

DECONSTRUCTING THE ROSENFELD CURVE: UNDERSTANDING CALIFORNIA'S LOW PER CAPITA ELECTRICITY CONSUMPTION

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Overview

Since the early 1970s, electricity consumption per capita in California has stayed nearly constant, while rising steadily for the United States as a whole. In the context of global energy policy making today, where both climate and energy security concerns play an increasingly large role, it is important to understand the factors behind California's success in stabilizing electricity consumption. This is particularly so because the state of California has led the nation in putting in place a number of measures aimed at increasing energy efficiency and reducing end user demand. In this paper we use empirical data to estimate the fraction of the difference between California and the United States owing to policy independent characteristics such as climate or demographics, and the fraction that may be due to policy measures aimed at saving energy. We analyze both the most recent available data, and historical statistics, and compare our derived estimate of the possible role of policy to savings estimates from California Energy Commission models.

This paper is organized as follows: Following an introduction, we examine electricity consumption in the residential, commercial and industrial sectors in Sections 2,3 and 4 respectively. Here we seek to quantify the role of various policy independent factors that influence electricity consumption. These include climate, demographics, fuel choice, urbanization and so on. Next, in Section 5, we carry out a historical comparison of these estimates with our deconstruction. Finally we summarize our results in Section 6 and conclude by discussing and critiquing our work in Section 7.

Methods

Multiple statistical hypothesis tests using empirical data from various sources. We define test statistics that are measures of the expected electricity consumption in California and the US, corrected for state-nation differences in one factor alone. A statistically

significant difference between the two values is then attributed to the particular characteristic in question.

Results

We conclude that for 2001, up to about 23% of the overall difference between California and US per capita electricity consumption could be due to state policy, the remainder owing to various structural factors.

We also carry out a sector by sector analysis of electricity consumption at different time points, beginning in 1980 and upto the most recent available data. We find that the influence of different structural factors has changed over time in a manner that is consistent with California Energy Commission estimates of increasing policy driven energy savings over the last few years. After correcting for structural factors we obtain a cumulative share for policy that is close to CEC estimates for 2001 (about 1200 KWh per capita) and 1990 (although we obtain a 50 percent over-estimate from CEC figures as we go back to 1980). Figure 1 illustrates this historical trend.

Finally, we present and critique our methodology, based on statistical analysis of empirical data as a means of understanding the effectiveness of state policy. We compare existing CEC estimates that are 'bottom up' efforts to model the effectiveness of various programs and policies, with our bounds on the role of policy, obtained by quantifying the role of structural factors. We discuss methodological shortcomings that remain in our approach and data and future work needed to alleviate them.

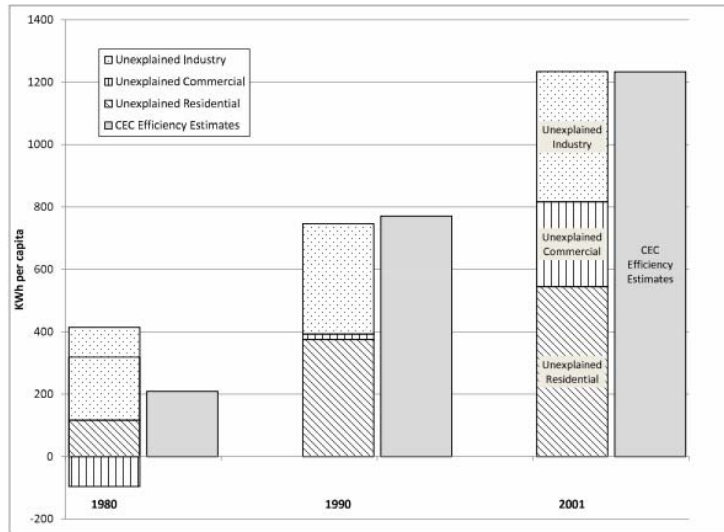


Figure 1: A comparison of CEC savings estimates with upper bound estimates of policy (California-US differences that remain ‘unexplained’ after accounting for the role of structural factors).

Conclusions

While state policy has likely played a significant role in mitigating against a rise in per capita electricity consumption in California, other factors have also had an important effect. These structural factors therefore need to be part of any evaluation of the effectiveness of policy in the future. Our work suggests cautious optimism for the effectiveness of efficiency policies and programs. There is however, an urgent need to collect more data nationwide to improve our understanding of factors influencing energy use patterns in different areas. There also seems to be some evidence to indicate lifestyle differences between California and the nation as a whole, suggesting the need for more work on evaluating the effectiveness of public education campaigns in changing behaviour.

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