

**Factors affecting the rise of renewable energy in the U.S.:
Concern over environmental quality or rising unemployment?**

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This paper analyzes the transition between renewable and nonrenewable energy sources by empirically examining the relationship between per capita income and the relative use of RE sources. Using 1990-2008 state level panel data from the US electricity market, I examine two measures of relative RE use: the percent of capacity that utilizes RE sources and the development of RE capacity, defined as the change in the percent of RE capacity. The basic regression results report a U-shaped relationship between income and RE capacity.

To understand the U-shaped empirical findings, I consider and test several theories presented in the literature. First, environmental quality (EQ) is often stressed in the promotion of RE, and several theories have been presented to explain the U-shaped relationship between income and environmental quality (Y-EQ). Explanations include: a) economies and diseconomies of scale of production for pollution, b) a changing economic composition from agrarian to manufacturing to service oriented industries, c) a change in demand for EQ at higher income levels, and d) an evolving property rights structure such that a common resource evolves into a well-defined private property structure. This paper contributes to the environmental literature by classify RE generating capacity as a new metric for EQ. Increases in relative RE use imply increases in EQ in terms of improved CO₂, methane, nitrous oxide, and sulfur dioxide emissions. Much of the environmental literature measures EQ using CO₂ emissions, water pollutants, deforestation, risk to hazardous waste exposure, or environmental actions. To date, the Y-EQ literature has not explicitly measured EQ through the relative use of RE.

Applying the Y-EQ theories to the U.S. electricity market from 1990-2008, I note several changes that potentially impact the use and development of RE. The four applications of the theories for the electricity markets include a) electricity market deregulation, which fundamentally changed the market and property rights structure, b) the implementation of the Clean Air Act Amendments of 1990, which developed air pollution markets for SO₂ and changed the property rights for pollution c) the transition of the US economy from a manufacturing based economy toward a service oriented economy, and d) the increase in renewable portfolio standards (RPS), which increase the demand for RE electricity generation. The empirical results for these control variables fail to provide support to the Y-EQ theories. Additionally, states with a large manufacturing share of GDP typically have more RE capacity than states with a small share.

Alternatively, I consider possible economic factors that impact RE capacity rather than focusing on EQ. Because advocates for RE typically promote the development of wind and solar projects as a means of job creation, I consider the hypothesis that unemployment rates impact RE capacity. I extend the model to examine the impact of lagged unemployment on RE. The results provide evidence that a high unemployment rate promotes RE development, but the impact decreases as a state's per capita income increases, explaining the U-shaped relationship. These results suggest that economic factors, such as unemployment and manufacturing GDP, are better predictors of RE development than environmental policies, supporting the existence of an electricity ladder. These results suggest that improvements in EQ can occur without an increase in income, when EQ projects are presented as a means of job creation.