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The effect of renewable energy policies on earnings management

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ABSTRACT

This study provides novel evidence that renewable energy policies, while environmentally motivated, can unintentionally influence firms' financial reporting behaviors. Leveraging cross-state policy shocks in renewable mandates and incentive programs, combined with electricity production metrics, we provide evidence that a higher intensity of renewable policy raises earnings volatility and, as a result, motivates additional earnings management. Energy-intensive industries especially exhibit this effect. Unlike prior studies that rely on voluntary firm disclosures, our identification strategy leverages regulatory shocks to establish a causal link between renewable energy adoption and financial reporting quality. Our findings underscore an often-overlooked cost of the green transition and offer important implications for policymakers, investors, and regulators.

1. Introduction

Heightened attention to energy security and climate risk over the last few decades has steered many countries toward low-carbon and renewable technologies. Policymakers at federal, state, and local levels have responded with legislation and fiscal programs intended to accelerate clean-energy uptake, limit environmental harms, and bolster long-run sustainability. In the United States, for instance, a federal production-based incentive grants firms a tax credit or subsidy for each unit of renewable electricity they generate.

At the state level, state governments have enacted legislation to reduce reliance on fossil fuels and promote the development of renewable energy technologies. Each state's Renewables Portfolio Standards (RPS) mandate that retail electricity providers deliver a minimum fraction of electricity from renewables by the applicable compliance year. These standards often include penalties for non-compliance and incentives for exceeding targets, which in turn drive investment in renewable energy infrastructure and support the growth of the renewable energy sector.

Despite their environmental intentions, the effects of these policies extend beyond ecological outcomes. As documented in the literature, they also introduce complex implications for a firm's financial performance. On the one hand, numerous studies highlight the financial benefits of adopting eco-friendly policies. Substantial research (Ambec & Lanoie, 2008; Cortez et al., 2022; Freeman & Evan, 1990; Porter & Linde, 1995) suggests that improved environmental performance can generate competitive advantages and reduce firm costs, ultimately improving operational efficiency and financial performance. Recent studies further substantiate this positive relationship, showing that firms with superior environmental performance often outperform their peers financially. For

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instance, Galama and Scholtens (2021) report that firms with lower emissions demonstrate superior financial metrics, including Tobin's Q and return on assets (ROA)/return on equity (ROE). Similarly, Endrikat et al. (2014) indicates that stronger environmental engagement is linked to better financial performance.

On the other hand, some empirical studies report mixed findings on the impact of environmental policies on firm financial performance. Some argue that potential financial gains may not sufficiently offset the significant economic costs of maintaining ambitious environmental targets. For instance, Walley and Whitehead (1994) suggest that enhancing environmental performance may negatively impact financial performance. Others, such as CaiHe (2024) and Brammer et al. (2006) posit that the high costs of implementing disruptive green technologies can erode corporate profitability. Further, in a global study of utility firms, Ruggiero and Lehkonen (2017) report that increases in renewable energy correspond to declines in financial performance. Additionally, Anderloni and Tanda (2017) find no financial advantage for green energy firms compared to traditional ones.

Although a substantial literature contests the financial ramifications of environmental policies, it lacks insight into how these policies affect corporate financial reporting behavior. This study contributes to the ongoing discussion by analyzing how state-level renewable energy policies, used as exogenous shocks, affect firm financial performance, with a focus on earnings management—a previously underexplored corporate behavior. Drawing on annual state electricity production statistics from the U.S. Energy Information Administration (EIA), our study assesses the effect of adopting renewable energy on the financial results of energy-dependent manufacturing firms in the United States. We also investigate the mechanism through which exposure to renewable energy, driven by state policy incentives, affects firms' use of earnings management.

To facilitate our investigation, we design the Renewable Energy Adoption Index, capturing how renewable energy adoption aligns with variations in a firm's operating volatility. Our empirical results yield several key insights. First, we find that renewable energy policies introduce volatility into firm earnings. This volatility likely arises from factors such as fluctuating energy prices, evolving regulatory frameworks, and uncertainties related to technological innovation and resource availability. As firms adapt to these shifts, fluctuations in financial performance intensify, making earnings management more challenging. Considering this revelation, we investigate whether the increased financial volatility encourages firms to engage in earnings management. The analysis demonstrates that greater renewable energy adoption corresponds to higher levels of earnings management, especially in electricity-intensive industries. These results underscore the practical and financial challenges firms face as they transition toward greener operations.

Our study offers two main contributions to the literature. First, we introduce a novel identification strategy by treating state-level renewable energy policies as exogenous instruments to study the financial implications of renewable energy adoption. Unlike previous studies that relied on firms' voluntary disclosures as proxies for renewable energy adoption, we focus on enforceable policies that mandate renewable energy production, helping to eliminate self-selection bias. Second, we establish a new link between renewable energy adoption and earnings management, an underexplored yet critical aspect of corporate behavior. By examining how environmental regulations influence financial reporting, our study offers valuable insights for policymakers, investors, and corporate stakeholders navigating the intersection of sustainability and financial accountability.

2. Theoretical framework and hypothesis development

This study builds its argument on two complementary theories: agency theory and positive accounting theory. These frameworks help explain how renewable energy policies influence firms' financial reporting behavior, specifically by increasing the use of earnings management.

2.1. Agency theory and managerial incentives

Agency theory (Jensen and Meckling, 1976) posits that because managers generally have better access to firm-specific information, they may engage in self-serving behavior that conflicts with the interests of shareholders. When firms face higher uncertainty, this conflict may become more severe.

We argue that state-level renewable energy policies introduce external shocks that increase the volatility of a firm's financial performance. Investors may interpret this volatility negatively, leading to consequences such as increased scrutiny, lower stock prices, or higher capital costs. As a result, managers have strong incentives to reduce perceived instability because their compensation, reputation, and job security often depend on consistent earnings. In this setting, agency theory suggests that managers will manage earnings to smooth reported performance and reduce perceived risk.

2.2. Positive accounting theory and accounting choices

Similar to agency theory, positive accounting theory (Watts & Zimmerman, 1990) also supports our argument and hypothesis. This theory asserts that managers select accounting methods in response to political and regulatory pressures. In our study, renewable energy standards and subsidies determined at the state level are legally binding and exhibit annual variationthese mandates generate significant operational and financial uncertainty. To manage this uncertainty, managers may rely on the discretion allowed under accounting rules to adjust reported earnings.

Consistent with this theory, prior studies (Aljughaiman et al., 2023; Qiao et al., 2025) have shown that firms facing higher performance volatility tend to engage in earnings management. By smoothing earnings, managers aim to reduce stakeholder concerns and maintain a stable image.

2.3. Hypothesis development

Drawing from both theories, we develop our primary hypothesis. Renewable energy policies introduce financial and operational uncertainty that increases earnings volatility. This increased volatility intensifies agency conflicts and encourages managers to manage earnings to present more stable financial outcomes. Guided by positive accounting theory, we expect that managers will use accounting discretion in response to these pressures. Therefore, we hypothesize the following.

H1. Firms that adopt renewable energy—due to state-level policies—tend to exhibit a greater propensity for managing earnings.

We test this hypothesis by using state-level renewable energy policies as exogenous shocks that drive the adoption of renewable energy.

Beyond our main hypothesis, we emphasize a critical assumption underlying our identification strategy: state-level renewable energy policies and incentives function as exogenous and systematic shocks within each state. These policies apply uniformly across all firms in a state, regardless of firm-specific characteristics or operations. Firms cannot opt out or tailor their responses to meet compliance requirements. Therefore, we treat these policies as external forces that shape firms' energy decisions independently of financial reporting preferences or conditions.

To support this argument, we examine whether firms located in states with more aggressive renewable energy mandates and incentives indeed exhibit higher levels of renewable energy adoption. This institutional feature enables us to treat variation in policy exposure as a natural experiment, thereby strengthening the causal interpretation of our results. Accordingly, we propose that.

H2. State-level renewable energy policies correlate positively with firms' renewable energy adoption, independent of firm-specific characteristics.

3. Data and methodology

The main sample covers the period from 2002 to 2023. We calculate all financial variables using data collected from Compustat and scale them by total assets; we obtain stock return data from CRSP. We also compute additional key variables of interest, which we describe below.

3.1. Renewable Energy Mandates and Supports across States

In our analysis, state-administered policies and incentive programs are treated as exogenous disturbances affecting renewable electricity production by firms. The study draws on counts of renewable energy rules and subsidies implemented by states, collected from the Database of State Incentives for Renewable & Efficiency. Since states frequently introduce new regulations and financial incentives for renewable energy, we incorporate the lag between policy enactment and implementation. To capture the enduring effects of these measures, we cumulate the number of renewable energy mandates and supports implemented by states starting in 2001.

3.2. Earnings management

Following Kothari et al. (2005), we use performance-adjusted abnormal accruals as our primary proxy for earnings management. We obtain each firm's adjusted discretionary accruals by controlling for industry and performance. Specifically, for each year, we estimate total accruals, TAC_{it}, cross-sectionally using two-digit standard industrial classification (SIC) codes.

$$TAC_{it} = \alpha_0\left(\frac{1}{A_{it-1}}\right) + \alpha_1\left(\frac{\Delta REV_{it} - \Delta AR_{it}}{A_{it-1}}\right) + \alpha_2\left(\frac{PPE_{it}}{A_{it-1}}\right) + \varepsilon_i, \tag{1}$$

where TAC_{it} represents the difference between the change in non-cash current assets and the change in current liabilities (net of the current portion of long-term debt), less depreciation and amortization, $\Delta REV_{it} - \Delta AR_{it}$ is the change in sales minus a change in accounts receivable, PPE_{it} is net property, plant, and equipment; and A_{it-1} is lagged total assets.

Then, we obtain abnormal discretionary, $ABACC_{it}$, accruals by taking the difference between total accruals from Equation (1) and average industry residuals cross-sectionally using Equation (2).

$$ABACC_{it} = \left\{TAC_{it} - \left[\widehat{\alpha_0}\left(\frac{1}{A_{it-1}}\right) + \widehat{\alpha_1}\left(\frac{\Delta REV_{it} - \Delta AR_{it}}{A_{it-1}}\right) + \widehat{\alpha_2}\left(\frac{PPE_{it}}{A_{it-1}}\right)\right]\right\} \tag{2}$$

We use the absolute value of $ABACC_{it}$ to measure the magnitude of the deviation from normal discretionary accruals; larger absolute values indicate greater earnings management.

As an alternative proxy for earnings management, we also estimate accrual quality (AQ) following McNichols (2002) and Francis et al. (2005). We run the following cross-sectional regression for each year and use the absolute value of the residuals as our AQ measure (Equation (3)):

$$TCA_{i,t} = \beta_{0,i} + \beta_1 \cdot CFO_{i,t-1} + \beta_2 \cdot CFO_{i,t} + \beta_3 \cdot CFO_{i,t+1} + \beta_4 \cdot \Delta Rev_{i,t} + \beta_5 \cdot PPE_{i,t} + \varepsilon_{i,t}, \tag{3}$$

In Equation (3), $TCA_{i,t}$ represents total current accruals in firm i and year t, defined as $\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta STDEBT_{i,t}$. Further, $\Delta CA_{i,t}$ denotes a change in current assets, $\Delta CL_{i,t}$ is a change in current liabilities, $\Delta Cash_{i,t}$ is a change in cash, and $\Delta STDEBT_{i,t}$ is a change in debt in current liabilities. $CFO_{i,t}$ represents cash flow from operations in firm i and year t, defined as $NIBE_{i,t} - TA_{i,t}$. $NIBE_{i,t}$ is net income before extraordinary items and $TA_{i,t}$ is total accruals. We calculate $TA_{i,t}$ as $\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta STDEBT_{i,t} - DEPN_{i,t}$, where $DEPN_{i,t}$ represents depreciation and amortization expenses. Further, $\Delta Rev_{i,t}$ is a change in revenue in firm i and year t, whereas $PPE_{i,t}$ is the value of property, plant, and equipment in firm i and year t. We normalize all variables by firm i's total assets in year t.

3.3. Renewable energy adoption

Measuring the amount of renewable energy that each firm consumes when producing goods and services poses a major challenge. One approach is to use firm-disclosed data. However, since only some firms voluntarily publish environmental reports, and because these reports vary in content and format, relying solely on them could introduce measurement error and self-selection bias into our analysis. Therefore, to mitigate these concerns we utilize state-by-state annual electricity generation data from the U.S. EIA, covering production from diverse sources,including petroleum, hydro, natural gas, solar, wind, geothermal, and others. We follow the EIA's classification of renewable energy sources. Using these data, we calculate each state's annual share of electricity produced from renewable sources and assign that value as a renewable energy adoption rate to firms headquartered or operating in that state. We use Equation (4) as follows:

$$Renewable\ Energy\ Adoption_{s,t} = \frac{Total\ electricity\ generated\ using\ renewable\ energy\ sources_{s,t}}{Total\ electricity\ generation_{s,t}} \quad (4)$$

4. Empirical results

Table 1 presents the summary statistics of the main variables for heavy consumers and all manufacturing firms. Manufacturers typically generate approximately 10% of their power using renewable energy technologies. Firms in energy-intensive industries are exposed to more renewable energy regulations and incentives across states, highlighting their heightened sensitivity to renewable adoption. Interestingly, heavy consumers show poorer financial performance, as reflected in significantly lower earnings EBIT/EMP, ROA, and ROE. This outcome occurs despite their relatively larger size, higher leverage, and greater investment in physical assets. One possible explanation is that the adoption of renewable energy increases operational costs, thereby reducing productivity and profitability.

We also consider the yearly and state-level variation in renewable energy mandates and incentives. Panel A in Table 2 indicates that the number of state-administered renewable energy requirements and subsidies increased substantially between 2006 and 2011, likely due to strong federal support during that period. For example, the Energy Policy Act of 2005 and the American Recovery and Reinvestment Act of 2009 offered financial incentives that encouraged firms to seek support and tax credits. Panel B in Table 2 shows a wide variation in state-level policy implementation. From 2001 to 2023, states like California, Texas, and Minnesota, noted for both resource abundance and heightened environmental awareness, adopted markedly more renewable energy policies and incentive programs.

Table 1
Descriptive statistics.

Variables	Panel A. Heavy Consumers					Panel B. All Manufacturing Firms				
	Obs.	Mean	Std. Dev	Min	Max	Obs.	Mean	Std. Dev	Min	Max
Renewable Energy Adoption	3098	0.106	0.117	0.002	0.875	7412	0.108	0.122	0.002	0.885
Number of Policies	3098	1.121	2.093	0	11	7412	0.942	1.894	0	12
Number of Incentives	3098	3.015	4.212	0	47	7412	2.931	4.891	0	48
Cumulative Policies	3098	16.215	10.726	1	49	7412	14.913	10.012	1	51
Cumulative Incentives	3098	34.812	23.612	1	115	7412	33.591	23.312	1	116
Abnormal Discretionary Accrual	3098	0.421	1.361	0.002	2.851	7412	0.451	1.391	0.002	2.896
Accruals Quality	3098	0.298	0.943	0.001	1.157	7412	0.263	0.961	0.001	1.169
EBIT/EMP	3098	−0.007	0.229	−0.471	0.232	7412	0.004	0.158	−0.473	0.233
ROA	3098	−0.004	0.192	−0.715	0.219	7412	0.031	0.168	−0.731	0.221
ROE	3098	0.065	0.404	−1.166	0.881	7412	0.127	0.364	−1.159	0.879
ln (Assets)	3098	6.869	2.351	1.798	10.235	7412	6.315	2.129	1.654	10.102
Leverage	3098	0.292	0.193	0.000	0.776	7412	0.227	0.183	0.000	0.779
Book to Market	3098	0.625	0.463	−0.152	1.561	7412	0.616	0.4221	−0.169	1.607
Sales Change	3098	0.026	0.295	−0.578	0.471	7412	0.0273	0.235	−0.585	0.495
Capital Expenditure	3098	0.091	0.059	0.001	0.153	7412	0.063	0.052	0.001	0.161
Dividend	3098	0.014	0.018	0.000	0.062	7412	0.012	0.017	0.000	0.067

Note. The study sample comprises 3098 observations spanning the period from 2002 to 2023. This table presents the summary statistics for renewable energy adoption, renewable energy-related policies and incentives, and other firm-level control variables, categorized by heavy consumers and all manufacturing industries. EBIT/EMP is in millions of dollars. The Appendix provides definitions for all variables.

Table 2
Summary of state renewable energy programs.

Panel A: Policy and incentives distribution by year

Year	# Incentives & Policies	# Policies	# Incentives
2001	46	32	14
2002	33	14	19
2003	41	26	15
2004	31	24	7
2005	48	15	33
2006	419	98	321
2007	203	53	150
2008	153	52	101
2009	270	33	237
2010	193	37	156
2011	120	48	72
2012	76	11	65
2013	27	1	26
2014	63	24	39
2015	94	15	79
2016	57	34	23
2017	16	1	15
2018	13	1	12
2019	36	0	36
2020	18	10	8
2021	255	6	249
2022	145	13	132
2023	94	16	78
Total	2451	564	1887

Panel B: Policy and incentive distribution by state

Name	# Incentives & Policies	# Policies	# Incentives
Alabama	21	2	19
Alaska	24	4	20
Arizona	56	23	33
Arkansas	33	6	27
California	160	50	110
Colorado	105	22	83
Connecticut	55	16	39
District of Columbia	20	11	9
Delaware	35	15	20
Florida	79	20	59
Georgia	40	8	32
Hawaii	36	16	20
Iowa	51	12	39
Idaho	38	6	32
Illinois	62	18	44
Indiana	62	9	53
Kansas	17	10	7
Kentucky	27	6	21
Louisiana	27	11	16
Massachusetts	84	19	65
Maryland	78	16	62
Maine	26	15	11
Michigan	52	14	38
Minnesota	138	16	122
Missouri	65	12	53
Mississippi	23	5	18
Montana	30	9	21
North Carolina	70	25	45
North Dakota	18	5	13
New Hampshire	45	12	33
Nebraska	24	6	18
New Jersey	53	17	36
New Mexico	46	15	31
Nevada	34	12	22
New York	103	20	83
Ohio	44	11	33
Oklahoma	33	8	25
Oregon	102	25	77
Pennsylvania	66	11	55

(*continued on next page*)

Table 2 (*continued*)

Panel B: Policy and incentive distribution by state			
Name	# Incentives & Policies	# Policies	# Incentives
Rhode Island	34	14	20
South Carolina	43	6	37
South Dakota	20	5	15
Tennessee	17	3	14
Texas	122	37	85
Utah	32	10	22
Vermont	69	12	57
Virginia	47	15	32
Washington	86	15	71
West Virginia	12	5	7
Wisconsin	54	13	41
Wyoming	24	5	19

As discussed in the development of H2, we treat state-administered renewable energy mandates and supports as exogenous, systematic shocks that affect all firms within a state. These policies apply uniformly across firms and do not allow firms to choose whether or how to comply. To validate this identification assumption, we estimate the following model:

$$\textit{Renewable Energy Adoption}_{i,t} = \beta_0 + \beta_1 \textit{Policies}_{s,t} + \beta_2 \textit{Incentives}_{s,t} + \beta_3 \boldsymbol{X}_{i,t} + \boldsymbol{\Lambda} + \varepsilon_{i,t} \tag{5}$$

where $\textit{Policies}_{s,t}$ ($\textit{Incentives}_{s,t}$) denotes the log-transformed total count of renewable energy mandates and incentive programs implemented in state s by year t. $\mathbf{X}_{i,t}$ represents a set of firm-specific control variables measured at time t. Included controls are firm size, capital structure, sales revenue, investments, and payout measures. $\boldsymbol{\Lambda}$ denotes fixed effects for states, firms, and years. Table 3 presents the estimation results.

For heavy consumers, we find a positive relationship between state-level policies and renewable energy adoption: one additional policy increases usage by approximately 9 %. While heavy consumers respond less strongly to state-level incentives, the relationship remains positive and statistically significant, with each additional incentive increasing a firm's renewable energy usage by about 5.4 %. In Columns 3 and 4, we present results for all manufacturing firms. Although the coefficients remain positive and significant, their magnitudes are smaller than those for heavy consumers. These results suggest that firms consume more electricity from renewable energy sources when states introduce more policies or incentives.

Following prior studies on earnings management in response to exogenous (e.g., Aljughaiman et al., 2023), we estimate the following model to assess the impact of higher green energy usage on earnings management:

Table 3
Renewable energy and policy/incentive.

Dependent variables	Heavy Consumers		All Manufacturing Firms	
	(1)	(2)	(3)	(4)
	Renewable Energy Adoption	Renewable Energy Adoption	Renewable Energy Adoption	Renewable Energy Adoption
Ln (Cumulative Policies)	0.091***		0.084***	
	(3.53)		(2.91)	
Ln (Cumulative Incentives)		0.054***		0.037***
		(3.25)		(2.97)
Ln (Assets)	0.312***	0.311***	0.529	0.333***
	(2.95)	(2.94)	(1.38)	(2.92)
Leverage	−0.049***	−0.047***	−0.054**	−0.047***
	(−3.10)	(−3.16)	(−2.26)	(−3.11)
Book to Market	0.022*	0.028*	0.074*	0.028*
	(1.85)	(1.91)	(2.11)	(1.89)
Sales Change	0.034	0.037	−0.995	0.039
	(0.37)	(0.38)	(−0.91)	(0.39)
Capital Expenditure	0.020	0.013	0.095*	0.015
	(0.52)	(0.31)	(1.88)	(0.28)
Dividend	−0.033	−0.023	−0.434	−0.027
	(−0.24)	(−0.31)	(−1.13)	(−0.25)
Constant	0.175	0.175	−0.134	0.175
	(1.37)	(1.47)	(−1.18)	(1.28)
Year, Firm and State Fixed Effect	Yes	Yes	Yes	Yes
Observations	3098	3098	7412	7412
Adj. R-Squared	0.694	0.673	0.795	0.776

Note. This table reports the regression results by heavy consumers and all manufacturing industries. We report t-statistics using standard errors corrected for clustering at the state level; the numbers in parentheses represent the standard errors. ***, ** and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively. The Appendix provides definitions for all variables.

$$Earnings\ Management_{i,t} = \beta_0 + \beta_1 Renewable\ Energy\ Adoption_{i,t} + \beta_2 \boldsymbol{X}_{i,t} + \boldsymbol{\Lambda} + \varepsilon_{i,t} \quad (6)$$

We proxy $Earnings\ Management_{i,t}$ is using performance-adjusted abnormal accrual (Kothari et al., 2005) and accrual quality, and the rest of the model follows Equation (5).

Table 4 presents the main findings. Across all model specifications, we observe a positive and statistically significant relationship between renewable energy adoption and earnings management. This effect is particularly strong among heavy consumers (see Columns 1 and 2). Economically, a one-standard-deviation increase in renewable energy adoption results in a 10 % to 20 % increase in discretionary accruals. Given the average discretionary accrual value of 0.42, this effect translates to a 25 % increase relative to the mean. Such a considerable economic effect suggests that renewable energy policies and incentives may distort financial reporting by increasing operational and financial uncertainty.

These results align with Barton (2001), who finds that volatile earnings increase earnings smoothing, and with Dechow et al. (2010), who argue that firms use discretionary as a buffer against external shocks. Our study contributes to this literature by identifying renewable energy policy as a new source of exogenous volatility that affects managerial reporting behavior.

To address potential endogeneity, such as managerial preferences or environmental commitments influencing green energy adoption and earnings management, we use the implementation dates of renewable energy policies as instrument variables (IV) for renewable energy adoption. We then re-estimate the regression model from Table 4 and report the IV regression results in Table 5. Across all models, the IV estimates confirm an upward correlation between renewable energy adoption and earnings management. Thus, we find no evidence that simultaneous effect or self-selection drives our results.

Additionally, we control for firm characteristics that may influence our findings. We include variables for firm size, sales growth, investment, and payout policies. Prior studies suggest that larger firms are more resilient to external changes such as political, economic, and business cycles (e.g., Chi & Gupta, 2009; Watts & Zimmerman, 1990). We examine the effects of firm size and sales growth, as smaller or rapidly growing firms often report higher accruals. We also utilize the book-to-market ratio to identify growth opportunities, which may lead to increased accruals due to greater inventory buildup. To account for financial volatility, we include leverage, as highly leveraged firms tend to experience more volatile profits and higher debt payments. Finally, we consider investment and payout policies. We test research and development (R&D) and capital expenditures, but report only the results using capital expenditure due to data availability. Payout policy often mitigates the agency issue by limiting private benefits (e.g., Pinkowitz et al., 2006); therefore, we include the payout ratio to account for internal cash holdings, which may otherwise lead to higher accruals.

One possible mechanism linking green energy adoption to earnings management is increased profit volatility. Prior literature (e.g., Barton, 2001; Dechow et al., 2010; Jayaraman, 2008) finds that volatile financial performance increases managerial motivation to manage earnings. If the adoption of renewable energy increases the volatility of a firm's financial performance, then the results in Table 4 are consistent with this explanation. To test this mechanism, we estimate the following model:

$$Volatility_{i,t} = \beta_0 + \beta_1 Renewable\ Energy\ Adoption_{i,t} + \beta_2 \boldsymbol{X}_{i,t} + \boldsymbol{\Lambda} + \varepsilon_{i,t} \quad (7)$$

We define $Volatility_{i,t}$ as the volatility of a firm's financial performance, measured by labor (EBIT/EMP), asset (ROA), and equity (ROE). The remainder of the equation mirrors Equation (5).

Table 4
Renewable energy and earnings management.

Dependent variable	Heavy Consumers		All Manufacturing Firms	
	(1)	(2)	(3)	(4)
	Abnormal Discretionary Accrual	Accruals Quality	Abnormal Discretionary Accrual	Accruals Quality
Renewable Energy Adoption	0.981***	0.667***	0.482***	0.237***
	(3.15)	(3.33)	(2.80)	(2.75)
Ln (Assets)	−0.054***	−0.062**	−0.043***	−0.082**
	(−3.03)	(−2.21)	(−3.11)	(−2.25)
Leverage	0.025*	0.071*	0.029*	0.036
	(1.83)	(2.06)	(1.86)	(1.48)
Book to Market	0.039	−0.935	0.036	0.051
	(0.37)	(−0.87)	(0.39)	(0.82)
Sales Change	0.014	0.092*	0.018	0.073
	(0.25)	(1.83)	(0.27)	(1.45)
Capital Expenditure	−0.022	−0.437	−0.049	0.173
	(−0.27)	(−1.22)	(−0.23)	(0.71)
Dividend	0.189	−0.193	0.183	−0.159
	(1.39)	(−1.25)	(1.56)	(−1.25)
Constant	−0.018	−0.113**	−0.021	−0.133**
	(−0.60)	(−2.65)	(−0.51)	(−2.57)
Year, Firm and State Fixed Effect	Yes	Yes	Yes	Yes
Observations	3098	3098	7412	7412
Adj. R-Squared	0.337	0.439	0.221	0.356

Note. This table reports the regression results by heavy consumers and all manufacturing industries. We compute t-statistics using standard errors corrected for clustering at the firm level; numbers in parentheses represent the standard errors. ***, ** and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively. The Appendix provides definitions for all variables.

Table 5
Renewable energy and earnings management: Instrument variable approach.

Dependent variable	Heavy Consumers		All Manufacturing Firms	
	(1)	(2)	(3)	(4)
	Abnormal Discretionary Accrual	Accruals Quality	Abnormal Discretionary Accrual	Accruals Quality
Instrument Variable	0.088***	0.076***	0.015***	0.030***
	(3.27)	(3.13)	(2.92)	(2.78)
Ln (Assets)	−0.033***	−0.036**	−0.030***	−0.075**
	(−3.15)	(−2.29)	(−3.13)	(−2.27)
Leverage	0.001	0.025*	0.032*	0.023
	(1.50)	(2.13)	(1.89)	(1.35)
Book to Market	0.013	−0.062	0.042	0.013
	(0.33)	(−0.79)	(0.33)	(0.87)
Sales Change	0.009	0.021*	0.052	0.093
	(0.33)	(1.89)	(0.37)	(1.63)
Capital Expenditure	−0.020	−0.433	−0.089	0.167
	(−0.35)	(−1.11)	(−0.56)	(0.75)
Dividend	0.113	−0.135	0.159	−0.153
	(1.27)	(−1.43)	(1.61)	(−1.27)
Constant	−0.032	−0.190**	−0.067	−0.130*
	(−0.13)	(−2.37)	(−0.49)	(−2.13)
Year, Firm and State Fixed Effect	Yes	Yes	Yes	Yes
Observations	3098	3098	7412	7412
Adj. R-Squared	0.234	0.325	0.211	0.329

Note. This table reports the regression results by heavy consumers and all manufacturing industries. The instrument variable is the date of implementation of renewable energy policy. We compute t-statistics using standard errors corrected for clustering at the firm level; the numbers in parentheses represent the standard errors. ***, ** and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively. The Appendix provides definitions for all variables.

Table 6 displays the results, showing that renewable energy adoption increases financial performance volatility. This relationship holds across all metrics, with ROE exhibiting the strongest sensitivity, especially among heavy consumer firms. Our findings suggest that adopting renewable energy introduces variability in cost and output. Our results align with Ruggiero and Lehkonen (2017), who find that the transition to green energy often entails financial instability. By confirming this volatility channel, we provide further empirical support for our main hypothesis: firms respond to green policy-induced uncertainty by managing earnings.

5. Conclusion

This paper explored the unintended financial consequences that arise when firms adopt renewable energy policies. We leveraged exogenous variation from U.S. state-level renewable energy mandates and incentives, combined with firm-level electricity consumption data, to investigate whether these environmental policies affect corporate earnings management. Our analysis revealed two key findings. First, state-level renewable energy policies increase firms' adoption of green energy, particularly among heavy consumer firms. Second, this increased exposure to renewable energy adoption leads to higher earnings volatility, which in turn drives an increase in earnings management. These results remain robust across alternative measures of earnings management and appear most pronounced in firms subject to stricter environmental regulations.

Our study makes two significant contributions to the literature. From a theory standpoint, we draw on agency theory and positive accounting theory to explain how external regulatory shocks can distort financial reporting incentives. On an empirical level, we provide new evidence that renewable energy policies, while environmentally beneficial, can create volatility that encourages firms to smooth their earnings. Unlike prior studies that rely on firms' voluntary disclosures, we utilize policy-induced variation to identify a causal association the uptake of renewable energy and earnings manipulation. Our findings have important implications for policymakers, investors, and corporate decision-makers.

Policymakers should recognize that renewable energy policies may unintentionally create incentives for financial distortions, even as they advance environmental sustainability. These insights suggest that policymakers must carefully assess the causes and effects of policies on renewable energy and the pace at which they introduce new policies. Future regulatory designs could benefit from integrating complementary disclosure requirements or transparency guidelines, especially for firms operating in high-volatility sectors.

For investors and risk managers, our findings underscore the importance of scrutinizing reported earnings in industries subject to environmental regulation. Managers operating in these sectors may adjust financial statements to mitigate volatility, increasing the risk of earnings management. Therefore, investors must consider this additional financial risk when evaluating firms in regulated industries.

For managers and board members, our findings highlight the importance of implementing robust internal controls and effective audit oversight during the transition to greener operations under regulatory pressure.

In summary, our study highlights an often-overlooked aspect of going green—its impact on financial reporting practices. As firms and governments continue to pursue sustainability targets, understanding the broader implications of environmental policies will be crucial to maintaining transparency, promoting accountability, and advancing climate action in tandem.

Table 6
Renewable energy and performance volatility.

Dependent Variable	Heavy Consumers			All Manufacturing Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
	Volatility(EBIT/ EMP)	Volatility (ROA)	Volatility (ROE)	Volatility(EBIT/ EMP)	Volatility (ROA)	Volatility (ROE)
Renewable Energy Adoption	0.163***	0.258***	0.915***	0.074**	0.133***	0.770***
	(3.54)	(4.32)	(4.15)	(2.13)	(3.20)	(4.15)
Ln (Assets)	0.006***	−0.006***	−0.055***	0.006***	−0.004***	−0.032***
	(2.99)	(3.35)	(3.93)	(3.32)	(3.67)	(3.69)
Leverage	0.001	0.049***	0.635***	0.029***	0.012***	0.493***
	(0.13)	(5.17)	(4.15)	(4.13)	(2.99)	(4.60)
Book to Market	0.032***	0.033***	0.132***	0.030***	0.0024***	0.037
	(4.56)	(3.26)	(3.60)	(2.99)	(3.89)	(1.51)
Sales Change	−0.004	0.004	0.052	−0.005	−0.002	−0.033*
	(0.50)	(0.36)	(1.55)	(0.16)	(0.90)	(1.88)
Capital Expenditure	1.353***	0.555***	2.323***	1.215***	0.467***	1.516***
	(4.99)	(3.57)	(4.20)	(5.10)	(5.14)	(5.93)
Dividend	−0.532***	−0.326***	−0.309	−0.253***	−0.199***	−0.276
	(3.97)	(6.17)	(0.98)	(5.93)	(4.92)	(1.24)
Constant	0.537	0.052*	0.345	0.050	0.099***	0.127
	(1.25)	(1.91)	(1.52)	(0.79)	(3.17)	(0.21)
Year, Firm and State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2485	2485	2485	6381	6381	6381
Adj. R-Squared	0.634	0.341	0.279	0.636	0.342	0.230

Note. This table reports the regression results by heavy consumers and all manufacturing industries. We compute t-statistics using standard errors corrected for clustering at the firm level; the numbers in parentheses represent the standard errors. ***, ** and * indicate significance at the 1 %, 5 %, and 10 % levels, respectively. The Appendix provides definitions for all variables.

Conflict of interest

There are no conflicts of interest to declare.

Appendix. Variable Definitions

Variables	Definitions
Renewable Energy Adoption	Renewable electricity production to total electricity generation.
Ln (Cumulative Policies)	Natural logarithm of the accumulated number of renewable energy policies by state.
Ln (Cumulative Incentives)	Natural logarithm of the accumulated number of renewable energy incentives by state.
EBIT/EMP	EBIT divided by the number of employees (EMP).
ROA	Net income divided by total assets.
ROE	Net income divided by total equity.
Ln (Assets)	Natural logarithm of total assets.
Leverage	Sum of short-term and long-term debt scaled by total assets.
Book to Market	Ratio of the book value of assets to the market value of total assets.
Sales change	Percentage changes in sales.
Capital Expenditure	Capital expenditure scaled by total assets.
Dividend	Common dividend scaled by total assets.

Data availability

The authors do not have permission to share data.

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