energy consumption and CO₂ emissions showed that as the fuel cell capacity and efficiency increased, primary energy consumption and CO₂ emissions were reduced from the baseline values that represent conventional homes' patterns. These results show that the use of residential fuel cells can offer environmental benefits from reducing primary energy consumption and CO₂ emissions, and grid reliability benefits by reducing peak electric load.

Keywords: natural gas, electricity, empirical energy use profile, primary energy consumption,

CO₂ emissions, peak electric load, fuel cell, residential building

Email addresses: nagasawa@utexas.edu (Kazunori Nagasawa), webber@mail.utexas.edu (Michael E. Webber)

^aDepartment of Mechanical Engineering, The University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200, Austin, Texas 78712-1591

^b Energy Institute, The University of Texas at Austin, 2304 Whitis Ave Stop C2400 Austin TX 78712-1718

^{*}Corresponding author

^{**}Principal corresponding author

Download English Version:

https://daneshyari.com/en/article/10145841

Download Persian Version:

https://daneshyari.com/article/10145841

<u>Daneshyari.com</u>