



Green businesses in a clean energy economy: Analyzing drivers of green business growth in U.S. states



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ABSTRACT

In a clean energy economy, green businesses play a central role by utilizing renewable energy technologies and employing green labor forces to provide clean energy services and goods. This paper aims at analyzing factors driving the growth and survival of green businesses in the U.S. states, with hypotheses proposed on the impacts from clean energy policies and tax incentives, labor market conditions, and economic and political environments. A fixed effect regression analysis is applied with a panel data set of 48 continental states from 1998 to 2007 in the United States. The statistical analysis with a longitudinal data set reveals that the adoption of renewable energy policies, the permission of renewable energy credits imports, the stringency of minimum wage legislations, and presence of clean energy business associations are the major driving forces of the green business development in the U.S. states.

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1. Introduction

The clean energy economy is an explosively growing economic sector over the last decade across the globe, as a response to global climate change, depleting traditional energy sources, and the need for industrial upgrade and structural transitions. For most countries, the most formidable challenge in mitigating climate change is to overcome the financial cost, especially when the country is suffering economic recession [47]. Thus, it is essential to ensure the robustness of a green economy so that the uses of renewable and sustainable technologies bring about stable economic growth, two indicators of which are job creation and business growth. In a clean energy economy, green businesses play a central role by utilizing renewable energy technologies and employing green labor forces to provide clean energy services and goods. Utilizing different kinds of renewable technologies, including biomass, solar thermal, energy efficiency, heat pumps and distributed generation [5,12,19, 50], green businesses are at the center of the clean energy economy. Therefore, it is essential to understand the policy, economic and political environments faced by the green businesses, which are the backbones of a green economy. More importantly, it is important to understand the driving factors underlying the growth and decline of green businesses so that policy makers and stakeholders can make timely adjustment to their policy tools.

Over the past decade, the states have experienced a rapid growth of renewable energy, with an accelerating rate over the last few years. Net generation of electricity from renewable energy in the U.S. grew from 79 million MWh (megawatt-hours) in 2003 to 218 million MWh in 2012 [16], compared with relatively slow growth from 64 million MWh to 79 million MWh from 1990 to 2003. Renewable energy capacity in electricity generation varies significantly across the states, with many states having no renewable energy capacity and Texas and California having 7536 MW and 6168 MW in 2008 respectively.

Economic growth is closely tied to energy development and consumptions [27,32]. The transition to a low-carbon, sustainable and clean energy economy requires a systematic transition in the whole economy, covering a whole range of economic sectors, including manufacturing, utilities, services and training, transportation, agricultural and natural resources conservation [15,29,45]. Therefore, the clean energy economy is not a single industry, but an overarching umbrella that covers burgeoning business activities that contribute to the conservation of energy and the growth of alternative energy resources [26]. In the context of United States, it has attracted much attention from academic community, think tanks and the government, who have recently come to a shared understanding of what constitutes a clean energy economy. The Pew Charitable Trust defines the clean energy economy as an economy that “generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources” [51],

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p. 5. Brookings Institution proposes that clean economy can be measured by business establishment and jobs associated with them. The clean economy “produces goods and services with an environmental benefit or adds value to such products using skills or technologies that are uniquely applied to those products” [34]. The U.S. BLS (Bureau of Labor Statistics) defines green goods and services as “jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources” [53].

The two pillars underlying the clean energy economy are business establishments and jobs. The creation of green jobs and the growth of green businesses are both essential for clean energy development. In the political discussions, much emphasis was placed on the creation of green jobs, partly due to the fact that the economy needs more jobs in an economic downturn. Academically, many studies were conducted to evaluate the potential of job creation in the clean energy sectors. Ref. [46] estimated the job creation potential of solar PV installations [23]. reported that a 20% national RPS (Renewable Portfolio Standard) by 2020 (85% biomass, 14% wind energy, 1% solar PV) would create a total employment of 163,669 for the United States. Ref. [54] forecasted that aggressive energy efficiency policies combined with a 30% national renewable portfolio standards target in 2030 could create over 4 million jobs by 2030 in the United States. Ref. [42] estimated that 400,000 new green jobs would be created under full compliance with the greenhouse gas emission regulations in California. Similar green economy and green jobs studies were conducted in other national contexts [3,7,9,25,28,30,33,38,44,52]. These studies are mostly *ex-ante* evaluations of job creation potentials of relevant clean energy technology and policy scenarios, using input–output analyses.

Several think tanks make efforts to classify, inventory and aggregate data on the number of green jobs that have actually been created and maintained over the years in the United States [18,34,51]. These reports provide detailed data and analysis on green jobs at state and metropolitan levels, but no statistical analysis is conducted to explain or analyze the factors affecting green job creations. Ref. [57] investigates policy and labor market factors underlying the distribution of green jobs across the U.S. metropolitan areas and finds that metropolitan areas with clean energy policies, such as RPS and other tax incentives are likely to have more green jobs.

Compared with the burgeoning literature on green jobs forecasting and evaluations, the evaluation of the growth trajectories of green businesses is somehow absent from the literature, except for a study by Ref. [6]. Given that both green jobs and green businesses are necessary components of the clean economy, the growth and survival of green businesses deserve academic attention and investigations. The growth of clean energy economy is not only about creating green jobs, but also about the long-term survival of clean energy businesses. Several differences between green businesses and green jobs are worth discussion. First, green businesses and green jobs may undergo different trajectories in the same area. Although green businesses provide employment opportunities, they may also make strategic responses to the policy, labor market, economic and political environments by laying-off employees. Thus a state or region may experience a growth in the number of green businesses without the growth of green jobs, or vice versa. Therefore, studying the survival of green businesses is a different question from evaluating the green job creation.

Second, green businesses and green jobs serve slightly different functions in the clean energy economy. Green jobs are essential for contributing to the overall employment of the economy, since a low unemployment rate is always preferred by policy makers. Green businesses serve multiple purposes by providing tax revenues and green services, in addition to the provision of employment opportunities. Policy makers are not only concerned with job creations,

but also overall fiscal health of the government, partially affected by the tax revenues. Third, green businesses are more robust to external policy, labor market, economic and political shocks compared with the green employment. A green business can lay-off workers when in business hardships, so that they can preserve itself and seize new opportunities for growth. Thus, to some extent, the health and competitiveness of green businesses are essential for ensuring the long-term green employment growth.

Given the unique roles of green businesses in the clean energy economy, and that there is no previous study investigating the factors underlying the growth and survival of green businesses in the context of United States, this paper aims at analyzing the policy, labor market, economic and political factors influencing the survival of green businesses in the 48 continental states. The goal is to theorize and test what factors are most critical for shaping the patterns of green businesses so that policy makers and relevant stakeholders are aware of the factors that can be manipulated to adjust the overall trajectory in the green economy. The next section features a theoretical framework developed to explain green business survival. A fixed effects model is then presented as the modeling strategy, with descriptions of variables and data. The results of the model are then discussed. The paper concludes with policy implications.

2. A theoretical framework for green business survival

To explain the survival of green businesses in the context of state economies, a four component framework is developed here as presented in Fig. 1. In this framework, factors that could potentially shape the business environment in the clean energy economy are categorized into four major components: clean energy policies, labor market conditions, economic environment and political environment. The first set of factors includes the adoption and implementation of RPS (renewable portfolio standards) and tax incentives, which stimulate the market demand for renewable energy businesses. With policy-induced market demand for renewables and energy efficiency, as well as other low-carbon services and goods, the green businesses take the opportunities to meet these demands. The fluctuations in clean energy policies could result in market anxieties so that businesses reduce or delay investment. In the most extreme cases, green businesses could go bankrupt when policy support for the industry is reversed.

The second set of factors covers labor market conditions. For green businesses, labor market conditions are essential for business operations, as the cost of conducting business and the quality and quantity of labor supplies fluctuates with the rules and conditions in the labor market. Three factors in the labor market are being considered here: the stringency of minimum wage laws, unionization activities and average educational attainment. The first two factors are regulating the degree of freedom in hiring decisions and average educational attainment is a measure of labor quality in the region. The next important factor is economic environment, which is critical for the growth of green businesses. Clean energy economy is part of and shaped by the larger economic environment. The key indicators of economic environment, GSP (Gross State Product) and unemployment rate, are included here. The argument here is that clean energy economy is embedded within a larger state economy that provides market demand and relevant services for green businesses.

Political factors are the last explanations of green business growth. Many green businesses are start-ups with urgent need for policy and investment support, and are potentially fragile when the political support for the new businesses fades away. As a result, green businesses are more vulnerable to the influences from the larger political environment. The social and political acceptability

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