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Forced to be green? The Performance Impact of Energy-Efficient Systems under Institutional Pressures

Abstract

With institutional pressures from various stakeholders concerned with climate change and efficient energy use in firms' operations, it has formed the belief that energy efficiency is crucial part for sustainable operations and firm competitiveness. While an increasing number of firms have adopted energy-efficient systems (EES), a limited understanding of the actual impact of EES adoption on financial performance and how institutional pressures moderate that impact remains. Based on 238 listed firms that have deployed EES, the study reveals that firms improve their return on assets (ROA), and different institutional pressures have significant and diverse effects on the performance of EES adoption. While pressures imposed by government policies and environmental non-government organizations (NGOs) provide less financial benefits of EES, pressures from competitors provide more financial benefits of EES. The research provides empirical evidence of how pressures from energy efficiency policies, environmental groups, and competitors affect the EES-performance relationship. We also discuss implications of the findings for managers, public policymakers, NGOs, and academia.

Keywords: Energy-efficient systems; EES; institutional pressures; financial performance

1. Introduction

Given that rigorous climate change and the exhaustibility of energy resources (e.g., natural gas) have become major social concerns related to sustainable development, energy-efficient systems (EES) have obtained increasing interest from both academics and practitioners (Ngai et al., 2012). A recent research report conducted by BBC Research predicted that the global market for energy-efficient equipment will grow to $124 billion in 2022, with a compounded annual growth rate of 5.1%. Based on the research efforts involving both survey data, field studies, and research with practitioners (Ngai et al., 2012), EES generally involves technologies, procedures, and policies a firm applies that are specifically aimed at controlling and reducing the energy-related environmental effects of products or services. With adoption of EES, firms aim to reduce sources of risk and liability by reducing energy-related environmental effects. Firms also seek to enhance firm image and revenue, reduce energy costs, and improve operational efficiency (Aflaki et al., 2013). Scholars have been seeking to understand various issues related to energy efficient initiatives. For instance, Muthulingam et al. (2013) studied the adoption rates of energy efficiency opportunities in small and medium-sized manufacturing firms. Wang et al. (2019) examined how face consciousness affected consumer energy-saving behavior and the mechanism through which the impact happened and conditions under which it varied. However, understanding of the actual impact of EES remains relatively limited and inconclusive. For example, while Worrell et al. (2003) found that energy efficiency investments offered a significant boost to overall productivity, Kounetas and Tsekouras (2010) showed that energy efficient equipment improved energy efficiency, but impacted negatively on production performance.

Moreover, firms face growing pressures from the government, environmental groups, and competitors to adopt energy efficient investments to reduce their energy-related environmental effects (e.g., carbon footprints) (e.g., Garrone et al., 2018; Zhang et al., 2018). For example, in the U.S., regulatory bodies have provided financial assistance such as tax incentives and direct subsidies to firms since the late 1970s (Gillingham et al., 2004). Therefore, it is rational to expect that these pressures will influence the approach a firm implements EES adoption to obtain financial and energy efficient benefits (Huo et al., 2013). According to institutional theory, firms in the same business context tend to seek homogeneity that are consistent with those of firms that are similar to them (DiMaggio and Powell, 1983). Institutional isomorphism focuses on three mechanisms: coercive isomorphism that results from regulative bodies or resource-dependent firms, normative isomorphism associated with other firms (e.g., industry associations, customers and suppliers) connected with the focal firm, and mimetic isomorphism caused by uncertainty of a practice or competitors (Meyer and Rowan, 1977; Scott, 1995). Institutional theory suggests that firms tend to conform to these pressures to obtain support, resources, and legitimacy for survival (Meyer and Rowan, 1977) while neglecting economic efficiency. On the other hand, Rogers et al. (2007) suggested that an innovation deployed in response to institutional pressures also has the potential to produce financial reward to some extent. For example, Huo et al. (2013) found that supplier integration which was driven by institutional pressures had direct positive impact on financial performance. A recent review has called for an examination of whether the link between green initiatives and financial performance varies across different institutional settings (Endrikat et al., 2014). Although a few studies have started to examine the effect of institutional pressures on performance of green innovations (e.g., Zhu and Sarkis, 2007; Aguilera-Caracuel and Ortiz-de-Mandojana, 2013), how the institutional context influences the relationship between EES adoption and firm performance remains unknown.

Can EES-adopting firms improve their financial performance? How do institutional context in terms of different types of institutional pressures affect the relationship between EES adoption and financial performance? To address this research questions, we first use event study methodology to investigate the effect of EES adoption on financial performance using a sample of 238 U.S. listed firms that have adopted EES. Next, we conduct regression analysis to investigate when EES adoption is financially worthwhile in the institutional environment. We focus on examining government pressures (energy efficiency policies), NGO pressures, and competitive pressures that have shaped the current institutional environments of EES adoption (Okereke and Russel, 2010; Zhu and Geng, 2013; Garrone et al., 2018). Our findings demonstrate that firms enhance their financial performance upon EES adoption. The findings also indicate that the financial performance of EES adoption is negatively associated with government and NGO pressures, and positively associated with competitive pressures.

The current research is particularly noteworthy for two reasons. First, this study helps firms to understand the economic value of EES adoption and provides important insights into whether investment in EES is sustainable for a firm in the long term. The findings also provide information on the debate on whether or not synergies exist between profits and environmental technologies. Second, the examination of the influence of government, NGO and competitive pressures helps managers understand the effect of EES adoption on their firm performance when conforming to these pressures. Moreover, the findings show policymakers and NGOs that there is room for improving government policies and NGO activities, so that firms have positive incentives to adopt EES.

2. Theoretical Development and Hypothesis

2.1 The Impact of Environmental Technologies

The financial implications of a firm's environmental technologies or environmentally friendly practices have garnered researchers' focus for years. The views on the effect of environmental technologies are divergent. Some scholars (e.g., Ambec and Lanoie, 2008) believe that environmental technologies can reduce costs through the use of less material and energy, the avoidance of environmental litigation, and the migration of environmental crises and risks. They also argue that environmental technologies allow firms to improve revenues by attracting environmentally sensitive customers, increasing customer loyalty, and enjoying higher profits from environmentally friendly products and services. On the other hand, some scholars suggest that environmental technologies lead to a reduction in firm's profitability because firms that improve environmental performance take management effort and resources which could have been dedicated to core areas of the business (Walley and Whitehead, 1994; Jaffe et al., 1995). The previous research in this area also shows inconsistent empirical findings persist. While some research finds a positive relationship between environmental technologies and financial performance (e.g., Melnyk et al., 2003), others do not find a positive relationship (Gilley et al., 2000). However, recent studies tend to agree that environmental technologies help firms enhance financial performance through cost reduction and revenue gains (Chopra and Wu, 2016).

2.2 Institutional Pressures and Firm Performance

Institutional theory is popularly applied for examining the diffusion and adoption of environmentally friendly practices among organizations (e.g., Berrone et al., 2013; Zhu and Geng, 2013). There are three types of institutional pressures: coercive, normative, and mimetic (Meyer and Rowan, 1977; Scott, 1987). Coercive pressures come from organizations such as business partners, suppliers, distributors, social groups and clients which firms' are dependent on (DiMaggio and Powell, 1983). In the framework of institutional theory, coercive power from government regulations can be based on two factors, namely, imposition and inducement (Scott, 1987). Imposition-based coercion includes regulations and mandates that have the power to accept or deny a firm's existence in jurisdiction, while inducement-based coercion refers to influencing strategies that provide organizations with incentives or rewards to willingly conform to specific conditions. Normative pressures primarily arise from professional organizations such as professional networks and industry associations (DiMaggio and Powell, 1983) as well as focal social groups (Scott, 1995) that define the appropriate behavior and standards for group members. Mimetic pressures are manifested when firms imitate other firms when confronted with ambiguous and uncertain situations or model their competitors that they perceive as considerably legitimate or successful (DiMaggio and Powell, 1983).

Institutional theory suggests that firms embedded in institutional environment face strong pressure to comply with institutional expectations to obtain legitimacy because violations may harm firms' survival and performance (DiMaggio and Powell, 1983; Meyer and Rowan, 1977). From this view, firms tend to emphasis legitimacy over economic efficiency. Such conformity can limit a firm's flexibility in operating its core business tasks and can move resources away from other productive activities, thus reducing the financial benefits of the conformity (Meyer and Rowan, 1977; Zucker, 1987). On the other hand, Rogers et al. (2007) demonstrated that an innovation that is aligned with firm's goals, has the potential to create financial benefits even though it was deployed to conform to institutional pressures.

Moreover, prior literature indicates that institutional pressures have moderating effect on firm performance in various context including operations and the supply chain. Zhang et al. (2018) showned that institutional pressures promoted top management support leading to firm's energy saving behaviors. Garrone et al (2018) demonstrated that institutional pressures (regulation and NOGs) drove the adoption of energy efficient activities. Dubey et al. (2015) showed that the effect of customer relationship management and total quality management on environmental performance was moderated by institutional pressure. Huo et al. (2013) found that supplier integration which was driven by institutional pressures had direct positive impact on financial return. Westphal *et al.* (1997) determined that conformity in the normative adoption of total quality management (TQM) was negatively related to financial performance because normative adoption tended to be standardized and was less suitable for the firm's specific environment. Based on a survey involving 341 Chinese manufacturers, Zhu and Sarkis (2007) investigated the effects of three types of institutional pressures on the relationship between green supply chain management (GSCM) practices and financial benefits. The researchers concluded that mimetic pressures had a positive effect on the relationship and regulation, and normative pressures had a negative impact on the relationship. Aguilera-Caracuel and Ortiz-de-Mandojana (2013) showed that regulatory pressures negatively impacted the link between green innovation and financial performance because of increased costs and difficulty differentiating for firms under high regulatory pressures.

2.3 The Effect of EES Adoption on Financial Performance

EES is important to operational decision making because energy composes a significant part of firm input, and energy efficiency in process normally involves process improvement (Muthulingam et al., 2013). EES involves technologies and policies a firm uses to control and reduce the energy-related environmental effects of products or services (Ngai et al., 2012). EES Examples of technologies include new technologies such as lighting, information systems, motor systems, combustion systems, and thermal systems, and the application of new technologies to decrease the amount of energy required to generate products and service. Energy management practices include the establishment of energy efficiency policy, development of an energy management team, applications of energy-efficient production process, and the training of employees to prevent energy waste.

From an institutional perspective, firms adopt EES may focus on the social factors of the adoption, while neglecting its financial benefits. However, some scholars (e.g., Rogers et al., 2007; Huo et al., 2013) argue that when the innovation aligns with firms' business strategies, it can potentially create financial benefits even though it is required to secure social legitimacy. For example, Huo et al. (2013) found that supplier integration which was driven by institutional pressures had positive impact on financial performance. From this perspective, EES should offer direct benefits to firms and is consistent with the goals of firms. Under such situation, managers will not only adopt EES symbolically or loosely, but also delicate efforts to enhance their EES (Huo et al., 2013). Hence, even though EES implementation may be motivated by institutional pressures, a substantive EES adoption still has the potential to generate financial benefits (Walker and Wan, 2012). Moreover, conforming to institutional pressures may help firms to gain legitimacy and resources from stakeholders, such as supply chain partners, for financial benefits (Scott, 1995), organizational survival (Meyer and Rowan, 1977), and strategic benefits (Colwell and Joshi, 2013).

From an operational perspective, as with other environmental technologies, we expect that EES adoption can improve a firm's financial performance through its bottom-line impacts on cost reduction and revenue growth. For cost, EES spending can enable firms to rationalize their production and operational processes to reduce energy-related environmental effects. The rationalization involves modification or replacement of equipment, redesign of the production processes, elimination of unnecessary processes, or streamlining of business processes to minimize energy usage (Muthulingam et al., 2013). Consequently, EES-adopting firms could substantially reduce their costs, such as electric energy usage, emissions, and utility bills (Hashmi et al., 2015). Furthermore, EES initiatives could reduce the costs of modifying operating policies and technologies to meet new government policies in the future (Delmas, 2004). In addition, effective EES adoption could reduce the mitigation of risks in losses from regulation and prevent expenses associated with lawsuits and legal settlements.

For revenue, consumers are increasingly focusing on firm's energy-efficient conduct (Aflaki et al., 2013). Firms with effective EES initiatives may have reputational benefits and competitive advantages that help increase sales among existing or new customers that are sensitive to energy-related environmental issues (Miles and Covin, 2000). For example, firms can market the EES initiative externally, thus enhancing their environmental reputation and differentiating in the market to have a competitive edge. In addition, when a firm deploys the latest EES, it could update the obsolete workflow and improve product and service quality, leading to considerably higher customer satisfaction and thus higher revenue (Kassinis and Soteriou, 2003).

On the other hand, EES adoption has some drawbacks. EES adoption may involve an internal cost of adjustment, including the capital cost, installation costs, ongoing costs (e.g., maintenance) (Liu et al., 2014b), and the costs of production disruption during implementation (Damanpour, 1996). In fact, energy efficiency products that are environment friendly are generally more expensive than those conventionally used. Moreover, EES payback periods vary from a month to several years (Reddy et al., 2010). While the initial investment into energy efficient technologies can be high, the benefits in terms of lower energy bills accrue slowly. Other hidden costs or risk premiums are another major drawback to EES adoption (Ramos et al., 2015). For example, it is hard to estimate the economic return of EES investments because political and technological environment change over time. However, considering the aforementioned benefits, we expect that in the long term, the benefits of the EES will be able to offset any additional costs of implementing EES adoption.

Therefore, we posit that EES adoption can lead to an increase in a firm's financial performance as measured by ROA, which is a common measure of the overall operational effectiveness in the field of operations management (Lo et al., 2014). We define ROA as operating income (before depreciation, interest, and taxes) per total assets.

H1. The adoption of EES significantly increases long-term financial performance.

2.4 The Moderating Effects of Institutional Pressures on the EES-Performance

Although we expect a positive effect of EES adoption on financial performance, the magnitude of this impact may be contingent upon the institutional environment.

2.4.1 Government Pressures

Government energy efficiency policies such as regulations and financial incentives are the main sources of coercive pressures on businesses (Hashmi et al., 2015; Garrone et al., 2018; Zhang et al., 2018). Regulations normally combine with negative consequences such as penalties and lawsuits to push firms to adopt a practice, whereas the financial incentives provide financial assistance such as direct subsidies and tax incentives to motivate firms to willingly conform to specific conditions. Table 1 shows sample of those energy efficiency policies which firms are required to comply with. These policies included regulation (e.g., building energy code) and financial incentives (e.g., rebates, grants, loans, corporate tax). Table 1 shows sample of those policies which are collected from the Database of State Incentives for Renewables and Efficiency (DSIRE).

Table 1

Samples of energy efficiency policies (Extracted from DSIRE).

Energy Efficiency Policies	Year	State	Details
Building Energy Code	2010	California	Eligible Efficiency Technologies: Comprehensive Measures/Whole Building, and is mandatory statewide. Buildings must also meet requirements set by CALGreen, the statewide green building code.
Property Tax Incentive	2008	Virginia	Eligible Efficiency Technologies: Comprehensive Measures/Whole Building.
State Rebate Program	2011	New Hampshire	Eligible Efficiency Technologies: CHP/Cogeneration, Comprehensive Measures/Whole Building Equipment Requirements: Addressed by energy-reduction plan Funding Source: Regional Greenhouse Gas Initiative (RGGI)

Government may provide technical assistance to potential adopters and thus reducing their search and information costs relate to the adoption (Delmas and Toffel, 2004). On the other hand, Scott (1987) pointed out that organizational changes created by inducements were unlikely to have strong or lasting effect on the firm performance. Motivated by high pressures imposed by immediate and direct financial incentives, firms are more likely to adopt EES that is a short-term and one-off initiative with limited impact on profitability, rather than a comprehensive and fundamental way of improving energy efficiency. As for regulations, the traditional view is that pressures from regulations are associated with diminished firm profits (Williamson et al., 2006; Darnall, 2009). Firms are required to internalize external costs that they would otherwise transfer to society. Under government pressures from specific and stringent requirements, firms would struggle to maximize the effectiveness of EES to improve energy efficient performance. Firms will need to budget financial resources for EES initiatives to meet those requirements. Consequently, firms' adoption costs will increase and thus lower their financial performance (Zhu and Sarkis, 2007). For example, Lanoie et al. (2011) concluded that the relationship between environmentally friendly practices and financial performance was less positive when the environmental regulation was constraining since a large portion of the investments necessary to comply with regulations entailed additional production costs.

Moreover, to reduce the costs of meeting government requirements, under regulatory pressures, firms with reactive EES strategy are likely to limit their EES investment to bare-minimum compliance (Sharma and Vredenburg, 1998; Albertini, 2014), Previous studies have suggested the reactive environmental initiatives that are driven by compliance with environmental regulations and that imply environmental activities need to meet a minimum level achieve lower financial performance than proactive approaches that extend beyond compliance (e.g., Klassen and Whybark, 1999). In addition, regulatory pressures have constraints on a firm's flexibility in addressing environmental issues (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013) and in customizing the EES adoption to that which is a better fit to their unique needs and capabilities (Berrone et al., 2013). Consequently, firms may experience lower return from EES adoption due the mismatch. According to the above arguments, we hypothesize below:

H2. The impact of EES adoption on financial performance is moderated by government pressures.

2.4.2 NGO Pressures

Environmental NGOs have played a key role in organizing climate change campaigns (Hall and Taplin, 2007) and thus shaped the coercive and normative institutional environment of EES adoption (Carter and Jacobs, 2014; Garrone et al., 2018). NGOs promote guidelines and codes of ethics that push firms to improve energy efficiency beyond the minimum regulatory requirements (Huo et al., 2013). NGOs, which have high requirements for environmental innovation for the achievement of environmental goals (Berrone et al., 2013), commonly lobby targeted firms to meet their requirements. NOGs campaigns and protests can advocate changes in government policies as well (Delmas and Toffel, 2004). There are several examples where firms adopt their energy efficient initiatives in response to environmental NGO pressures to reduce carbon footprint (Trimi and Park, 2013). For example, Green Grid establishes technological standards and guidelines and measurement models for energy efficiency of IT facilities, and its power usage effectiveness (PUE) has become a standard for calculating data center energy efficiency (Trimi and Park, 2013).

Firms encounter more pressure when the presence and campaigns of NGOs increase. NGOs, which have a limited ability to reward firms for following their practices, exert pressure on firms to adopt energy management initiatives by mobilizing resources, using their voice, and channeling and coordinating activist groups and social movement initiatives (e.g., boycotts, protest, and lawsuits) that can damage or pose a threat to the financial performance and reputation of firms (Berrone et al., 2013). Thus, firms under NGOs pressures may need to exert more effort to remain consistent with those NGOs' requirements on EES adoption to avoid or limit such damage (Sasser et al., 2006). Consequently, these firms may suffer an increase in adoption costs and a reduction in flexibility in terms of customizing the adoption in a manner that is more appropriate for their specific environment (Westphal et al., 1997; Berrone et al., 2013); this, in turn, leads to less financial benefits.

On the other hand, NGOs develop basic norms to facilitate EES adoption. They can receive better knowledge, experience, management expertise, and resources, when communicating with officials of various government agencies and managers of other firms, which will, in turn, strengthen their acceptance and perception of EES (Zhang et al., 2018). Under NGO pressures, firms are likely to obtain experience and knowledge about EES from NGOs, lead to higher financial returns from EES. However, under NGO pressures, firms also will need to have commitment in terms of resources and time in the dialog processes (Burchell and Cook, 2006); these could have been used in core areas of the business performance-enhancing activities. Therefore, we suggest the hypothesis:

H3. The impact of EES adoption on financial performance is moderated by NGO pressures.

2.4.3 Competitive Pressures

Firms are under mimetic pressures to adopt EES because firms are following their competitors in their sector to adopt EES (Jones and Jones, 2018). For instance, when Wal-Mart launched energy-efficient stores, other retailers such as Target and Kohl's Department Stores followed. Mimetic pressures increase over time when more firms have imitated others to adopt EES. EES involve uncertainties and risks (Ramos et al., 2015) including production failure and production disruption, it is critical to learn from successful EES adoption. Followers can obtain better performance by imitating their competitors (Teo et al., 2003; Ritchie and Melnyk, 2012). On the other hand, when the innovation becomes more commonly adopted, followers receive fewer competitive advantages from the adoption (Porter and Millar, 1985). In other words, when competitive pressures are low, that is the adoption is in the early diffusion, the financial benefits of EES adoption are likely to be higher.

In addition, firms tend to follow the "best practice approach" generated by prior adopters rather than use an environmentally aligned and customized adoption that meets their specific requirements (Fiol and O'Connor, 2003). This kind of "me too" adoption may negatively influence the realization of the firm value (Fiol and O'Connor, 2003; Swanson and Ramiller, 2004) because firms normally ignore the high costs and apparent risks involved (Swanson and Ramiller, 2004). In fact, a study conducted by Barreto and Baden-Fuller (2006) shows that a mimetic bank branching decision negatively affected a firm's financial performance because decision makers followed both strong and poor practices that were adopted by competitors. Therefore, the current study presents the following hypothesis.

H4. The impact of EES adoption on financial performance is moderated by competitive pressures.

Figure 1 illustrates the research model and hypotheses.

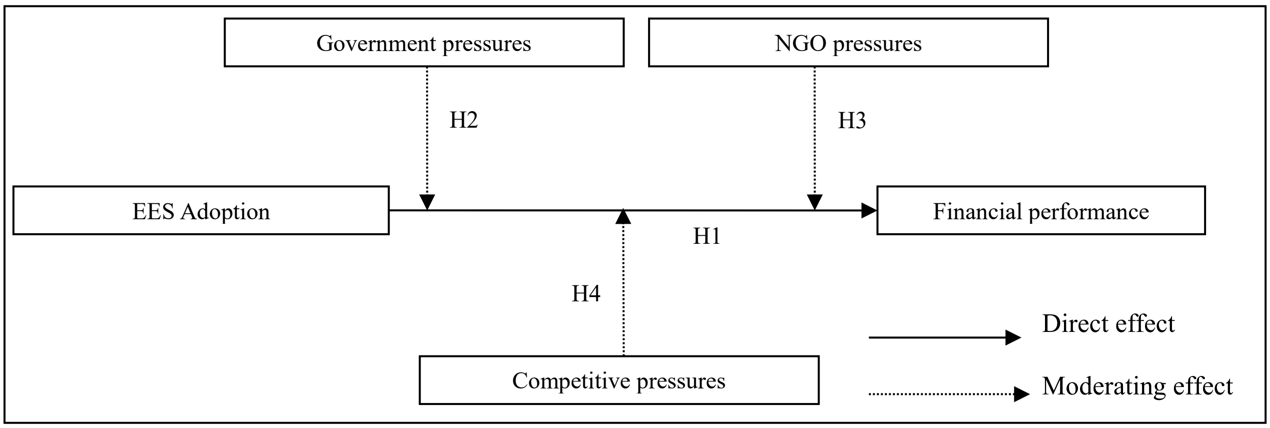

Figure 1. Research framework.

3. Data Processing and Variables

To examine our hypotheses, we identified EES adopters from Factiva (Dow Jones Newswires).Following previous studies in obtaining announcements from Factiva (e.g., Lam et al., 2016; Lui et al., 2016; Lui et al., 2019), we applied a systematic mechanism to ensure the validity of data. First, we searched news articles in Factiva using sample firms' names and keywords such as energy efficient systems and energy management. We limited our searches to the period 2002 to 2011. The extensive time period for data collection is useful to obtain the trend of EES adoption in different institutional environment. For all the news articles collected from Factiva, the research team studied and evaluated the announcements identified. We also exclude duplicated news of the same EES initiative from different publication sources. For ambiguous cases, the research team rechecked announcements by searching other sources, such as annual reports and corporate energy efficiency reports from company websites, for announcements of EES adoption for each firm. Only firm-wide initiatives are included in the study.

Below is an example of EES initiatives (text extracted from Factiva).

Jan 1, 2002: Modern Bulk Transporter: "Chevron Corp (NYSE: CVX) is using a new system to manage its energy use more effectively and monitor greenhouse gas emissions from all of its worldwide operations, including transportation."

The above step uncovered 338 EES-adopting firms between 2002 and 2011. We further discarded 58 firms because there was no information for these firms on the year of their EES adoption. We removed announcements with confounding events, including mergers and acquisitions, and new business units developed during the period of EES adoption. In addition, we discarded 42 firms for which financial data was unavailable from the EES adoption period (these firms had adopted EES before listing on the stock exchange). Finally, we included 238 sample firms that have adopted EES.

To verify whether firms actually adopt the EES initiatives that they have disclosed in Factiva, we read through each of these announcements to determine the EES deployed by firms. We observed that among these 238 announcements, 90 were certificates or awards from government entities (e.g., US Environmental Protection Agency (EPA)), or private organizations (e.g., IDG's Computerworld) for their EES which we can check corresponding records in the websites, e.g., via EPA website (https://www.epa.gov/newsreleases/search/subject/awards-and-recognition). 61 were announcements related to EES implementation made by EES vendors. For example, Electric City announced that Dean Foods entered into an agreement with it to install EnergySaver systems in Dean Foods' production facility. For the remaining 87 announcements, we were able to confirm 76 of these 87 announcements according to other sources such as reports, books, and magazines. Overall, we verified 227 (95.4%) of the announcements, thus demonstrates the alignment between the announcements and actual implementation of firms' EES initiatives.

Panel A of Table 2 presents the sample breakdown by industry (two-digit SIC codes). EES adoption is most popular in manufacturing industries (SIC 20–39) with 85 manufacturers having adopted EES (36% of the sample). Panel B of Table 2 presents the characteristics of the sample firms in $t-2$. The median total assets and the R&D intensity (divide R&D expenditure by sales) were US$ 9.836 billion and 0.4%, respectively, while the median carbon footprint (the ratio of the carbon dioxide to sales, which is estimated based on data collected from Trucost), sales growth, and ROA were 173.596 tons of CO_{2e} per million of U.S. dollars, 9.4%, and 10.1%, respectively.

Table 2

Sample and descriptive statistics.

Panel A: The distribution of sample firms across industries		
Industry (2-digit SIC codes)	Sample No.	%
Manufacturing (20–39)	85	35.71
Transportation & public utilities (40–49)	30	12.61
Wholesale & retail (50–59)	34	14.29
Finance, insurance, real estate (60–67)	71	29.83
Services (70–89)	18	7.56
Total	238	100

Panel B: The characteristics of sample firms (t – 2)						
	N	Mean	Median	s.d.	Min.	Max.
Sample firms						
Total assets [a]	238	68.348	9.836	263.093	0.954	2,949.092
R&D intensity	238	0.037	0.004	0.073	0.000	0.496
Carbon footprint [b]	216	529.814	173.596	1,470.294	28.057	11,506.708
Sales growth	238	1.325	0.094	17.499	–0.282	269.489
ROA	238	0.112	0.101	0.071	–0.028	0.290

[a] In billions of U.S. dollars.
[b] In tons of CO_{2e} per million of U.S. dollars. The sample size is smaller because Trucost, founded in 2000, provides related data only from 2002.

In this study, we used financial data from the COMPUSTAT database and energy consumption data from the Trucost database. Information regarding government energy efficiency policies originated from the Database of State Incentives for Renewables and Efficiency (DSIRE), and NGOs information originated from the National Center for Charitable Statistics (NCCS).

3.1 Measures of Variables

3.1.1 Moderating Factors

Government Pressures. Previous studies have suggested that budgets can serve as measures of stakeholder power (e.g., Kassinis and Vafeas, 2006). Accordingly, we used information on state budgets to measure a state’s resource allocation for energy efficiency issues. We estimated the ratio of total state energy efficiency budget relative to total state budget to measure government pressures. We collected the energy efficiency budget from the Consortium for Energy Efficiency which surveys annually administrators of public benefits programs to obtain trends in aggregated expenditures and budgets. The total state budgets were collected from Council of State Governments. To consider all those states where the firms had a subsidiary (Berrone et al., 2013) as well as the influence of size of each subsidiary, we calculated a weighted average of government pressures by considering all the states where the firm had a subsidiary and by including the proportion (based on the number of employees) of subsidiaries the firm had in each of the states as weights. Considering the non-normal distribution of this variable, we included it in the model after using a log transformation. We collected data on a firm's subsidiary location and the number of employees in each subsidiary from SEC filings and D&B Hoovers.

NGO Pressures. We used the total revenue of environmental NGOs concerned with energy efficiency and climate change issues in a state and year as a proxy for NGO pressures. This measure describes these NGOs' sizes and thus the visibility of the movement toward energy efficiency concerns. Movements by larger NGOs are more influential and imply a greater source of pressure for firms to adopt environmental initiatives (Pacheco and Dean, 2015). We calculate the ratio of total revenue of NGOs relative to total state GDP per year to capture NGO pressures. We obtained data about NGOs from the National Center for Charitable Statistics (NCCS) to determine the total revenue of NGOs included in the "Renewable Energy and Energy Conservation" category within a state and year. Again, we measured the weighted average by considering all those states in which the focal firm had a subsidiary and by including the proportion (based on the number of employees) of subsidiaries the firm had in each of the states as weights. Given the non-normal distribution of this variable, it was log transformed before inclusion in the model. Previous studies have used a similar approach in measuring NGO pressures. For example, Berrone et al. (2013) used the number of environmental NGOs to capture NGO pressures. Our results maintain robust when we used the number of environmental NGOs. Table A1 in Appendix A1 provides Statistics of the NGOs and policies of the government on energy efficiency in some states.

Competitive Pressures. Based on the sample firms we collected, we measured competitive pressures as proportion of adopting firms in an industry (two-digit SIC codes) (Haunschild and Miner, 1997). This measure captures the cumulative number of EES adopters that increase each year and thus the increasing competitive pressures toward EES adoption. Previous studies have suggested that the number of firms in the same industry that have deployed an organizational form in the past increase the likelihood of subsequent adoption by the remaining firms in the industry (DiMaggio and Powell, 1983; Delmas and Toffel, 2004; Yeung et al., 2011). Given the non-normal distribution of this variable, it was log transformed before inclusion in the model.

3.1.2 Control Variables

We included a broad range of control variables which may affect the dependent variable of *abnormal ROA*. First, a more profitable firm could be more capable of achieving higher financial performance in the future (Lo et al., 2014). Therefore, we controlled for a *firm's previous ROA*. Each firm's previous ROA was industry-adjusted (minus the industry average ROA in the same two-digit SIC code industry in the same year). We also controlled for *firm size* (logarithm of the firm assets), *R&D intensity*, and *capital investment* (capital expenditures over total assets), because a firm with large size, high R&D intensity, and high capital investment may have more resources and higher capacity to implement EES (Dehning and Richardson, 2002; Xue et al., 2012) and thus could positively affect abnormal ROA. The above firm-level control variables were based on data in $t-2$. Because a firm may have adopted an environmental management system (i.e., ISO 14000), we controlled *ISO 14000* by coding the variable as 1 to represent a firm with an ISO 14000 certification during the same period ($t-2$ to $t+2$) and 0, if otherwise. It is possible that firms with existing environmental initiatives attain lower financial performance because they have limited room for additional financial benefits from the EES initiative.

Second, we included industry sales growth, industry competitiveness, and industry carbon footprint as industry-level control variables. *Industries sales growth* represents the economic environment of the industry and was calculated as the mean industry change in sales from year *t* – 2 to *t* + 2. Firms in high sales growth industries could positively impact the relationship between financial performance and EES adoption; however, high sales growth industries could also focus more on business development and have fewer resources to implement EES (Lu and Jinghua, 2012). We also controlled for *industry competitiveness,* calculated as the Herfindahl index (H-index) (Boyd, 1995). H-index is the sum of the squared fraction of industry sales by a firm (two-digit SIC code). In highly competitive industries (small value of H-index), returns from innovative investments tend to be competed away (Melville et al., 2007). We used *industry carbon footprint* to control the influence of energy intensive industries. *Industry carbon footprint* was defined as the natural logarithm of the industry-average carbon footprint (two-digit SIC code). High industry carbon footprint indicates high energy intensity of an industry. It is likely that industries that are more polluting are able to obtain more financial benefits from EES adoption (Klassen and Whybark, 1999).

4. Analysis and Results of Hypothesis Testing

4.1 Analysis of Direct Effect of EES (H1)

We employed the long-horizon event study approach to study the causal link between EES adoption and financial performance. Long-horizon event study has been increasingly used to examine the impact of corporate initiatives (e.g., Lui et al., 2016). The year of the formal EES adoption, which indicates that a firm has successfully adopted full-scale EES, is represented as *t.* Previous studies suggested that full-scale EES implementation requires approximately one year to one year and a half (Eichholtz et al., 2012). Therefore, we defined *t* – 2 (i.e., pre-event year) as the initiating time of EES adoption that the firm was free from the impact of the EES adoption. Previous studies (e.g., Lo et al., 2012; Liu et al., 2014a) suggest that when an innovation adoption starts to be implemented, it is likely to have impact on firm performance on the subsequent year following the base year. Also, for longer than two years post-event performance, firms are likely to encounter other confounding events that might affect their firm performance as well. Accordingly, we examined abnormal performance over a period of four years from the start of the EES adoption process (i.e., $t - 1$, t, $t + 1$, $t + 2$). The four-year event window is also aligned with previous research (e.g., Deng et al., 1999; Lo et al., 2014) that indicates three to four year event window can reflect the long-term impact of an innovative practice.

As the adoption of EES is not a random event, to measure the abnormal changes in financial performance, propensity score (Rosenbaum and Rubin, 1983) calculated from a logistic regression was used to match control firms. Employing propensity score method allows us to compare EES-adopting firms with similar (propensity scores) firms that do not adopt EES. The matching procedure is widely used in previous research to reduce selection bias issues (e.g., Lui et al., 2016). We considered factors influencing the decision of EES adoption according to findings from previous studies (e.g., Damanpour and Schneider, 2009; Cooremans, 2012; Berrone et al., 2013). The predicting variables were firm size (total assets), ROA, financial slack, R&D intensity, capital intensity, government, NGO, and competitive pressures. We included *financial slack* (current assets over total assets) because it influences a firm's willingness or readiness for EES adoption (Cooremans, 2012). When firms have low financial slack, other issues prevail the management mindset, relegating environmental issues to a lower priority (Henriques and Sadorsky, 1996). Firms with high R&D intensity indicated that their top managers are risk-takers who can bear innovations adoption with risk and uncertainty in financial returns (Damanpour and Schneider, 2009). Capital-intensive firms have higher technology-specific resources and capabilities, such as employee innovative capabilities to handle innovations, than non-capital-intensive firms (Love et al., 2009). Capital-intensive firms are therefore more likely to invest in EES adoption. Capital intensity was measured using the logarithm of the ratio of the total assets and sales of a firm. To make sure that control firms are similar to sample firms, year fixed effects and industry (four-digit SIC) fixed-effects were used to match sample firms with control firms. Measurement of government pressures, NGO pressures, and competitive pressures was discussed in section 3.1.1 Moderating Factors. Financial data for the sample and control firms were collected from the COMPUSTAT database. We are unable to control all factors because of a lack of available data. The error term represents those unknown factors which are normally held by all firms. Specifically, the logistic model is as follows:

$$\Pr(EES_{it}) = \alpha_0 + f_{\text{industry}} + f_{t\text{-}2} + \beta_1\text{Firm size}_{it-2} + \beta_2\text{ROA}_{it-2} + \beta_3\text{Financial slack}_{it-2} + \beta_4\text{R\&D intensity}_{it-2} + \beta_5\text{Capital intensity}_{it-2} + \beta_6\text{Government pressures}_{it-2} + \beta_7\text{NGO pressures}_{it-2} + \beta_8\text{Competitive pressures}_{it-2} + e_{it},$$

Where α_0 is the estimation of the regression intercept, t is the adoption year, and Pr (EES*it*) is the probability of the *i*th firm adopting EES in year t. Table 3 (before matching model) shows that there were 981 control firms for the 238 sample firms. The results also show that firms with large size, high R&D intensity, and under government, NGO and competitive pressures are more likely to adopt EES. After estimating the propensity scores of each firm, we used a one-to-one nearest neighbor (with a caliper size within 0.05) matching without replacement to select a control firm for each sample firm. Specifically, we selected a control firm (with the same four-digit SIC) with the nearest propensity score in the base year t – 2 for each sample firm. Consequently, 181 sample firms were successfully matched with control firms which are non-EES adopters. Table 3 indicates that these selection parameters were not significant in the logistic model (i.e., the after matching model), indicating that the matching does not create a selection bias, thus the matching is successful. In addition, after the matching, there is no statistical significance (t-test) on those parameters between sample and matched control firms.

Table 3

Results of propensity score matching.

Independent variables	Before matching	After matching
Firm size[a]	0.171 (0.062) *	0.091 (0.290)
ROA	–0.636 (0.152)	0.426 (0.225)
Financial slack	0.070 (0.240)	0.021 (0.360)
R&D intensity	1.313 (0.097) *	0.913 (0.541)
Capital intensity	–1.106 (0.173)	–0.612 (0.406)
Government pressures[a]	1.514 (0.091) *	–0.912 (0.207)
NGO pressures[a]	1.204 (0.032) **	0.512 (0.311)
Competitive pressures[a]	1.258 (0.039) **	0.723 (0.492)
Control	981	238
Sample	238	238

[a] Logarithm transformed.

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$; one-tailed tests.

We examined the presence of multicollinearity by testing the variance inflation factor (VIF) values among the independent variables. A VIF value more than ten suggests potential multicollinearity problem (J.F. Hair Jr., 2006). The VIF values for the independent variables we obtained ranged less than two, indicating that multicollinearity may not be an issue among the independent variables (J.F. Hair Jr., 2006). Furthermore, we examined the marginal effect of government pressures, NGO pressures, and competitive pressures respectively. When we kept other factors constant by shifting government/NGO/competitive pressures from one standard deviation above average government/NGO/competitive pressures, the likelihood of EES adoption increased by 8.75%/6.98%/7.56%, respectively.

Abnormal performance was estimated as the sample actual performance minus the expected performance. We measured the expected performance as the sample pre-event performance plus the control firm's change of performance during the same period (Barber and Lyon 1996). The formula for estimating the abnormal changes is listed below:

$$AP_{(t+j)} = PS_{(t+j)} - EP_{(t+j)}$$

$$EP_{(t+j)} = PS_{(t+i)} + [PC_{(t+j)} - PC_{(t+i)}]$$

where AP is the abnormal performance of the sample firm. PS is the actual performance of sample firm. PC is control firm's performance. EP is the sample firm's expected performance. t is the year of EES adoption. i is the base year ($i = -2$) and j is the ending year of comparison ($j = -1$, 0, 1, and 2). We performed the Wilcoxon signed-rank (WSR) test and sign test to investigate abnormal performance. We used the results of the WSR test to provide a discussion in the following section because the WSR test considers the magnitude of observations that are less influenced by outliers (Yeung et al., 2011). However, we also performed parametric t-tests for the means of abnormal performance to show the robustness of our findings.

Table 4 presents the results of the year-to-year and cumulative abnormal performance analyses using event study methodology. The column "Time period" shows the event periods for abnormal changes in performance, where t is the year that the sample firms complete their first EES adoption. Due to the unavailability of data, the sample size, N, gradually decreased as we looked into longer time periods beyond the baseline year ($t - 2$). Hypothesis 1 predicted that EES adoption significantly improved a firm's financial performance. As shown in Table 4, abnormal changes in ROA were insignificant in the periods ($t - 2$ to $t - 1$) and ($t - 1$ to t), whereas the results were significantly positive across all other yearly and cumulative periods. As an example, the median abnormal ROA in the period ($t - 2$ to $t + 2$) was 0.677% ($p < 0.01$). The results demonstrate the positive impact of EES adoption on firm financial performance. Therefore, Hypothesis 1 is supported.

Table 4

Results of abnormal changes in ROA (%).

Time frame	N	Median	WSR Z-statistic	Mean	t-statistic	% positive	Z-statistic
$t - 2$ to $t - 1$	238	0.061	1.039	0.020	1.045	52.92	0.723
$t - 1$ to t	234	0.052	1.106	0.072	0.292	51.23	0.740
t to $t + 1$	216	0.003	1.561*	0.314	2.331**	54.12	0.901
$t + 1$ to $t + 2$	191	0.220	2.602***	0.627	2.891***	57.24	2.232**
$t - 1$ to $t + 1$	216	0.195	1.445*	0.542	2.342**	58.11	2.450
$t - 1$ to $t + 2$	191	0.388	2.781***	0.834	2.873***	53.12	1.990**
$t - 2$ to $t + 1$	216	0.491	2.811***	0.768	3.210***	53.45	1.981**
$t - 2$ to $t + 2$	191	0.677	3.593***	1.432	2.912***	58.11	2.673***

$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$; one-tailed tests.

The results clearly show that EES adoption improves a firm's profitability in the long term. The results are also consistent with the results indicated in other event studies related to organizational innovations such as OHSAS 18001 (Lo et al., 2014). Moreover, these results provide information on the debate on whether or not synergies exist between profits and environmental technologies. The findings are consistent with those of recent studies, which demonstrate that the benefits of environmental technologies are greater than the associated costs and required investments (Klassen and Whybark, 1999; Kassinis and Soteriou, 2003). Nevertheless, our findings do not support studies that indicate that a trade-off exists between environmental performance and financial performance (Walley and Whitehead, 1994).

4.1.1 Intermediate Organizational Outcomes

To show how EES adoption contributes to the improvement of financial performance through intermediate organizational outcomes, we further investigated EES-adopting firms' performance on two key intermediate organizational outcomes: carbon footprint (reduced carbon footprint suggests reduced energy cost) and sales growth. Panel A in Table 5 shows that the abnormal changes in carbon footprint significantly decreased during the periods (*t* to *t* + 1) and (*t* + 1 to *t* + 2). Cumulative changes in carbon footprint were significantly negative in all the cumulative periods. For example, the median abnormal carbon footprint in the period (*t* – 2 to *t* + 2) was –0.002 tons of CO2e per million of U.S. dollars ($p < 0.05$). Thus, the results show that EES adoption reduces the carbon footprint of a firm. Panel B in Table 5 shows that the yearly abnormal changes in sales growth significantly increased to 1.34% in the second year after EES adoption (*t* + 1 to *t* + 2; $p < 0.05$). The cumulative changes in sales growth during the periods of three years (*t* – 1 to *t* + 2; *t* – 2 to *t* + 1) and four years (*t* – 2 to *t* + 2) were 1.654%, 1.587, and 2.061%, respectively, which are statistically significant ($p < 0.05$). Therefore, these results suggest that EES adoption improves sales growth of a firm as well. Our results also indicate that efficiencies gained from EES adoption are reflected strongly in carbon footprint, as opposed to sales growth. This pattern is not surprising as the main function of EES is to improve the efficiency of energy use and to generate less energy-related environmental effects.

Table 5

Abnormal changes in carbon footprint and sales growth.

Time frame	N	Median	WSR Z-statistic	Mean	t-statistic	% positive	Z-statistic
Panel A: Carbon footprint [a]							
t – 2 to *t* – 1	216	–0.001	–0.824	–0.001	–1.210	47.17	–0.571
t – 1 to *t*	191	–0.001	–0.630	–0.002	–0.549	42.69	–0.825
t to *t* + 1	151	–0.000	–2.189**	–0.006	–2. 497***	40.61	–1.880**
t + 1 to *t* + 2	102	–0.000	–1.831**	–0.007	–2.201**	42.92	–1.757**
t – 1 to *t* + 1	151	–0.001	–1.913**	–0.020	–2.579***	38.01	–1.683**
t – 1 to *t* + 2	102	–0.001	–1.819**	–0.012	–1.910**	39.30	–1.712**
t – 2 to *t* + 1	151	–0.001	–2.191**	–0.014	–3.356***	40.19	–1.937**
t – 2 to *t* + 2	102	–0.002	–2.280**	–0.003	–2.584***	41.45	–2.021**
Panel B: Sales growth (%)							
t – 2 to *t* – 1	238	0.191	0.554	1.901	0.156	51.45	0.189
t – 1 to *t*	234	0.809	0.454	1.093	0.583	51.38	0.853
t to *t* + 1	216	0.783	0.177	0.271	0.138	53.30	0.825
t + 1 to *t* + 2	191	1.340	2.346**	5.430	2.680***	55.19	1.853**
t – 1 to *t* + 1	216	0.102	0.189	0.691	0.293	50.18	0.128
t – 1 to *t* + 2	191	1.654	3.006***	5.524	2.840***	52.50	2.068**
t – 2 to *t* + 1	216	1.587	1.740**	2.209	1.603*	52.28	0.598
t – 2 to *t* + 2	191	2.061	2.601***	2.751	2.639***	54.82	2.346**

[a] In tons of CO_{2e} per million of U.S. dollars. The sample size is smaller because Trucost, founded in 2000, provides related data to some firms from 2002.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; one-tailed tests.

4.1.2 Robustness Tests on the Direct Effect

Endogeneity test. We performed tests to examine whether the link between EES adoption and financial performance was not due to endogeneity issues. We first examined changes from "t – 3 to t – 2" to detect whether systematic bias exists before the implementation of EES. Table 6 demonstrates that there was no significant change among all performance indicators in the period.

Table 6

Findings of systematic bias tests.

Performance	N	Median	WSR Z-statistic	Mean	t-statistic	% positive	Z-statistic
ROA (%)	238	–0.031	–1.039	–0.291	–1.157	43.06	–0.454
Carbon footprint	216	0.000	0.554	0.005	1.084	46.60	0.081
Sales growth (%)	238	0.263	0.614	–0.322	0.177	38.41	0.280

Using Barber and Lyon's (1996) matching method. We examined whether the matching approach affects the results by applying Barber and Lyon's (1996) matching method. This approach selects control firms using three factors: firm size, industry, and pre-event performance (e.g., Yeung et al., 2011). After matching, each sample firm was matched with an average of 6.54 control firms (please see Appendix A2 for more details on the matching process). Table A2 in the Appendix A2 shows that the results are similar to our findings based on propensity score matching.

Testing abnormal ROA in five year period (t – 2 to t + 3). To test the impact of EES in a longer period, we further test the abnormal changes in ROA in the period of five years (t – 2 to t + 3). The results show that the impact of EES on abnormal ROA remains significant positive in (t – 2 to t + 3). Specifically, the median abnormal ROA in the period (t − 2 to t + 3) was 0.796% ($p < 0.01$).

4.2 Analysis and Results of the Moderating Effect (H2-H4)

We applied hierarchical regression analysis to examine Hypotheses 2 to 4. To measure the dependent variable, we used *abnormal ROA* (i.e., t – 2 to t + 2) because it is commonly used to represent overall firm performance. The three moderating factors including government, NGO, and competitive pressures in the analysis were measured based on data collected in t – 2. Below is the regression model to test the hypotheses:

Abnormnal $ROA_i = \alpha_0 + \beta_1$Preivous ROA of the $firm_{it-2} + \beta_2$Firm $size_{it-2} + \beta_3$R&D $intensity_{it-2}$ + β_4Captial $intensity_{it-2} + \beta_5$ISO $14000_{it-2} + \beta_6$Industry sales $growth_{it-2} + \beta_7$Industry $competitiveness_{it-2}$ + β_8Industry carbon footprint $_{it-2} + \beta_9$Government $pressures_{it-2} + \beta_{10}$NGO $pressures_{it-2} + \beta_{11}$Competitive $pressures_{it-2} + e_{it}$,

where t is the adoption year. For each variable X in the equation, Abnormal ROA_i represents $X_{it+2} - X_{it-2}$ of the ith firm adopting EES.

Table 7 lists the correlations between various variables. Table 8 presents the results of the hierarchical regression analysis. Model 1 in Table 8 presents the control model that affects abnormal ROA during EES adoption. The other three models are government, NGO, and competitive pressures models. F values in all models are greater than 1 ($p < 0.01$), suggesting that the models are well specified. Adjusted R square ranges from 9.4% to 15.2%.

Model 2 tests Hypothesis 2; that is, the financial performance of EES adoption should be associated with government pressures. The results show that government pressures were significantly and negatively associated with the abnormal ROA ($p < 0.05$) of the firms. This result implies that government pressures have negative impact on the relationship between EES adoption firm financial performance. Therefore, Hypothesis 2 is supported.

Model 3 (testing Hypothesis 3) demonstrates that NGO pressures were significantly and negatively associated with abnormal ROA ($p < 0.05$). The result implies that the lower the NGO pressures were, the higher the financial benefits firms experienced. Thus, Hypothesis 3 is supported.

Model 4 (testing Hypothesis 4) illustrates that the level of competitive pressures was positively associated with the abnormal performance of firms ($p < 0.05$). The result suggests that firms under high competitive pressures obtained higher abnormal ROA than other firms. Therefore, Hypothesis 4 is supported.

Table 7
Summary of variables in hierarchical regression.

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Abnormal ROA	1											
2.	Firm size [a]	–0.060	1										
3.	Previous ROA of the firm [b]	0.204**	–0.088	1									
4.	R&D intensity	0.208**	–0.032	0.357**	1								
5.	Capital investment	0.080	–0.241	0.422	–0.144	1							
6.	ISO 14000	–0.128	–0.033	0.113	0.266**	0.026	1						
7.	Industry sales growth	–0.189**	0.065	–0.109	–0.036	–0.142	–0.089	1					
8.	Industry competitiveness	–0.044	0.007	–0.220**	–0.203**	–0.021	–0.044	–0.063	1				
9.	Industry carbon footprint [c]	–0.087	–0.089	–0.162*	–0.159*	0.225	0.104	0.119	–0.286**	1			
10.	Government pressures	–0.150*	–0.081	–0.107	–0.122	0.018	0.001	–0.035	–0.079	0.207**	1		
11.	NGO pressures	–0.058	–0.021	–0.089	–0.078	0.071	–0.086	–0.026	0.128	–0.029	0.014	1	
12.	Competitive pressures	0.117	–0.009	–0.140	–0.095	0.024	–0.055	–0.199**	0.161*	0.191**	0.148*	0.016	1
	Mean	0.677	35.494	0.112	0.037	0.050	0.288	0.314	0.062	772.159	0.002	0.056	0.010
	s.d.	0.042	119.155	0.219	0.073	0.041	0.454	0.312	0.064	1176.765	0.003	0.093	0.015
	Min	–0.100	0.022	–0.061	0.000	0.000	0.000	–0.291	0.009	34.36	0.000	0.001	0.000
	Max	0.954	1,351.520	0.321	0.496	0.270	1.000	2.775	0.426	3928.010	0.019	1.160	0.091

Note: N = 191; [a] In billions of U.S. dollars; [b] Industry mean adjusted; [c] In tons of CO_{2e} per million of U.S. dollars.
$^{*}p < 0.05$; $^{**}p < 0.01$; two-tailed tests.

Table 8
Hierarchical regression analysis of the effect of institutional pressures on abnormal ROA.

Variables	Model 1: Base model	Model 2: Government pressures model	Model 3: NGO pressures model	Model 4: Competitive pressures model
Intercept	–0.537 (–0.229)	–1.429 (–0.609)	–0.835 (–0.356)	0.965 (1.020)
Previous ROA of the firm	–0.000 (–0.096)	0.001 (0.173)	–0.000 (–0.056)	–0.000 (–0.085)
Firm size	0.004 (1.627)	0.003 (1.290)	0.003 (1.061)	0.003 (1.132)
R&D intensity	0.101 (2.061)**	0.102 (2.104)**	0.091 (1.894)*	0.065 (1.327)
Capital investment	0.151 (1.701)*	0.160 (2.067)**	0.152 (1.746)*	0.144 (1.830)*
ISO 14000	–0.022 (–3.163)***	–0.020 (–2.964)***	–0.021 (–3.120)***	–0.022 (–3.175)***
Industry sales growth	–0.024 (–2.520)**	–0.024 (–2.533)**	–0.025 (–2.649)***	–0.025 (–2.651)***
Industry competitiveness	0.000 (0.003)	–0.014 (–0.282)	–0.030 (–0.591)	–0.022 (–0.432)
Industry carbon footprint	0.001 (0.155)	0.002 (0.259)	–0.000 (–0.015)	–0.004 (–0.582)
Government pressures		–0.040 (–2.450)**	–0.030 (–2.074)**	–0.030 (–2.238)**
NGO pressures			–0.020 (–2.049)**	–0.022 (–2.252)**
Competitive pressures				0.030 (2.173)**
Model of F value	2.976***	3.326***	3.454***	3.618***
R square	0.142	0.170	0.189	0.210
Adjusted R square	0.094	0.119	0.134	0.152
R square change	0.142	0.028	0.019	0.021
F change	2.976***	6.001**	4.200**	4.721**

Note: N = 191; $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$; two-tailed tests.

The results for Hypotheses 2 to 4 show the effect of EES adoption is influenced by the institutional context. We find that firms under government or NGO pressures obtain lower abnormal performance. These findings support empirical studies (e.g., Westphal et al., 1997; Zhu and Sarkis, 2007) that found firms under coercive or normative pressures had lower financial performance because of the increase in costs while being subjected to these pressures.

However, we find that the economic outcome of EES adoption is positively associated with competitive pressures. This result can be explained by the nature of EES adoption. EES adoption often involves technological innovations that have risk and uncertainty (Farsi, 2010). Therefore, more cases of EES applications observed in industries will provide more experience and knowledge on how to implement EES adoption effectively (Teo et al., 2003). As suggested by Teo et al. (2003), mimicking the practices of successful competitors would facilitate the establishment of standard procedures, minimize search and experimental costs, and reduce costs and risks that were borne by first-movers in the adoption of innovation with high risk and uncertainty. Zhu and Sarkis (2007) also found that the performance of GSCM practices was positively impacted by mimetic pressures because more experiences that were accumulated in the market could shorten the learning curve, thus increasing the effectiveness and efficiency of GSCM practices. This argument and evidence may explain why the current study does not find support for the negative association between the performance of EES adoption and mimetic pressures. Overall, the results for Hypotheses 2 to 4 indicate that the three types of pressures have significant but diverse impacts on the consequences of EES adoption. The findings confirm assertions from prior studies that different institutional pressures could lead to different financial returns (McWilliams et al., 2006).

4.2.1 Robustness Tests on the Moderating Effect

Selection bias test. One may argue that the results shown in Table 8 are likely to be influenced by selection bias. For example, the sample firms that adopted EES under competitive pressures may have already been high performers before adopting EES. To overcome this bias, we conducted additional analyses, which focused on matching during $t - 2$. The ROA median (mean) of the firms that adopted EES at low government pressures was compared with that of firms at high government pressures. Table A3 in the Appendix A3 presents that the median (mean) ROA of EES-adopting firms with low government pressures was 10.87 percent (11.26 percent) which is not significantly different ($p > 0.10$) from 10.33 percent (10.21 percent) of EES-adopting firms with high government pressures. We performed similar tests among firms with low and high NGO and competitive pressures. No significant ($p > 0.10$) differences were found in their performance in ROA before the adoption.

Hierarchical linear modeling. Given that our sample firms are nested within industries and states, we considered applying hierarchical linear modeling (HLM), which allows analysts to explicitly model both industry- and state-level variances in firm outcomes (Bryk and Raudenbush, 1992). However, the chi-square tests of HLM analysis indicated no significant differences between group variance. Therefore, multi-level modeling is inappropriate in our case.

Using alternative measures. We used alternative operationalization of firm size log (employee) which yielded substantively similar results. Likewise, results remain similar when government pressures are measured using the count of regulatory policies and financial incentives respectively. Finally, the results remain consistent when we used an industry dummy variable as an alternative measure to *industry carbon footprint*. We coded the dummy variable as 1 for firms belong to energy intensive industries (e.g., chemicals, metal industries, petroleum refining industries), and 0, if otherwise.

Adding control variables. We controlled for adoption year to test if adoption time affects the impact of EES adoption. The results show that adoption year has no significant impact on the performance of EES adoption, and results remain similar when adoption year is controlled.

5. Implications

Our findings provide important implications for firms, policymakers, NGOs and researchers on EES adoption.

5.1 Implications for Firms

The major managerial implications are twofold. First, managers are cautious about investments in EES because of the perceived lack of evidence of the link between EES adoption and financial performance (Melnyk et al., 2003). Managers who are considering EES adoption can predict that EES adoption increases operating performance (i.e., ROA). Second, the study identifies the effects of the different types of institutional forces on the performance of EES adoption. Managers who have not adopted EES can evaluate their own level of government, NGO, and competitive pressures to understand the likely benefits of the adoption. Managers should expect less performance from EES adoption under government or NGO pressures. Managers should identify and develop resources and abilities that are beneficial when conforming to these pressures. Nonetheless, managers should be aware of the benefits of competitive pressures.

5.2 Implications for Policymakers and NGOs

Government energy efficiency policies and environmental NGOs have exerted pressures on firms to adopt EES to reduce carbon emissions. This study provides a timely understanding of the influence of external pressures on the performance of EES adoption in the industry. Our findings indicate that government and NGO pressures are effective in influencing the adoption of EES initiatives, but these pressures are negatively associated with the financial benefits of EES adoptions. To motivate commercial sector improving energy-related environmental performance, the applicable decision makers should provide positive incentives for firms to commit resources to reduce their carbon emission. For example, designing effective government policies and NGO codes to have increased flexibility for firms to define their own strategies that achieve broadly defined common objectives (Darnall, 2009; Lanoie et al., 2011). Moreover, policymakers and NGOs may consider utilizing competitive measures, such as industry forums and social networks that facilitate knowledge transfer to guide managers to mitigate outcome uncertainties, to complement government and NGO measures when attempting to convince firms to adopt EES.

5.3 Implications for Researchers

This study contributes to the literature in two ways. First, this study extends prior research on EES by providing evident that EES adoption has the ability to create financial performance. The findings are consistent with those of recent studies, which demonstrate that the benefits of environmental technologies are greater than the associated costs and required investments (e.g., Klassen and Whybark, 1999; Kassinis and Soteriou, 2003; Vachon and Klassen, 2008; Xie et al., 2019). Nevertheless, our findings do not support studies that indicate that a trade-off exists between environmental performance and financial performance (e.g., Walley and Whitehead, 1994).

Second, our results reveal that, government and NGO pressures are negatively associated with the performance of EES adoption. These findings support previous empirical studies (e.g., Westphal et al., 1997; Zhu and Sarkis, 2007; Lanoie et al., 2011) and assertation (Meyer and Rowan, 1977; Zucker, 1987) that firms under government or NGO pressures had lower financial performance. On the other hand, competitive pressures are positively associated with the financial performance of EES adoption, suggesting that when more experiences were accumulated in the market, the effectiveness and efficiency of EES adoption is improved (Teo et al., 2003; Ritchie and Melnyk, 2012). Our empirical evidence of the moderating effects of different types of institutional pressures extends the understanding of institutional theory in an operations management context. Moreover, these findings may serve as a critical reference for future research on sustainability innovations under institutional context. Researchers on sustainability innovations should consider the influence of institutional context in their research design, for example, investigating the effects of different types of pressures (e.g., customer and investor pressure) on the relationship between sustainability innovations and financial performance. In addition, in future study, it will be worthwhile to study the interaction effect between these pressures on the performance of EES adoption.

5.4 Conclusions

Focusing on the specific context of EES adoption, we provide empirical evidence of the financial effect of EES adoption and how the impact varies with institutional pressures. The results demonstrate the positive relationship between EES adoption and financial performance. Moreover, the results show that the financial benefits of EES adoption increase when competitive pressures increase, whereas the benefits diminish when government and NGO pressures increase. The current study provides one of the first instances of empirical evidence of the financial effect of EES adoption and the impacts of institutional pressures on that impact. While the current study helps in resolving the empirical puzzle of the effects of institutional pressures on the performance of EES adoption, it opens a new avenue for research for the exploration of how the effects of environmental innovations on financial performance may vary under different types of institutional pressures. In addition, this study provides important implications for managers, policymakers and NGOs when promoting energy efficiency to reduce carbon footprint.

Certain limitations are inherent in our research design and data availability. First, the scope of this study has been limited to U.S. firms. Firms in other countries encountering other institutional environments for EES adoption may provide different results. Future research can extend the analysis to other countries such as those in Europe, where firms are under higher external pressures to adopt EES. Second, we focused our analysis on publicly listed firms. Our results may be inapplicable to small- and medium-sized firms because listed firms are chiefly large firms that have sufficient resources to adopt EES. Third, although the proxy we used to measure government, NGO, and competitive pressures are in line with previous studies, there are limitations using secondary data for the measurement. Future research may examine these measures from primary data.

Fourth, it is not a common practice to reveal firms' annual budgets or spending on EES in announcements. Therefore, we are not able to measure EES adoption using firms' budgets or spending on

EES. In addition, the announcements in the study originated from the published press releases of firms. Therefore, firms were excluded from this research if they did not release information on their EES investment. Similarly, the selected control firms may not disclose their EES adoption. However, we believe that such an issue, if it exists, would only make our results more conservative (i.e., the differences between adopters and non-adopters are more difficult to detect), instead of distorting our results.

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Appendix A1

Table A1
Statistics of some government energy efficiency policies and NGOs in some states [a].

State	Energy building code [b]	Tax incentives [b]	Cash incentives [b]	Total revenue of NGOs	Firm size (no. of employee)
Alabama	2010	N	2009	303,897	1,567,892
Arizona	N	2006	N	2,271,221	2,064,969
California	2008	N	2001	78,017,957	12,534,000
Colorado	2007	N	2009	9,727,983	1,955,143
Connecticut	2007	N	2005	17,264	1,436,743
District of Columbia	2003	N	2012	119,360,110	463,022
Florida	2007	N	N	2,911,142	6,625,579
Georgia	2010	2008	N	7,017,662	3,314,707
Hawaii	2009	N	2006	1,485,917	478,736
Iowa	2009	N	N	92,727	1,252,943
Idaho	2010	N	N	8,949	487,807
Illinois	2009	N	2008	19,454,044	4,978,877
Indiana	2009	N	N	7,424,616	2,400,148
Kansas	2007	N	N	412,727	1,126,940
Louisiana	N	N	N	170,982	1,599,373
Massachusetts	2009	N	2011	128,907,205	2,928,152
Maryland	2009	1985	2008	5,287,591	2,075,218
Michigan	2010	N	2010	20,833,450	3,287,831
Minnesota	2007	N	1998	18,131,136	2,357,792
Missouri	N	2008	N	328,996	882,099

Montana	2009	2001	2001	6,178,190	338,372
North Carolina	2011	N	2007	3,622,016	3,233,995
Nebraska	2005	N	1990	203,956	769,347
New Jersey	2009	N	2008	569,475	3,366,827
Nevada	2010	2005	2009	820,000	1,002,755
New York	2010	N	2009	16,777,258	7,264,831
Ohio	2011	1974	2011	3,445,721	4,351,999
Oregon	2010	N	1980	203,906,373	1,350,820
Pennsylvania	2009	N	1982	9,178,305	4,975,554
Rhode Island	2009	N	N	283,209	398,945
South Carolina	N	N	N	874,201	1,502,619
Tennessee	2011	N	2011	28,462	2,263,470
Texas	2007	1981	N	2,081,624	8,783,916
Virginia	2010	2008	N	2,260,117	2,997,938
Vermont	2011	N	2011	50,040,988	264,040
Washington	2009	N	N	2,469,770	2,326,173
Wisconsin	2008	N	N	283,411,270	2,320,319

N: Nil; [a] Based on data collected in 2011. Depending on the adoption time of a sample firm, data (e.g., total revenue of NGOs and no. of employee) in other years may be used when estimating government and NGO pressures;
[b] Effective year of the first policy.

Appendix A2

To select control firms, we also followed a number of recent event studies (Yeung et al., 2011; Lo et al., 2014). We created an individual portfolio for each sample firm for the performance indicator to be tested (i.e., ROA in our case). The portfolio meets three criteria: industry, firm size, and performance on that ROA. First, each sample firm was matched to a portfolio of control firms in the same industry (two-digit SIC codes) (Barber and Lyon, 1996), 90% to 110% of the pre-event performance, and 50% to 200% of the total assets in $t - 2$ (Yeung et al., 2011; Lo et al., 2014). To include more sample firms in the analysis, we adopted one-digit SIC codes, 90% to 110% of the performance, and 50% to 200% of the total assets, if we found no control firm in the first step. We applied only 90% to 110% of the performance and 50% to 200% of the total assets, if we found no control firm in the second step. Lastly, we selected control firms with the nearest performance if no control firm were found after the three steps mentioned previously.

Among the 238 firms, 152 were matched in Step 1 (63.87%); 55 in Step 2 (23.11%), 31 in Step 3 (13.03%), and none in Step 4 (0%). We matched each sample firm with an average of 6.54 control firms. The pre-event ROA of the sample and the control firms shows no significant difference in t-test, suggesting that the matching was proper. After the matching process, the abnormal performance was measured as the sample firm's post-event performance minus its expected performance. Expected performance was measured as the sample firm's pre-event performance plus the control firms' median change of the performance in the same period (Barber and Lyon, 1996).

Table A2
Abnormal changes using Barber and Lyon's (1996) matching approach.

Time period	N	Median	WSR Z-statistic	Mean	t-statistic	% positive	Z-statistic
Panel A: ROA [a]							
$t-2$ to $t-1$	238	0.224	0.934	0.341	0.769	54.62	0.497
$t-1$ to t	234	0.041	0.354	0.056	0.408	50.85	0.262
t to $t+1$	216	0.263	2.142**	0.452	2.200**	57.41	2.182**
$t+1$ to $t+2$	191	0.455	2.139**	0.557	2.313**	56.54	1.891**
$t-1$ to $t+1$	216	0.198	1.416*	0.684	2.225**	52.31	0.612
$t-1$ to $t+2$	191	0.499	2.119**	1.019	2.658***	55.50	1.600*
$t-2$ to $t+1$	216	0.177	1.852**	0.547	2.394***	52.31	0.540
$t-2$ to $t+2$	191	0.796	4.716***	1.501	4.875***	63.35	3.618***
Panel B: Carbon Footprint							
$t-2$ to $t-1$	216	–0.001	–0.942	–0.004	–1.253	43.06	–0.973
$t-1$ to t	191	–0.001	–0.642	–0.003	–0.684	46.60	–0.868
t to $t+1$	151	–0.000	–2.224**	–0.021	–2.792***	38.41	–1.469*
$t+1$ to $t+2$	102	–0.003	–1.783**	–0.008	–1.792**	41.18	–1.123
$t-1$ to $t+1$	151	–0.001	–1.999**	–0.022	–2.598***	38.41	–1.549*
$t-1$ to $t+2$	102	–0.012	–2.098**	–0.021	–2.359**	37.25	–1.939**
$t-2$ to $t+1$	151	–0.001	–1.851**	–0.020	–1.618*	41.06	–2.116**
$t-2$ to $t+2$	102	–0.002	–1.681**	–0.033	–2.670***	40.20	–1.327*
Panel C: Sales growth [a]							
$t-2$ to $t-1$	238	0.798	0.494	0.609	0.805	50.42	0.065
$t-1$ to t	234	1.214	1.187	0.978	0.829	54.70	1.373*
t to $t+1$	216	0.785	0.054	–0.433	–0.326	53.24	0.885
$t+1$ to $t+2$	191	1.098	1.322*	5.573	2.392***	51.83	0.434
$t-1$ to $t+1$	216	1.579	0.767	0.961	0.600	52.78	0.748
$t-1$ to $t+2$	191	1.068	1.668**	4.422	2.210**	54.45	1.158
$t-2$ to $t+1$	216	2.011	2.075**	2.749	2.625***	56.48	1.837**
$t-2$ to $t+2$	191	2.542	1.995**	2.993	2.203**	56.54	1.737**

[a] In percent.
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; one-tailed tests.

Appendix A3

Table A3
Difference between the moderating factors sub-samples in firms' ROA in $t-2$.

	N	Median	Mean	*p*-Value (Mann-Whitney test)	*p*-Value (*t*-test)
Government pressures					
0 (low)	96	10.87	11.26	0.681	0.671
1 (high)	95	10.33	11.21		

NGO pressures					
0 (low)	96	10.88	11.34	0.686	0.744
1 (high)	95	10.68	11.08		
Competitive pressures					
0 (low)	96	10.57	11.17	0.903	0.910
1 (high)	95	11.34	11.26		

N = 191; sample in hierarchical regression analysis.
$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$; two-tailed tests.

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