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Residential support for energy efficiency by utility organizations in the Southeast US

Christopher A. Craig

Montana State University Billings, Billings, MT 59101 United States

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ABSTRACT

This study examined residential policy support for energy efficiency (EE) subsidies for investor-owned utility organizations in the southeast United States. Residents in this region continue to increase electricity consumption, and utility organizations remain reliant on fossil fuels for generation. States in the region are resistant to federal clean energy policy. Investor-owned utilities in the region have offered residential EE programs, however, with mixed results. The study explored the likelihood that awareness of EE, past participation in EE, perceptions about utility motives for offering EE, socio-economic factors, attitudes, and planned behaviors would influence residential policy support for EE subsidies for utility organizations. Drawing from the theory of planned behavior, the study is the first to the author's knowledge to explore the mediating role that residential attitudes and planned behaviors occupy between the focal intrinsic and socio-demographic variables in the study and residential policy support for EE. The study found that the influence of Democratic affiliation on residential EE policy support was fully mediated through both attitudes and planned behaviors, and that perceptions of utility motives were fully mediated through planned behaviors. A large gap between attitudes and planned behaviors emerged for Democratic affiliates. Partially mediated relationships emerged for awareness in EE programs, past participation in EE programs, gender, and perceptions of utility motives. Gain- and loss-framing of messages was introduced and was significantly related to both residential attitudes and planned behaviors. The use of effective messaging strategies and implications for policy makers, utility organizations, and energy efficiency implementers are discussed.

1. Introduction

Energy producing organizations have emitted the majority of the worlds' carbon dioxide since the 1850's (CO_2; Heede, 2014). Over the past decade electricity consumption has risen across the United States (US) and many states remain reliant on greenhouse gas (GHG) emitting fossil fuels such as CO_2 to meet electricity demand (EIA, 2015a, b). States that rely on fossil fuels for energy generation have contested federal policy to regulate fossil fuels (e.g., Biesecker, 2015; Michigan et al., 2015), making federal-level clean energy policy less viable as a GHG reducing mechanism. In 2016, state and/or utility policy to reduce electricity consumption had been introduced in every state (Berg et al., 2016) to address public issues such as carbon emissions, climate change, extreme weather events, population shifts, and costly infrastructure development (e.g., Craig, 2016; Craig and Feng, 2017; Sioshansi, 2013).

This study seeks to address the knowledge gap related to residential support for energy efficiency (EE) subsidies for utility organizations. The residential sector was chosen for this study because they are the largest electricity consuming segment, yet the least adaptive to EE offerings (Craig and Feng, 2016; EIA, 2015b).

Utility organizations offer EE programs across the US in an effort to reduce electricity consumption and generation. EE was encouraged as early as the 1970's in response to oil shortages, and federal regulation focused on energy conservation was passed in 1979 (Sioshansi, 2013). EE and conservation moved from a focus on the supply towards management of energy demand in the 1990's, and today an integrated approach that includes managing and/or responding to energy demand is common (Sioshansi, 2013). Many utility organizations operate EE programs that provide incentives for residents and organizations to reduce electricity consumption to help reduce electricity demand (Allcott and Greenstone, 2013). In its most basic form, "EE is a measure of how resourcefully energy is used" (Nilsson et al., 2015, p. 91). According to Gilleo et al. (2014a,b), EE can help electricity consumers "meet their needs by using *less*

E-mail address: Christopher.craig@msubillings.edu.

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energy," (p. v) resulting in economic, environmental, and social benefits. Examples of EE efforts include (but are not limited to) lighting retrofits, installation of smart meters, installation of motion sensors, increased insulation, duct sealing, and rebates in retailers for efficient appliances. To quantify the long-term focus on EE in the US and around the world, approximately $7.7 billion was spent on EE in the United States in 2016, and EE spending is expected to increase from $130 billion in 2013 to $550 billion in 2035 (Berg et al., 2016; Gilleo et al., 2014a,b; International Energy Agency, 2014).

Today, EE programs are an essential component of the product mix for many utility organizations across the US. The vast majority of electricity in the US is produced by investor-owned utilities that adhere to investor profit objectives (EIA, 2015a; Sioshansi, 2013; Weimer and Vining, 2011). Investor-owned utility organizations are responsible to state regulatory bodies to maintain the electricity production capacity to serve all customers within their respective service territories at any given moment (Tombari, 2008). State regulatory bodies and investor-owned utilities across the US continue to expand energy efficiency (EE) programs as a cost-effective method of reducing demand and GHG from fossil fuels (Craig and Feng, 2017; Gilleo et al., 2014a,b). Cost-effective offerings occur when the cost of an EE incentive is lower than the cost of saved energy (Allcott and Greenstone, 2013).

At first glance it may seem counter-intuitive that utility organizations provide consumers incentives to reduce energy use while maintaining investor profit objectives. This is not the case, however. Utility organization EE programs are primarily funded through riders, or fees, on the bills of customers to offset the cost of administering the programs (Craig and Allen, 2014). Additionally, the majority of states offer utility organizations recovery, or repayment, mechanisms such as rate increases to counteract lost sales (Berg et al., 2016). EE programs also help utility organizations avoid risks with increased customer demand. Demand-side response (DSR) is the use of mechanisms such as EE, price disincentives, or behavioral change efforts to reduce consumption during peak use periods (Sioshansi, 2013). DSR efforts are important to utility organizations to help maintain capacity while avoiding infrastructure additions or the purchase of costly energy elsewhere during peak or extreme weather conditions (Craig and Feng, 2017). For a full suite of EE programs and policies that are used to rank state-level and utility organization, please see Berg et al. (2016).

Residential electricity consumers use more electricity than any other sector, yet, residential electricity consumption continues to rise and is the second most significant contributor to utility organization CO_2 emissions (Craig and Feng, 2016; EIA, 2015b). Residential EE programs are commonly used by utility organizations to respond to or avoid peak electricity demand conditions (i.e., DSR) that increase the price of electricity generation. Residential consumers have not been as receptive to EE offerings as organizational users (Craig and Feng, 2016), further warranting the inclusion as the focal sector. For instance, socio-demographic indicators, perceptions, attitudes, and perceived behavioral control have all been shown to more saliently influence residential support for and participation in EE efforts than economic benefits alone in the past (e.g., Craig, 2016; Asensio and Delmas, 2015; Lo et al., 2014).

Rising electricity usage is particularly problematic in the southeastern US among the residential sector. States in the region, for instance, consume more per capita than other regions throughout the US (EIA, 2015b). This consumption pattern is magnified by extreme weather events, long-term climatic trends, and a reliance on electric heating and cooling equipment (EIA, 2009; Ingram et al., 2013). A recent study found that an increase in cooling degree days, or the number of days over a pre-defined temperature threshold, was significantly related to increased electricity consumption (Craig, 2016). McFarland et al. (2015) predicted that electricity demand will continue to increase with temperature absent intervening factors.

Further magnifying the climatic impact in the southeast US, Preston (2013) noted that states in the region are more socioeconomically susceptible to extreme weather events including extreme precipitation and drought than most other regions. Preston (2013) estimated financial losses will increase by a factor between 1.8 and 3.9 by 2050. These losses are present today. In fact, between 1980 and 2014 the southeast US experienced more billion dollar disasters than any region in the country (National Oceanic and Atmospheric Administration (NOAA), 2015). In 2016, the southeast US experienced nine of 15 billion dollar disasters including drought, hurricanes, tornados, and wildfire with estimated damages of $35.7 billion and 107 deaths (NOAA, 2017). These totals are sure to be dwarfed in 2017 with the costly and deadly hurricanes Harvey and Irma that impacted the southeast US. Further complicating matters, climate simulations suggest that drought conditions predicted in the southeast US will reduce the amount of electricity utility organizations in the US can produce using existing infrastructure (Bartons and Chester, 2015; Ingram et al., 2013; van Vandt et al., 2012).

EE has become essential to utility organizations seeking to address societal challenges including carbon emissions, climate change and ensuing extreme weather events, costly energy infrastructure, and changing electricity demand conditions. Support for EE policy and participation in EE is needed from residents in the at-risk southeastern US to address salient energy-related issues such as these. Accordingly, the current study seeks to better understand the individual factors that influence residential support for EE subsidies. Individual factors include socio-demographic indicators, awareness of current EE offerings, previous participation in EE offerings, and perceptions of utility motives (i.e., trust). The affective, or attitudinal, nature of individual responses has been widely studied for environmental topics such as EE and conservation (e.g., Allen, 2016; Craig, 2016; Dunlap et al., 2000). Also, attitudes and behavioral intentions have both acted as mediators preceding behavioral change related to EE and energy conservation (e.g., Ajzen, 1991; Allen, 2016; Armitage and Conner, 2001; Craig and Allen, 2014; Lynch and Martin, 2013). Accordingly, this study will draw from the Theory of Planned Behavior (TPB; Ajzen, 1991) to explore the potentially mediating role of attitudes and planned behavior.

This study is the first to the author's knowledge to explore the likelihood that individual residential factors are related to the support for EE subsidies. This study is also the first to the author's knowledge to introduce the mediating role of attitudes and planned behaviors specific to the dependent variable of EE policy support. By exploring the odds that individual factors will influence EE policy support as mediated through attitudes and planned behaviors, the study will provide invaluable insights into the processes by which individuals makes EE policy decisions. Please see Fig. 1 the proposed model and variables included in the study.

In the following section, literature will be reviewed and research questions posed. Methods and measures, calculations, and a discussion will then be presented.

1.1. Energy efficiency and residents

EE efforts have historically reduced GHG emissions, and are crucial to future mitigation strategies that address climate change (Yang and Lin, 2016; Zuberi and Patel, 2016). As the largest electricity consumer segment and voting public, there is a need for residential consumers to embrace efficiencies in their homes and