1. Introduction

The National Energy Policy (NEP) released in 2001 provides more than 100 recommendations from the Bush administration on energy-related policy. As part of the NEP, the U.S. Department of Energy (DOE) is endeavoring to identify factors at the state level, including the states’ energy-related policies and programs that have contributed to efficient energy use over the past two decades.

The NEP, among its other recommendations, calls for continued reductions in energy intensity, which is typically defined as energy consumption per dollar of gross economic output. For this state-level study, we measured energy intensity as energy use per dollar of gross state product (GSP). By identifying those states in which energy intensity has declined most sharply after taking into account non-policy-related factors that influence changes in energy intensity, this study identifies those states for which reductions in energy intensity have been greater than expected over the period of analysis. Factors that contributed to this better-than-expected performance may have included state policies that affect energy consumption.

Data at the state level provide the means for examining the potential impact of state policies and actions on energy intensity nationwide. If actions that states have taken in regard to energy usage and energy program funding were uniform across the states, an evaluation such as this one would be far more difficult to conduct, and its potential usefulness would be lessened. But because the states differ greatly, including having differing energy policies, between-state variation is likely to a big part of total variation in energy intensity.

Background

Since the 1970s, energy analysts have measured changes in energy intensity as a proxy for energy efficiency.\(^1\) When energy intensity declines, less energy per dollar of economic output is used; therefore, the U.S. economy is said to be less “energy intensive.” This does not mean that the United States as a whole uses less energy. It could mean, for example, that industries use less energy per dollar

\(^1\)For example, other measures of energy intensity, aside from energy per dollar of economic output, include energy use per capita, residential energy use per household, and transportation energy use per vehicle miles traveled.
of output, or that commercial buildings use less energy per dollar of commercial sector activity, or, in the case of residential buildings, it could mean that households use less energy per person.

From the early part of the 20th century until the mid-1970s, the relationship between economic growth and energy demand growth tended to be constant. But, prompted by hikes in oil prices in 1973, the rate of economic growth since the mid-1970s has outpaced the rate of increased energy use. It is likely that most of the change in the comparative rates of growth was in response to energy price increases. However, other factors may have been at work because even after 1985, when oil prices returned to their historic levels, the link between growth in energy use and economic growth was not restored.

States have played an important role in U.S. energy policy since the 1970s. Some states have implemented building codes aimed at saving energy, instituting various types of codes at various levels of enforcement (Ortiz and Bernstein, 1999). Because building codes require new structures to be more energy efficient than existing ones, overall energy efficiency should improve. States have also been instrumental in working with utility companies to fund demand-side management (DSM) programs, although the level of funding in the states for DSM programs varied widely—from less than $1 per capita to $40 per capita—during the 1990s (Loughran, Kulick, and Bernstein, forthcoming).

**Study Objectives**

In this study, we address some key questions:

- What were the state-level trends in energy intensity over the past two decades (1977 through 1999)?
- Which factors affected those trends, and to what degree did they affect them?

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1 Naturally, when prices increase, demand goes down, and as prices went up, energy efficiencies improved. Therefore, the old linear relationship between increased energy use and economic growth ended, and a new relationship between the two was created.

2 Those factors, which we discuss later in this report, include changes in the U.S. industrial mix, increased air-conditioning loads, new building construction, and changes in the mix of vehicle types, among other factors.

3 Increased numbers of energy-using devices, increased building size, and increased air-conditioning loads may make it difficult to see these efficiency improvements in the aggregate.

4 DSM programs are designed to reduce demand for energy, in particular peak-load electricity, as well as encourage energy efficiency.
• How have those factors and their effect on energy intensity varied across states, and which states have been most successful in reducing energy intensity?

• If it were possible to replicate the experience of the states that had the most success in reducing energy intensity, potentially because of their policies and program actions, what would be the potential nationwide effects?

The analysis in this report is a first step toward understanding how changes (i.e., increases or decreases) in energy intensity differed across states over the past two decades, and how much of those changes is attributable to measurable factors and how much of those changes is left unexplained.

Our analysis should be helpful in identifying those states that have performed well in reducing energy intensity. However, an underlying objective of our analysis is to provide a framework for further research in the form of in-depth case studies of state energy policies and programs. While we identified some significant factors that in part account for variations in energy intensity across states, our analysis leaves some of the variation unexplained. Some of these unexplained differences may potentially be due to state-level energy policies and actions. Unobserved factors, not easily captured in statistical analysis, may account for much of the observed reductions in energy intensity.6

Study Limitations

For this study, we were interested solely in addressing the factors that may have influenced how energy intensity has changed over the past two decades. We specifically did not examine other energy-use measures, such as actual levels of energy use and absolute levels of energy intensity. The focus on changes in energy intensity was based on Recommendation 14 in Chapter 4 of the NEP (National Energy Policy, 2001), which calls for reductions in energy intensity nationwide. Nevertheless, an understanding of the implications of changes in actual levels of energy use and energy intensity is important, and the DOE should address this area of study in the future.

An examination of changes in energy intensity provides a greater understanding of the issues surrounding energy usage overall. However, there are some limitations to using energy intensity as a measure of energy use. Declining energy intensity does not necessarily mean that people are reducing the amount

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6The analysis we use in this study is based on an approach used in a study of state education policies by Grissmer et al. (2000).
of energy they use because changes in energy intensity depend greatly on the way in which energy intensity is measured.

Energy intensity increases or decreases because of variations in both energy use and economic growth, both of which occur for a variety of different reasons. Sorting out the causal connections between changes in energy use and economic growth is difficult; furthermore, some factors may influence both energy use and the economy, while others may influence only one or the other. In addition, energy intensity does not translate directly to energy efficiency; therefore, we cannot directly interpret reduced energy intensity as an improvement in energy efficiency, even though energy intensity is often used as a proxy for energy efficiency.

Future Analysis

Practically speaking, it would be difficult to examine the policies and programs of every state to assess their impact on energy intensity and their potential success in promoting energy efficiency. As such, we identified a representative group of states (see Chapter 7) that have reduced their energy intensity to the greatest degree and whose policies may have played a significant role in reducing energy intensity over the study period (1977 through 1999). This study was done with an eye toward follow-on research that may include examining these states in greater depth to better understand how state policy can affect future energy intensity. An analysis of state-level actions and policies that may be successful in reducing energy intensity and that may be replicable in other states would in turn help to guide national energy planning.

Organization of This Report

Chapter 2 contains a discussion of state-level trends in energy intensity. Chapter 3 lists those factors that may affect energy intensity. Chapter 4 details the methodology we used to measure energy intensity. In Chapter 5, we present the results of our energy-consumption analysis by energy-consuming sector, and we compare the results for the two subperiods we studied. In Chapter 6, we offer our interpretation of the overall state-level results. In Chapter 7, we report on those states that had the largest reductions in energy intensity over the past two decades. Chapter 8 addresses the following questions: What would be the impact on U.S. energy intensity if the energy intensity trends of the top-ranked states were replicated in other states, and what would be the impact on U.S. energy intensity if all states performed as poorly as the bottom-ranked states? Chapter 9 presents our conclusions from this study and our thoughts in regard to follow-on
analysis. Appendix A lists our data sources. Appendix B details the results of our regression analysis. Appendix C describes our methodology for predicting future changes in energy intensity given the results of our quantitative analysis. Appendix D lists the detailed energy-intensity data for each state.