HOUSEHOLD ENERGY CONSUMPTION: UNDERSTANDING THE IMPACT OF INCOME, RACIAL DIVERSITY AND PRO-ENVIRONMENTAL BEHAVIORS

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The energy sector is an important marketing system and consumer service. The energy sector enables the manufacturing of goods and the provision of services; and the consumption of energy involves multiple entities including firms, consumers, and even government institutions. Our research focuses on an area important to marketers and the energy sectors, that of household energy consumption. Specifically, we use an interactive approach that integrates demographic and situational variables to better understand household energy consumption To address our research questions, we develop a dataset compiled from several publicly available sources, appending zip code level electricity usage data with zip code tabulation area data on household income, dwelling characteristics, and racial diversity. Results indicate that diversity attenuates the direct effect of income on electricity usage. Our study provides an illustrative example of how firms could use multiple sources of publicly available data to garner insight for strategic discussions and to better understand individual energy consumption.

INTRODUCTION

The recent energy crisis within Texas demonstrated the ranging concerns regarding energy consumption (Villarreal, 2021). Beyond the financial price of energy consumption, consumers, policymakers, and firms in the energy ecosystem are concerned about energy consumption and its impact on the environment (Kilbourne & Mittelstaedt, 2011). A variety of examples demonstrate the importance and concern for this relevant issue of marketing, namely energy consumption. At the international level, the European Commission has set long-term goals to reduce energy demand; and the International Energy Agency recently advocated for policies to increase energy efficiency (IEA, 2018). Within the U.S., individual states are focused on energy consumption. The topic was among the top five public policy concerns discussed in state governments in 2016 (Dermody, 2016), and the state of California set a requirement for 100% clean energy generation by 2045. Meanwhile, other states, such as Massachusetts and New Jersey, set 2030 for their deadline to reach 35% and 50% levels, respectively, of renewable energy generation (EIA, 2019). At the consumer level, a segment of Americans possesses an interest in energy issues and the environment. Results from a 2019 Gallup poll finds that 60% of adults support “dramatically reducing the country's use of fossil fuels over the next two decades as a way to reduce greenhouse gas emissions and address climate change” (McCarthy, 2019). Regardless of wide-ranging sentiment, U.S. energy consumption recently reached a record of 101.3 quadrillion British thermal units (Btu) in 2018 (McFarland, 2019). The U.S. consumes 17% of the world’s energy with only 5% of the world’s population (Center for Sustainable Systems, 2018). Therefore, shifts in the U.S energy consumption could hold implications for the world’s aggregate energy consumption.

Extant research on energy issues dates to the 1970s during the “energy crisis” (e.g., Fisk, 1973; Levitt, 1974). Yet despite its longstanding importance, there is a dearth of research addressing the means to reduce energy consumption. For example, Fisk (1973) develops a theory of responsible consumption more than 45 years ago. And while long-standing research does explore marketing’s role in the production process, it fails to consider its environmental impact (Shapiro, 1978). More recent research, using a macro-environmental

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perspective, suggests that energy consumption challenges stem from four sources: 1) a lack of oversight in the sale of alternative energy, 2) the discontinuity between regional and national policies, 3) a lack of national energy infrastructure, and 4) a policy that fails to increase average fuel economy and power plant emissions standards (Press & Arnould, 2009).

Hence, many important research opportunities exist. First, Press and Arnould (2009) argue that analysis focusing on the household level may provide a greater understanding of energy consumption. Second, research indicates that energy consumption may be influenced by factors beyond the size of the home structure (Van Raaij et al., 1983). Third, previous research on residential energy usage has often focused solely on either demographic, situational, or psychological variables (see Abrahamse & Steg, 2009). Hence, opportunities exist to integrate a more interactive approach.

As such, we develop an interactive model utilizing both, demographic and situational, variables at the household level; and we integrate dwelling size to demonstrate the incremental value of our variables. From a demographic perspective, income appears to be an important but complex variable. Low-income households may not be concerned with energy consumption, as they face more pressing constraints or may already be monitoring their energy consumption. However, as income increases, households may show differences. For some households, increasing levels of discretionary income may not shift their attention to energy costs and consumption (Verhallen & Van Raaij, 1981). Conversely, other households may deploy discretionary income to upgrade their appliances and household heating and cooling systems to reduce their energy consumption (Frederiks et al., 2015).

From a situational perspective, we integrate the level of racial diversity in which the household is located. Previous research investigates situational factors, such as racially diverse environments, and its impact on environmentally-related behaviors and concerns. For instance, individuals with experience in more racially diverse environments were found to be engaged in more pro-environmental and civic-oriented actions (Holoien, 2013; Gurin et al., 2004). Hence, the situational aspects surrounding a household may create a moderating condition that impacts the relationship between household income and household energy consumption.

In sum, our conceptual model integrates a demographic and a situational perspective to better understand their interactive effects on energy consumption. Further, we incorporate dwelling size in our analysis. However, our main goal is to better understand the demographic and situational factors that impact our understanding of household energy consumption. Hence, our research investigates the following questions:

- How do varying levels of household income influence household energy consumption?
- How do situational conditions, such as racial diversity within a geographic area, affect the relationship between income and energy consumption?

Our study offers several contributions. First, our data and analytical approach are unique, as we use multiple forms of publicly available data to identify the factors that influence household energy consumption. As such, we demonstrate how energy marketers, utility firms, and even policymakers could use multiple sources of publicly available data to garner insight for energy consumption discussions. Second, our research findings provide potential insight and direction for organizations, such as utility providers. As a greater understanding of energy consumption occurs, utilities may be better able to target market segments that are more likely to be open to energy-saving initiatives and communication. For instance, energy marketers could collaborate with public policymakers to provide targeted incentives to households demonstrating a propensity for energy conservation. These incentives may reduce the risk for the household to adopt smart-technology thermostats or integrate alternative energy sources within the home.

LITERATURE REVIEW

Energy Consumption and Conceptual Model

Energy use and consumption remain a relevant topic for marketing, as it is a major area of a household's budget and consumption activity. After decades of steady per-capita growth, electricity consumption in the U.S. was stagnant in the new millennium, based on data from the World Bank and U.S. Census (Farrell, 2014). Some considered strides in energy efficiency were playing a major role in this phenomenon (Nadel & Young, 2014). However, energy consumption increased recently (McFarland, 2019). Yet regardless of the varying usage trend, electricity is a significant part of household budgets, with monthly residential expenditures topping $14 billion per month in 2015 (U.S. Energy Information Administration, 2016).

Interestingly, considerable variance in consumption occurs across households. Fischer (2013) finds that the top 10% of households in terms of electricity consumption consumed 24% of the kilowatt-hours (kWh). The analysis determined that while home size is a driver of this discrepancy, variation in usage among houses with the same square footage can differ by up to a factor of six. Therefore, the demands of the dwelling structure are not the sole influence on household consumption (Fischer, 2013). Instead, research must include additional factors.

Research on energy usage and consumption has increasingly turned toward incorporating more interactive models, including demographic, situational, and psychological factors (Abrahamse & Steg, 2009). Our conceptual model adopts this interactive approach by integrating demographic and situational influences to better understand household energy consumption. Demographically, we use household income. Income provides a base of resources for the household to deploy toward appliances and comfort, including that of lighting and heating (Poortinga et al., 2004), all of which necessitate energy consumption. Hence, our model outlines a direct link between household income and energy consumption.

Next, our conceptual model integrates a moderating condition of geographic racial diversity. Diversity is an important characteristic of municipalities (Sparber, 2010), and some municipalities and regions view diversity as a competitive advantage in the areas of economic development and urban innovation (Florida, 2019). Racial or ethnic diversity produces a variety of positive outcomes in several contexts (e.g., Hartenian & Gudmundson, 2000; Jayne & Dipboye, 2004; Milem, 2003; Richard, 2000). It produces positive outcomes, in some part, due to its ability to enable interactions of individuals with different backgrounds and perspectives. Hence, diversity may create a context for the potential sharing of ideas with those operating with different motivations and/or a different geographical focus for their actions. In application to our study, research demonstrates that those with experience in racially diverse environments tend to be more likely to participate in environmental and civic behaviors (Holoien, 2013). We suggest that one form of environmental behavior plausibly includes energy consumption.

Finally, our conceptual model integrates an indirect relationship between the demographic variable (i.e., income) and our distal outcome, energy consumption, through dwelling size. Thus, we acknowledge explicitly the research regarding the influence of dwelling size on energy consumption (Schipper et al., 1989). Previous research demonstrates that dwelling size and type partially explain differences in consumption across households (McLoughlin et al., 2012). Further, this link aligns with research that suggests demographic variables indirectly impact energy consumption through various forms of mediating variables (Black et al., 1985).

HYPOTHESIS DEVELOPMENT

The conceptual framework of electricity consumption is shown in Figure 1. The model includes a mediated process, as well as a conditional direct path (e.g., Hayes, 2017). For the mediation, dwelling energy requirement serves as the mechanism by which median household income impacts average usage. The direct path indicates the effect of income on usage that is not explained by the dwelling energy requirement mechanism (i.e., it accounts for unspecified processes), with the effect being conditional on the level of diversity.

Household Income

First, we suggest that household income is positively correlated with energy use. At lower income levels, the lack of financial resources focuses on the household's attention on expenses, including that of energy consumption. As the household budget is constrained, it may attempt to ensure their income provides for a range of necessities at lower levels.

As income increases, households may be less likely to focus their attention on energy consumption and associated costs (Verhallen & Van Raaij, 1981). Hence, these households may be less likely to feel financially constrained in their energy consumption compared to lower-income households. Further, energy costs may assume a smaller proportional share of their household budget. And thus, they may not garner as much attention as areas assuming a greater proportion of the household's budget. Finally, higher-income households may have discretionary funds to cover varying degrees of energy consumption. Thus:

H_1: Household income positively impacts energy consumption.

Dwelling Size

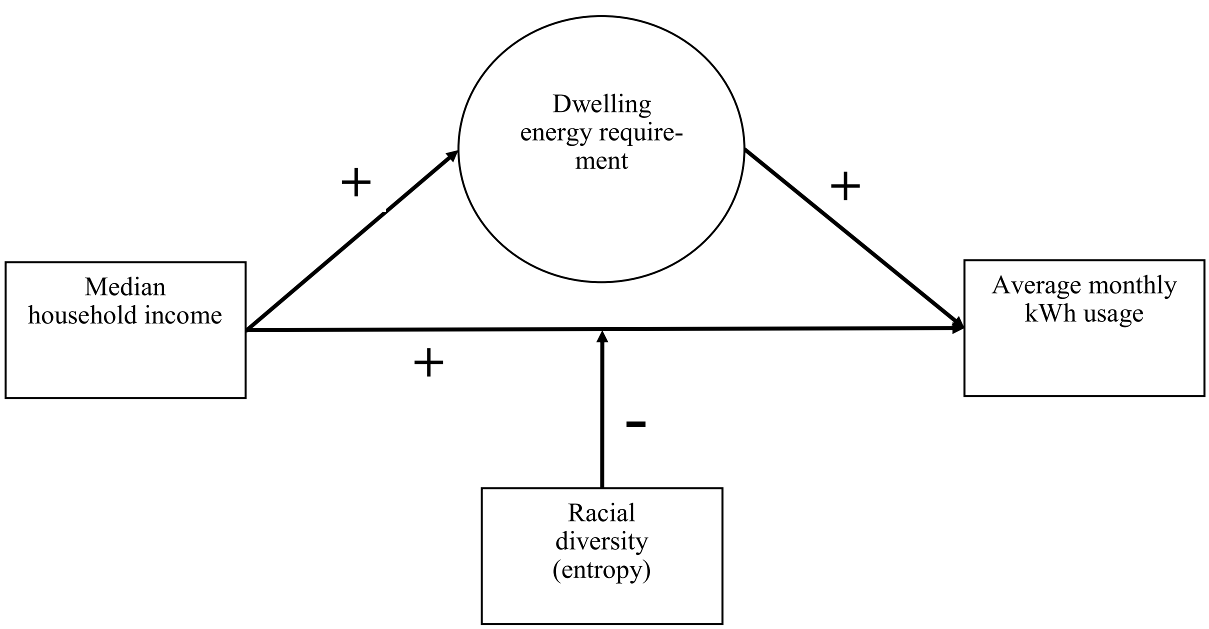
Next, we suggest that the size of the dwelling also drives energy use. Research demonstrates that detached dwellings (a variable correlated to size) are associated with higher energy use than attached dwellings, such as apartments (McLoughlin et al., 2012). As the dwelling integrates multiple floors, varied rooms, distinctive room styles, and other attributes, it places additional requirements on lighting, heating, ventilation, and cooling systems (Van Raaij & Verhallen, 1983). As such, as dwelling size increases, it affects energy consumption. Hence:

H_2: Household dwelling size positively impacts energy consumption.

Mediating Mechanism

Our conceptual model allows for the dwelling's energy requirement to be a function of household income, a straightforward accommodation for those with higher incomes generally living in larger homes. The dwelling size provides a mechanism for the household to

FIGURE 1:
Conceptual Model



deploy its income, and thereby increase its energy consumption. This premise suggests that as households increase financial resources, the dwelling provides the means (and physical area) to invest in a range of household devices that consume energy (e.g., Abrahamse & Steg, 2009; Craig et al., 2014). Thus, the dwelling size enables the household income to purchase more things, such as technology appliances, which increase the levels of energy consumption. Hence:

H_3: Household income positively impacts energy usage through a larger dwelling energy requirement.

Racial Diversity

We argue that racial diversity may play a moderating role in energy consumption. While household income may have a positive effect on energy usage, the effect of income on energy consumption may be attenuated due to the sharing of diverse ideas, including that of energy use. Diversity exposes individuals to a wide variety of attitudes, including attitudes focusing on energy consumption and environmental concerns. The exposure to these attitudes may impact a household's attitudes regarding energy conservation, the legitimacy of energy concerns, and the household's role in energy consumption (Seligman et al., 1979), and thereby impact behavior (Craig et al., 2014).

As applied to our setting, higher-income households are less likely to feel financially constrained in their energy consumption as compared to lower-income households. However, when residing within a context of diverse ideas, higher-income households may become more aware of issues related to energy usage and the consequences of increasingly higher levels of energy usage. In this scenario, those with higher incomes are better situated to employ energy-saving measures, which may be costly (Abrahamse & Steg, 2009). Hence:

H4: The direct effect of household income on energy usage is attenuated by racial diversity.

METHODS

Our dataset focuses on the city of Los Angeles. This particular dataset was available to the public via Data.gov. California is also an appealing research setting due to public policy initiatives regarding energy. In 2019, California governor, Jerry Brown, signed a bill into law with the goal for the state to use entirely zero-emission electricity by 2045 (Domonoske, 2018). Such legislation is also important due to its potential impact. In 2018, California possessed the fifth largest economy in the world, greater than that of the United Kingdom and India (May 4, 2018).

Further, we suggest the focus on Los Angeles, CA is appropriate for an energy consumption context. Scholars suggest the majority of major climate actions within the United States exist at a more micro-level, that of the state and city level (Selby, 2019). For instance, cities such as Burlington, Vermont, Georgetown, Texas, and Aspen, Colorado have developed and discussed policies for renewable electricity and production (Domonoske, 2018).

Our study combines multiple publicly available datasets to effectively address our research objective. We used datasets from Data.gov, the U.S. Census, and UDS Mapper. Our first dataset emanates from Data.gov, containing the dependent variable, average monthly kWh usage by zip code for the 125 zip codes in Los Angeles for 2013. Data.gov is an online clearinghouse launched in 2009 that aggregates metadata about open data from federal, state, and local government resources. The energy usage dataset is sparse, consisting only of zip codes and kWh usage over several years for each Los Angeles Zip code.

We accessed the second dataset via the U.S. Census's American FactFinder online portal. To address the research questions in this study, the characteristics of each zip code were required. The U.S. Census provides a multitude of data aggregated at a variety of levels. However, while zip code is one of several hundred choices for census data aggregation, far more data categories are aggregated using zip code tabulation areas (ZCTAs) than zip codes. Therefore, before appending census data to the energy use data, zip codes were mapped to zip code tabulation areas using the "Zip Code to ZCTA Crosswalk" tool provided by UDS Mapper (2016). This allowed the appending of the desired ZCTA-level data from the U.S. Census to the electricity usage data.

For each of the 33,120 ZCTA's in the U.S., 2014 data was downloaded for variables including median household income, characteristics of the dwellings (percentage of dwelling detached, the average number of rooms, the average number of bedrooms), and the distribution of the population by race, retrieved using the U.S. Census (2016) "American Fact Finder" tool. This data was then appended based on the Los Angeles zip codes to the energy dataset. One ZCTA, 91330, was dropped from the analysis due to a lack of U.S. Census data.

MEASURES AND ANALYSIS

The dwelling energy requirement was operationalized as a reflective, latent construct with items consisting of the commonly used characteristics from the literature representing the size of the dwelling: percentage of dwellings detached, the average number of rooms, and the average number of bedrooms. The construct has a Cronbach's alpha of .839. Utilizing a latent construct for the mediator in the model allows for the straightforward assessment and interpretation of the indirect effect of income on electricity usage.

A common, and generally preferred measure of racial diversity, entropy (Budescu & Budescu, 2012; Teachman, 1980), was calculated for each ZCTA. As racial diversity increases, entropy increases. Race was assessed across the following U.S. Census categorizations: white, black or African-American, Asian, and Hispanic or Latino, with the remaining categories in the dataset combined into a fifth category.

The measure representing income is the median household income for each ZCTA. Electricity usage was measured as the average monthly kWh usage per household in each ZCTA during 2013. The percentage of households in each ZCTA using electricity as their home heating fuel was used as a control variable. A summary of the data is presented in Table 1.

The latent variable dwelling energy requirement (R) is specified as a function of median household income (I), for each ZCTA, i,

$$R_i = \beta_0 + \beta_1 I_i + \varepsilon_i. \qquad (1)$$

Average monthly kWh usage (U) is specified in log form,

$$\ln U_i = \gamma_0 + \gamma_1 R_i + \gamma_2 I_i + \gamma_3 H_i + \gamma_4 I_i x H_i + \gamma_5 E_i + \delta_i, \qquad (2)$$

where H is the common notation for entropy (representing racial diversity), and E represents the percentage of households using electricity for heating fuel.

In reduced form, the effect of income on the log of electricity usage is the partial derivative

$$\frac{\partial \ln U}{\partial I} = \gamma_1 \beta_1 + \gamma_2 + \gamma_4 H, \qquad (3)$$

TABLE 1:
Summary of the Data (N=124).

Variable	Mean	Standard Deviation	Minimum	Maximum
Median household income	$55,875	$28,116	$7,071	$170,193
Percentage of dwellings detached	41%	23%	0%	93%
Average number of rooms	4.5	1.0	1.6	7.0
Average number of bedrooms	2.1	0.6	0.4	3.5
Racial diversity (entropy)	1.45	0.38	0.26	2.16
Average monthly kWh usage	509	261	236	1944
Percentage using electricity as heating fuel	26%	9%	10%	53%

where $\gamma_1\beta_1$ represents the indirect effect of income on usage that will test H_3; and $\gamma_2+\gamma_4H$ corresponds to the conditional, direct effect that will test H_4 (Preacher & Kelley, 2011).

RESULTS

The analysis was conducted using MPlus, simultaneously estimating the regressions shown in Equations 1 and 2. The parameters, along with the indirect and conditional effects, were estimated using 5000 bootstrapped samples of the data to allow for the construction of confidence intervals required to test the mediation (i.e., the first term in Equation 3, $\gamma_1\beta_1$) and the conditional direct effect (i.e., the remaining terms in Equation 3, $\gamma_2+\gamma_4H$) (see Preacher & Hayes, 2008). The results of the analysis are presented in Table 2.

H_1 relates to the total effect of household income on energy consumption as shown in Equation 3, (i.e., the sum of the indirect and direct effects), with diversity at the mean. The effect is positive and significant [.240, 95% CI (.166, .313)], supporting H_1. The Johnson-Neyman point is with diversity at 1.15 standard deviations above the mean (see Spiller et al., 2013), meaning that the total effect of income on energy consumption is positive and significant as long as diversity is no more than 1.15 standard deviations above the mean.

H_2 concerns the impact of household dwelling size on energy consumption, specifically γ_1 in Equation 2. As expected, dwelling size has a positive effect on consumption [1.323, 95% CI (1.037, 1.652)], providing support for H_2.

H_3 corresponds to the indirect effect of income on usage via the dwelling energy requirement, (i.e., the first term in Equation 3, $\gamma_1\beta_1$). The effect is positive and significant [.177, 95% CI (.128, .235)], supporting H_3.

TABLE 2:
Parameter Estimates

Effect	Parameter estimate	Bootstrapped lower 2.5% of confidence interval	Bootstrapped upper 2.5% of confidence interval
Effect on dwelling energy requirement			
Intercept	0.193*	0.166	0.221
Income	0.133*	0.108	0.159
Effect on log of average monthly kWh usage			
Intercept	5.611*	5.389	5.827
Dwelling energy requirement (H_2)	1.323*	1.037	1.652
Income	0.499*	0.329	0.711
Diversity (entropy)	-0.084	-0.189	0.020
Income x diversity	-0.301*	-0.441	-0.164
Percentage of households using electric for home heating	1.466*	1.001	1.992
Indirect effect of income on log of average monthly kWh via dwelling energy requirement	0.177	0.128	0.235
Direct effect of income on log of average monthly kWh with …..			
diversity (entropy) at -1 standard deviation (H_2)	0.177*	0.111	0.256
diversity (entropy) at +1 standard deviation (H_2)	-0.052	-0.145	0.056
Total effect of income on log of average monthly kWh with …			
diversity (entropy) at the mean (H_1)	0.240*	0.166	0.313

* significant at 0.05 level

H_4 pertains to the direct effect (i.e., unmediated effect) of income on usage. Following Preacher and Hayes (2008), the hypothesis can be tested by assessing the effect at two levels of diversity, -1 and +1 standard deviations from the mean level of entropy. H_4 is also supported, since the direct effect exists at low levels of diversity [.177, 95% CI (.111, .256)], but not at high levels of diversity [-.052, 95% CI (-.145, .056)] – (i.e., diversity attenuates the direct effect of income on electricity usage). This test result is consistent with the observation of a significant and negative interaction effect, i.e. γ_4 in Equation 3, [-.301, 95% CI (-.441, -.164)].

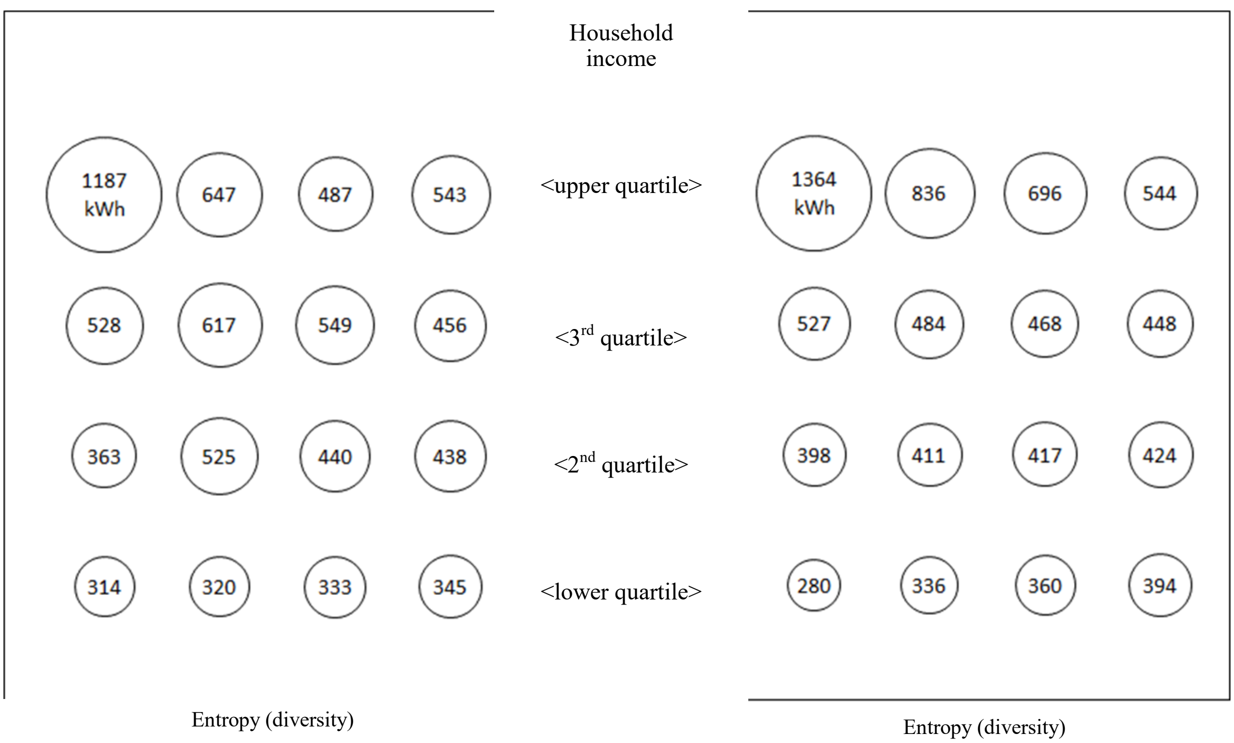
DISCUSSION

Our study examines a topic that lies at the intersection of marketing, households, and organizations. In our research, we have melded together areas of household energy consumption, ZIP code, and mapping data to illustrate the insights for public utility strategies, individual-level consumption benefits, and even public policy discussions on energy policies.

Our results show that household income indirectly drives electricity consumption through dwellings with higher energy requirements (i.e., large, detached). But racial diversity appears to attenuate the direct effects of income on usage. As argued in support of this hypothesis, racial diversity allows for the sharing of ideas that may include moral obligation and pro-environmental behaviors, through higher levels of awareness and a sense of responsibility.

The combined effects of income and diversity on kWh usage, both observed and predicted by the model, are illustrated in Figure 2. The graphs can be interpreted in a couple of ways. First, for the observed data in the left panel, the average kWh usage for those in the top income quartile is 278% higher when diversity is low (1187 kWh vs. 314 kWh), but only 57% higher when diversity is high (543 kWh vs. 345 kWh).

FIGURE 2:
kWh by Income and Entropy (Diversity)



Observed average kWh by income and entropy quartiles

Predicted kWh at quartile means of income and entropy

Stated otherwise, electricity usage grows at a much higher rate as income increases when diversity is low than when diversity is high. The panel on the right relates a similar story for the usages predicted by the model.

A second interpretation of the effect is consistent with the wording used in H4. In the left panel of Figure 2 for the top income quartile, usage decreases dramatically, by 54%, as diversity goes from low to high (1187 kWh vs. 543 kWh). For the bottom income quartile, there is no statistically significant difference in usage as diversity increases (314 kWh vs. 345 kWh). This interpretation is also evident for the predicted usages in the right panel. As hypothesized and empirically supported, diversity attenuates the effect of income on electricity usage.

Academic Contributions

Our study offers several academic contributions. First, we utilize unique, multi-source datasets to examine energy consumption. Our research demonstrates how publicly available data may be used for academic research examining energy consumption. As such, we illustrate one use of big data for academic research. Big data commonly refers to the "collection, management and analysis of massive amounts of data," (McNeely & Hahm, 2014, p. 305). For marketing scholars, the ability to analyze the amount of data produced daily and generate useful insights for their strategic research is both daunting and enthralling. As such, we provide an exemplar of generating insights not available with smaller-scale data like surveys (Mayer-Schonberger & Cukier, 2013).

Second, our study adds to the literature on energy consumption and racial diversity. One of the study's main areas of focus is whether racial diversity plays a role in electricity consumption, after accounting for income (and therefore dwelling size). Our underlying premise suggests that racial diversity may enable levels of interaction that allow for the diffusion of diverse ideas. While, racial diversity has been found to produce pro-social behaviors, in a variety of contexts (e.g., Hartenian & Gudmundson, 2000; Jayne & Dipboye, 2004; Richard, 2000; Milem, 2003), this study appears to be the first to look at racial diversity as a moderating condition between household income and energy consumption.

Managerial Implications. Our study offers several managerial implications. By appending multiple datasets, we developed and tested a model of energy consumption. Undoubtedly, the nature of our data is diverse in terms of the source from which it emanated, the nature and reason for its collection, and ultimately our use and application of the data. However, these issues are illustrative of the challenges confronted by firms and marketers that choose to use big data to inform decisions.

First, the aggregation and analysis of multiple forms of data may require marketers to alter their perspectives (Mayer-Schönberger & Cukier, 2013). As some suggest (Mayer-Schönberger & Cukier, 2013), the use of big data necessitates the need to recognize and acknowledge the biases inherent in data, as well as require us to transition away from seeking causality, and instead to look for a signal that provides insight. While "correlations may not tell us precisely why something is happening… they alert us that it is happening…and that in many situations …is good enough" (p. 14). Hence, as illustrated by our research, the question lies in the comfort level of marketers and their stakeholders of using disparate, diverse sources of data that may indicate, but not confirm, plausible insight that may be used within strategic initiatives.

Second, we provide one approach of how utilities and their business intelligence personnel could utilize various forms of data to encourage energy conservation more efficiently. Our results have demonstrated a way to broadly locate individuals that already exhibit some energy-conservation behaviors, providing an initial indication of where to deploy investment in marketing communication, incentives, and other marketing programming that would encourage energy conservation. Additionally, the ZIP code level provides one approach toward segmentation; and an opportunity to target motivated individual households with the potential opportunity and ability to act upon their motivation (Prothero et al., 2011) on the adoption of energy conservation initiatives, such as smart metering. Considering the time and capital investment required to add additional energy capacity to a utility, our approach demonstrates one path toward finding energy users already exhibiting elements of energy consumption.

Third, studying energy consumption patterns is important for marketers within the energy sector. For example, energy marketers could use data about energy consumption to provide insights that would enable energy firms to make better decisions about, "which message to send to which household at which time in order to get them to conserve energy" (Knowledge@ Wharton, 2012). This form of targeted conservation communication may have partially ameliorated the recent energy crisis in Texas, which left millions without power during harsh winter conditions (Cohen, 2021).

Fourth, we submit that marketers confront a data environment with the fluidity of a gold rush. While data continue to be produced in epic amounts, several questions emerge regarding the data, their uses, and application. First, do marketers have the capacity and capabilities to use the data? What are the necessary financial and human resources required to deal with the varied forms, formats, and uses of the data? What are the current analytics capabilities of marketers and their firms? How do marketers decide which data to utilize and which data not to utilize? Further, several opportunities exist for marketers to consider their internal policies for data collection, reporting requirements for uniform data measurements, repositories for accessing the data, and the ability to use the data in a meaningful and responsive way to inform their strategies.

LIMITATIONS AND FUTURE RESEARCH

The data pertain to a single market, Los Angeles, California. The findings may or may not replicate in other markets. However, the market is characterized by a wide variety of zip code tabulation areas (ZCTAs) in terms of racial make-up, providing an opportunity to test other geographic areas and determine if our findings can be replicated. The analysis focuses on a snapshot in time, thereby assessing the impact of diversity through the comparison of ZCTAs, rather than directly testing the impact of diversity on change in behavior over time.

This study is agnostic in terms of interpreting the findings from the perspective of any particular race, given our measure of entropy. In our study, a neighborhood consisting of 90% households of race A and 10% households of race B would have the same entropy as a neighborhood with 10% households of race A and 90% households of race B. Therefore, those two neighborhoods would be equivalent in our data in terms of racial entropy, despite the races attached to A and B.

The typical limitations consistent with studies relying on secondary data also apply. First, the findings are descriptive rather than prescriptive, given no control over sampling and no experimental manipulation. Second, endogeneity could be an issue, and as a result, increasing the racial entropy of an existing neighborhood may not necessarily reduce energy usage, e.g., there is a correlation between those that prefer to use less energy and those that prefer to live in diverse neighborhoods. That being said, even with secondary data, we have demonstrated that including a measure of racial entropy enhances a model of energy consumption.

Many opportunities for future research based on this study exist. First, these findings could be replicated in other markets. Second, various forms of diversity other than race could be considered. Finally, future research could integrate longitudinal research designs.

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