“Do fossil fuel finance restrictions promote renewable energy? The moderating role of banking system depth”

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DO FOSSIL FUEL FINANCE RESTRICTIONS PROMOTE RENEWABLE ENERGY? THE MODERATING ROLE OF BANKING SYSTEM DEPTH

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Abstract

Renewable energy expansion is a cornerstone of environmental policy, yet empirical evidence on whether restricting international public finance for fossil fuels accelerates this transition remains scarce. This study assesses whether international public finance restrictions on fossil fuels promote renewable energy development across a panel of 128 countries, and how banking system depth moderates this policy effect. The analysis employs fixed-effects models with country-specific linear trends, validated through event-study, placebo, and first-difference checks, drawing on World Bank and Clean Energy Transition Partnership data. The results indicate that fossil fuel finance restrictions increase the share of renewable energy in total final energy consumption by 11.5-15.3 percentage points ($p < 0.05$), representing a relative increase of 40–53% compared with the sample mean of 28.9%. The first-difference estimator confirms that restrictions add nearly 1 percentage point to annual growth in the renewable energy share ($\beta = 0.908$, $p = 0.013$). The effect concentrates on non-hydro technologies: excluding hydropower, the estimated increase reaches 15.1 percentage points ($p = 0.013$), indicating that the policy primarily stimulates solar and wind deployment. Banking system depth significantly moderates these effects ($p < 0.05$): the policy impact is virtually zero where domestic credit is below 25% of GDP, but reaches 12.9 percentage points where credit exceeds 100% of GDP. This conditional pattern shows that fossil fuel finance restrictions deliver meaningful environmental gains only where the financial system can redirect capital toward renewable energy investment.

Keywords fossil fuels, renewable energy, public finance, banking depth, export credit, energy transition, panel data

JEL Classification Q42, Q48, G21, H81

INTRODUCTION

Mitigating climate change requires a rapid decarbonization of the global energy system, in which renewable sources supplied 32% of global electricity generation in 2024, up from 30% in 2023 (IEA, 2025). Yet the transition remains uneven across countries and insufficient to meet international climate targets, underscoring the need to examine – from an environmental-economics perspective – which policy instruments most effectively accelerate renewable energy deployment.

A critical obstacle to this transition is the continued flow of public finance toward fossil fuels, which sustains carbon-intensive capital and reproduces the negative externalities that environmental policy seeks to internalize. Despite repeated pledges to phase out inefficient subsidies, the global fiscal cost of government support measures for fossil fuels amounted to USD 916 billion in 2024, well above historical averages (OECD, 2025). Export credit agencies – government-backed institutions that provide loans and guarantees for cross-border trade

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– remain among the largest international public financiers of fossil fuels, directing significantly more resources to carbon-intensive projects than to clean energy alternatives. In response, 34 countries and five public financial institutions signed the Glasgow Statement on International Public Support for the Clean Energy Transition at COP26 in November 2021, committing to end new direct public support for the international unabated fossil fuel energy sector by the end of 2022. This initiative has delivered measurable results: fossil fuel financing by signatories fell by two-thirds to USD 5.2 billion in 2023 (Jones et al., 2024), although implementation has been uneven, with several signatories continuing to approve fossil fuel finance through definitional loopholes.

Despite this policy momentum, the environmental economics evidence on whether fossil fuel finance restrictions promote renewable energy development remains scarce. The specific effect of international public finance restrictions on renewable energy outcomes has received limited empirical attention. Equally unaddressed is the moderating role of the national banking system's depth – the institutional capacity to reallocate capital from fossil fuels to renewables – through which any policy effect would be transmitted. The present study addresses both gaps, providing systematic environmental-economics evidence on whether and under what financial-system conditions such restrictions translate into renewable energy growth.

1. LITERATURE REVIEW

The global expansion of renewable energy has attracted considerable scholarly attention to the factors that shape its pace and direction. A growing body of cross-country evidence indicates that environmental pressures, fossil fuel price dynamics, and macroeconomic conditions jointly determine the share of renewables in national energy mixes: higher CO_2 emissions and stronger climate commitments tend to raise renewable participation, whereas energy security concerns may counter-intuitively incentivize continued reliance on fossil fuels (Aguirre & Ibikunle, 2014; Mukhtarov et al., 2023). Rising natural gas prices reduce the cost gap between fossil and clean sources, accelerating the deployment of domestic renewable capacity (Baghirzade & Kosormyhin, 2025). GDP per capita generally supports renewable energy growth, though this relationship is nonlinear and may weaken beyond a critical income threshold (Trinh, 2025). Beyond these demand-side drivers, renewable energy development also acts as a proactive driver of systemic energy resilience (Havrylenko & Myroshnychenko, 2025). At the EU level, investments in renewables affect economic development through indirect channels rather than direct GDP effects (Okunevičiūtė Neverauskienė et al., 2025), and CO_2 efficiency and renewable consumption contribute to balancing growth with environmental management (Dilanchiev et al., 2024). Government technological readiness, including AI-related capabilities, is positively linked to installed renewable capacity, though the connection to generation output is less robust (Lyeonov et al., 2025c), and the reliability of decentralized electricity systems depends critically on high-granularity forecasting (Wojciechowski et al., 2025). Importantly, policy instruments such as tradeable certificates and feed-in tariffs stimulate innovation in renewable energy technologies, though effectiveness varies by technology type (Johnstone et al., 2010). The multidimensional nature of these determinants raises questions about how public finance instruments fit into this complex landscape, particularly whether restricting international public finance for fossil fuels can accelerate the transition.

The persistence of public financial support for fossil fuels represents one of the most significant barriers to the clean energy transition. Global energy subsidies generate net social costs, including fiscal deficits and aggravated environmental damage (Sovacool, 2017), while the continued channeling of public finance toward carbon-intensive infrastructure creates path dependencies that lock economies into high-emission trajectories. A rapid phase-out would require writing down substantial capital assets, generating stranded asset losses concentrated in advanced economies (Semieniuk et al., 2022). Public financial actors, including development banks and export credit agencies, play a dominant role in renewable energy deployment

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by absorbing risks that private investors avoid (Mazzucato & Semieniuk, 2018; Mursalov, 2025), yet market-driven transparency alone is insufficient to redirect capital flows, reinforcing the case for direct regulatory restrictions (Ameli et al., 2021). Empirical evidence on whether international climate finance policies deliver their intended outcomes remains sparse (Bhandary et al., 2021). The EU energy crisis of 2022–2023 exposed persistent structural dependencies on fossil fuels that voluntary mechanisms failed to address (Kuzior et al., 2023b), and financial market reactions to climate signals are uneven: Asian investors tend to reduce exposure to fossil fuel financiers while European investors sometimes demonstrate the opposite response (Nkwaira & Van Der Poll, 2024). This asymmetry underscores the need to examine the financial system characteristics that condition the transmission of public finance restrictions into renewable energy outcomes.

The financial system, and the banking sector in particular, has emerged as a pivotal intermediary in the energy transition. Green bonds and sustainable finance mechanisms are increasingly central to mobilizing climate mitigation capital, with empirical evidence confirming that green finance issuance promotes innovation in renewable energy technologies (Filipava & Murshudli, 2023; Zheng et al., 2023; Streimikiene et al., 2024). Nevertheless, evidence from Nordic secondary bond markets finds no statistically significant green bond premium, suggesting that market participants do not yet systematically reward green labeling (Aleknevičienė et al., 2025). Beyond capital markets, the depth and structure of the domestic banking system shape the conditions under which renewable energy investment occurs (Murshudli, 2023; Zapotichna, 2023; Kovalenko & Serhieieva, 2025). Insurance companies serve as important institutional investors in renewables, though their participation depends on supportive policy frameworks (Lyeonov et al., 2025a), and bibliometric mapping confirms that green bonds represent a rapidly expanding research frontier while the mechanisms linking financial instruments to deployment outcomes remain fragmented (Mammadov & Murshudli, 2023; Lyeonov et al., 2025b). Corporate governance quality is positively conducive to financial performance across banking and insurance sectors, suggesting that well-governed institutions are better positioned to channel capital toward clean energy markets (Noor et al., 2024). Banking infrastructure expansion enhances profitability and thereby the capacity to support large-scale transition projects (Budhathoki et al., 2025; Sitnicka et al., 2025). However, financial inclusion without stringent environmental standards may paradoxically increase carbon emissions in the short run (Fatur Šikić et al., 2025). The financial system thus serves as a necessary but insufficient transmission channel for climate policy – a consideration that extends equally to the design of specific energy policy instruments.

The effectiveness of energy policy instruments varies substantially across institutional settings. Feed-in tariffs remain among the strongest drivers of renewable electricity development (Raboshuk et al., 2025; Lyeonov & Moroz, 2025), while power purchase agreements serve as a particularly important mechanism for mobilizing public investment in hydro and wind capacities (Lyeonov et al., 2025d). Market-based mechanisms such as auctions and certificates show weaker effects, and energy taxes demonstrate heterogeneous impacts depending on a country's initial energy structure (Kuzior et al., 2023a). Climate regulations may inadvertently push activity into informal sectors that bypass environmental compliance (Lyeonov et al., 2025d), and fiscal decentralization fosters renewable generation only when local capacity aligns with national coordination (Lyeonov et al., 2025e). Policy uncertainty can cause government-backed instruments to impede rather than foster renewable investment (Aguirre & Ibikunle, 2014). At the same time, regulatory quality and the control of corruption – itself shaped by technological capacity (Yefimenko et al., 2025) – are consistently associated with higher renewable energy consumption (Mukhtarov et al., 2023; Prokopenko et al., 2025), and minority investor protection facilitates equity financing in clean energy start-ups (Halynskyi & Telizhenko, 2024). State support programs for green entrepreneurship in post-fossil-fuel regions confirm that synergy between regulation and private initiative determines the transition pace (Avlogiaris et al., 2023; Burrell et al., 2025). EU decarbonization has not undermined industrial export competitiveness in energy-intensive sectors (Zábojník & Branch, 2025). These heteroge-

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neities are amplified by structural differences in energy systems across EU regions (Kurbatova et al., 2025; Popescu et al., 2025; Kuzior et al., 2025), and the Russia–Ukraine war has further exposed divergences, accelerating deployment in some countries while revealing vulnerability in others (Vasylieva et al., 2025; Kuzior et al., 2023b).

Despite the extensive literature on renewable energy determinants, green finance, and energy policy instruments, a significant empirical gap persists. The question of whether restrictions on international public finance for fossil fuels lead to measurable increases in renewable energy deployment has rarely been addressed through formal causal inference methods. The literature has examined fossil fuel subsidy reform (Sovacool, 2017), green finance mechanisms (Zheng et al., 2023; Mazzucato & Semieniuk, 2018), and the determinants of renewable energy growth (Aguirre & Ibikunle, 2014; Trinh, 2025), yet the channel through which withdrawal of public finance from fossil fuels may redirect investment toward renewables remains untested. Equally absent is a formal examination of how financial intermediation depth conditions this environmental policy: while several studies identify financial system maturity as a key enabling condition (Lyeonov et al., 2025a; Bhandary et al., 2021), none have tested whether the impact of restrictions is conditional on the depth of domestic credit intermediation. Against this background, this study pursues two aims: first, to assess whether international public finance restrictions on fossil fuels promote renewable energy development; and second, to examine how national banking system depth moderates this policy effect. Using a difference-in-differences framework with 128 countries, the analysis provides systematic environmental economics evidence on the conditions under which such restrictions translate into renewable energy growth.

2. METHODOLOGY

2.1. Data sources and sample

The empirical analysis draws on a strictly balanced panel of 128 countries observed annually over 2010–2021 (T = 12), yielding 1,536 country-year observations (34 OECD, 94 non-OECD). Coverage is complete for renewable electricity generation, the four core covariates, and the treatment indicator; the principal dependent variable, renewable energy consumption (renew_energy_pct), is missing for 12 country-year units, so the main consumption regressions rely on 1,524 observations. The full country list is provided in Appendix A (Table A1). The panel begins in 2010, marking the onset of large-scale renewable energy deployment, and ends in 2021 – the latest year for which all three renewable energy indicators in the World Development Indicators (renew_energy_pct, renew_elec_pct, renew_elec_exhydro_pct) are jointly available on a harmonized cross-country basis. These indicators rely on IEA's harmonized national energy balances, which are released with a multi-year reporting lag.

Three principal data sources are used: the World Bank's World Development Indicators (World Bank, n.d.a) for dependent variables, banking system indicators, macroeconomic controls, and CO_2 emissions; the Worldwide Governance Indicators (World Bank, n.d.b) for the Regulatory Quality estimate; and official documents of the Clean Energy Transition Partnership (CETP, 2021), supplemented by the Oil Change International "Promise Breakers" report (Oil Change International, 2023), for the fossil fuel finance restriction dummy. Countries were included based on complete coverage of four core variables: renewable electricity generation, domestic bank credit to the private sector, GDP per capita, and trade openness. Sierra Leone was removed due to a data error in the broad money series.

A comprehensive list of all variables, their definitions, data sources, and roles is provided in Appendix A (Table A2). The dependent variables are the share of renewable electricity in total electricity generation (renew_elec_pct, DV1) and the share of renewable energy in total final energy consumption (renew_energy_pct, DV2). An alternative dependent variable – renewable electricity excluding hydroelectric sources, with 55 negative observations clipped to zero – is used in robustness checks.

GDP per capita was log-transformed to reduce skewness. Broad money was winsorized at the 99th percentile (280.59%), capping 13 extreme observations. The core variables – renew_elec_pct, credit_banks_gdp, ln_gdp_pc, trade_openness, reg_quality, and ban_dummy – have complete coverage across all 1,536 observations. Several extended variables have partial coverage: bank nonperforming loans (N = 1,187; 22.7% missing), broad money (N = 1,289; 16.1%), energy use per capita (N = 1,301; 15.3%), and CO_2 emissions (N = 1,488; 3.1%). Specifications including these variables employ listwise deletion; the missing observations are concentrated in low-income and small economies and are unlikely to correlate systematically with the treatment variable.

The primary treatment variable (ban_dummy) equals 1 from the year of a country's first adoption of restrictions on international public finance for fossil fuels. Coding follows a country-specific approach, assigning treatment from the earliest binding restriction – whether through national legislation, the Glasgow Statement, or OECD Export Credit Group decisions. The 20 treated countries and their adoption years are listed in Appendix A (Table A3). Two alternative treatment variables are used in robustness checks: the Glasgow Statement dummy (treatment uniformly from 2021 for all signatories) and a compliance-based dummy restricted to countries assessed as having fully implemented their commitments – Denmark, Finland, France, Sweden, and the United Kingdom.

The baseline specification employs a two-way fixed effects (TWFE) model:

$$Y_{it} = \alpha_i + \lambda_t + \beta_1 Ban_{it} + \gamma' X_{it} + \varepsilon_{it}, \qquad (1)$$

where Y_{it} denotes the renewable energy outcome for country i in year t; α_i captures time-invariant country characteristics; λ_t absorbs common time shocks; Ban is the restriction dummy; and X_{it} is a vector of controls (domestic credit, GDP per capita, trade openness, regulatory quality). The coefficient β_1 captures the effect of fossil fuel finance restrictions on the renewable energy outcome; γ is a vector of coefficients on the control variables; and ε_{it} is the idiosyncratic error term.

The event study analysis reveals significant pre-treatment trends, so the preferred specification augments Equation (1) with country-specific linear time trends:

$$Y_{it} = \alpha_i + \delta_i \cdot t + \lambda_t + \beta_1 Ban_{it} + \gamma' X_{it} + \varepsilon_{it}. \qquad (2)$$

The coefficient β_1 now captures the deviation from each country's pre-existing trend attributable to the policy intervention. Country-specific trends also mitigate potential bias from staggered adoption (Goodman-Bacon, 2021; Callaway & Sant'Anna, 2021) by allowing each country's counterfactual trajectory to differ.

The identification strategy is validated through an event study specification:

$$Y_{it} = \alpha_i + \delta_i \cdot t + \lambda_t + \Sigma_k \neq_{-1} \beta_k \cdot D_{it}^k + \gamma' X_{it} + \varepsilon_{it}, \qquad (3)$$

where D_{it}^k equals one when country i is k periods from treatment adoption, with k = –1 as the reference period and endpoints binned at k = –5 and k = +2.

A first-difference estimator provides an additional robustness check:

$$\Delta Y_{it} = \lambda_t + \beta_1 \Delta Ban_{it} + \gamma' \Delta X_{it} + \varepsilon_{it}. \qquad (4)$$

A placebo test shifts treatment dates backward (by two and three years) on pre-treatment data only (2010–2018); an insignificant placebo coefficient provides additional confidence that the estimated effect is not an artefact of pre-existing trends.

To examine the moderating role of banking system depth, the analysis estimates an interaction specification:

$$Y_{it} = \alpha_i + \delta_i t + \lambda_t + \beta_1 Ban_{it} + \beta 2 Credit_{it} + \beta_3 (Banit \cdot Credititit) + \gamma' X_{it} + \varepsilon_{it}, \qquad (5)$$

where $Credit_{it}$ denotes domestic credit to the private sector by banks (% of GDP) and the marginal effect of the restriction at a given level of banking development is $\beta_1 + \beta_3 \cdot Credit_{it}$.

The identification strategy benefits from the staggered temporal structure of the treatment. Denmark and France have been subject to restrictions since 2019 (three post-treatment years), the United Kingdom and Sweden since 2020 (two years), while 16 Glasgow signatories contribute one year of post-treatment data. The earliest adopters,

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therefore, provide the primary source of temporal variation. Moreover, renewable energy indicators are annual aggregates reflecting investment decisions made one to three years prior, meaning that the 2021 observation already captures the cumulative effects of policy signals preceding the formal Glasgow commitment.

Standard errors are clustered at the country level to account for heteroskedasticity and within-country serial correlation, supported by the Breusch–Pagan test (LM = 42.69, $p < 0.001$), the White test (LM = 180.79, $p < 0.001$), and the Wooldridge test for serial correlation ($p = 0.044$). The Hausman test ($\chi^2(5) = 10.22$, $p = 0.069$) is borderline, but fixed effects are preferred given the strong expectation that unobserved country characteristics correlate with both treatment and outcomes. Variance inflation factors for all covariates are below 7. The full correlation matrix is reported in Appendix B. All estimations are performed in Python 3.12 using pyfixest, linearmodels, and statsmodels.

3. RESULTS AND DISCUSSION

3.1. Descriptive statistics

Table 1 reports the descriptive statistics for all variables included in the analysis. The strictly balanced panel comprises 128 countries observed over the period 2010–2021 (N × T = 1,536 observations), of which 34 are OECD members, and 94 are non-OECD economies. The mean share of renewable electricity generation is 31.13% of total electricity output (SD = 29.12), ranging from 0% to 100%, reflecting substantial cross-country heterogeneity. Renewable energy consumption as a share of total final energy averages 28.90% (SD = 25.60), with a similarly wide distribution. Renewable electricity excluding hydropower averages only 8.48% (SD = 11.81), highlighting hydropower's dominant role in many countries.

The fossil fuel finance restriction dummy has a mean of 0.017, indicating that policy treatment is concentrated in a small number of country-year observations. Twenty countries are classified as treated, with treatment onset in 2019 (Denmark and France), 2020 (the United Kingdom and Sweden), and 2021 (16 Glasgow Statement signatories). The remaining 108 countries serve as the control group. A comparison of pre-treatment (2010–2018) means reveals that treated countries have systematically higher GDP per capita (mean ln_gdp_pc: 9.86 vs. 8.50) and substantially greater banking sector depth (mean domestic credit: 87.09% vs. 46.16% of GDP), underscoring the importance of country fixed effects and country-specific trends to absorb these time-invariant differences.

Among the banking system indicators, domestic credit to the private sector by banks averages 53.91% of GDP (SD = 41.39), while broad money averages 62.29% of GDP (SD = 42.48). Bank nonperforming loans average 6.71% of gross loans (N = 1,187 due to partial coverage). The log of GDP per capita has a mean of 8.77 (approximately USD 6,400 in constant 2015 terms), trade openness averages 89.80% of GDP, and energy use per capita averages 2,297 kg of oil equivalent. Regulatory quality ranges from –2.10 to 2.23, with a mean of 0.12. CO_2 emissions per capita average 5.03 tonnes, and FDI net inflows average 6.44% of GDP. The variance inflation factors for all independent variables are below 10 (ban_dummy: 1.04; credit_banks_gdp: 5.42; ln_gdp_pc: 6.96; trade_openness: 4.56; reg_quality: 1.70), confirming the absence of multicollinearity. The variables with partial coverage – NPL, energy use, and CO_2 – serve as additional controls in the robustness analysis (Table 5).

A comparison of pre-treatment means between treated and control countries (Appendix C) confirms that treated countries have higher GDP per capita and more developed banking systems, consistent with the predominantly OECD composition of the treated group and reinforcing the rationale for country-fixed effects.

3.2. Diagnostic tests

The Breusch-Pagan test (LM = 42.69, $p < 0.001$) and the White test (LM = 180.79, $p < 0.001$) both reject the null hypothesis of homoskedasticity. The Wooldridge test for serial correlation yields a significant result ($p = 0.044$), and the Durbin–Watson statistic of 0.87 indicates positive autocorrelation. These findings justify the use of standard errors clustered at the country level, which are robust to both heteroskedasticity and within-cluster

Table 1. Descriptive statistics

Variable	Mean	SD	Min	Max	N
Renewable electricity (%)	31.126	29.116	0.000	100.000	1,536
Renew. elec. excl. hydro (%)	8.480	11.808	0.000	81.558	1,536
Renewable energy cons. (%)	28.904	25.601	0.000	95.100	1,524
Fossil fuel ban dummy	0.017	0.129	0.000	1.000	1,536
Credit by banks (% GDP)	53.908	41.386	3.203	259.184	1,536
Bank NPL (% gross loans)	6.713	7.497	0.128	55.080	1,187
Broad money (% GDP)	62.287	42.484	8.585	280.590	1,289
Log GDP per capita	8.766	1.345	5.857	11.616	1,536
Trade openness (% GDP)	89.797	54.029	4.128	442.620	1,536
Energy use p.c. (kg o.e.)	2,297.4	2,442.0	112.9	21,456.1	1,301
Regulatory quality	0.118	0.906	–2.104	2.231	1,536
CO_2 per capita (t CO_2e)	5.033	6.301	0.002	53.599	1,488
FDI net inflows (% GDP)	6.442	29.494	–296.0	452.221	1,516

Note: The panel is strictly balanced: 128 countries × 12 years = 1,536 observations. N varies for variables with partial coverage. Source: World Bank WDI, WGI, CETP/OCI reports.

serial correlation. All regression results employ country-clustered standard errors.

The Hausman test comparing fixed effects and random effects yields $\chi^2(5) = 10.22$ ($p = 0.069$). Although borderline at the 5% level, the fixed effects estimator is preferred on theoretical grounds, as unobserved time-invariant country characteristics – including resource endowments, energy infrastructure legacy, and institutional traditions – are likely correlated with both fossil fuel finance restrictions and renewable energy outcomes.

3.3. Parallel trends and identification

The validity of the difference-in-differences framework rests on the parallel trends assumption. Table 2 reports the event study coefficients estimated with leads and lags relative to the year of policy adoption, using t – 1 as the reference period.

The standard event study without country-specific trends reveals statistically significant negative pre-treatment coefficients ($t - 5$: $\beta = -6.43$, $p = 0.003$; $t - 4$: $\beta = -4.79$, $p < 0.001$; $t - 3$: $\beta = -3.61$, $p < 0.001$; $t - 2$: $\beta = -2.28$, $p = 0.018$). The joint Wald test rejects the null of zero pre-treatment effects ($\chi^2(4) = 15.21$, $p = 0.004$). This pattern indicates that treated countries were already on an upward trajectory in renewable electricity generation prior to policy adoption, which would bias standard fixed effects estimates upward.

To address this, country-specific linear time trends are included in the preferred specification, absorbing differential pre-existing growth paths. With country trends, all pre-treatment coefficients become statistically insignificant at the 5% level ($t - 5$: $\beta = 8.81$, $p = 0.259$; $t - 4$: $\beta = 10.24$, $p = 0.173$; $t - 3$: $\beta = 11.05$, $p = 0.128$; $t - 2$: $\beta = 12.28$, $p = 0.089$), confirming that the parallel trends assumption holds after this adjustment. The post-treatment

Table 2. Event study coefficients – Parallel trends test

Period	β	SE	p	Sig.	β	SE	p	Sig.
	– Without trends –				– With trends –			
t – 5	–6.432	2.098	0.003	***	8.806	7.765	0.259	–
t – 4	–4.791	1.287	< 0.001	***	10.243	7.473	0.173	–
t – 3	–3.611	0.985	< 0.001	***	11.054	7.209	0.128	–
t – 2	–2.275	0.947	0.018	**	12.281	7.155	0.089	*
t – 1	0.000	–	ref.	–	0.000	–	ref.	–
t + 0	1.934	1.058	0.070	*	13.959	7.804	0.076	*
t + 1	6.848	3.347	0.043	**	23.945	12.160	0.051	*
t + 2	6.152	5.447	0.261	–	21.873	20.430	0.286	

Note: Dependent variable: renewable electricity generation (% of total). Reference period: t – 1. Clustered SE at the country level. Endpoints binned at t – 5 and t + 2. *** p < 0.01, ** p < 0.05, * p < 0.1.

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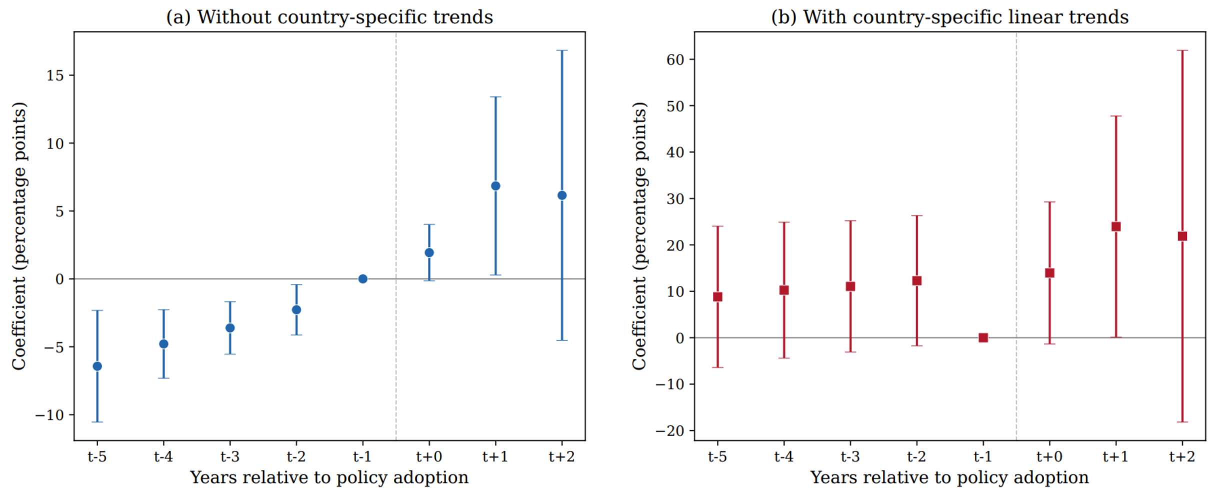

Note: Panel (a) shows event study coefficients without country-specific trends; panel (b) includes country-specific linear time trends. Shaded areas represent 95% confidence intervals. The dashed vertical line marks the treatment period. Reference period: $t - 1$.

Figure 1. Event study: Effect of fossil fuel finance restrictions on renewable electricity generation

coefficients show positive and growing effects ($t + 0$: $\beta = 13.96$, $p = 0.076$; $t + 1$: $\beta = 23.95$, $p = 0.051$), consistent with a treatment effect that increases over time. Consequently, all preferred specifications include country fixed effects, year fixed effects, and country-specific linear time trends. Figure 1 provides a visual representation.

A placebo test further supports the identification strategy. Shifting the treatment dates three years earlier and restricting the sample to 2010–2018, the placebo dummy yields $\beta = 3.73$ ($p = 0.035$). A two-year shift produces an insignificant coefficient ($\beta = 6.84$, $p = 0.122$). The complete set of placebo tests with one- to five-year shifts is reported in Appendix E. These results, combined with the corrected event study, provide reasonable confidence that the estimated effects are not driven solely by pre-existing trends.

3.4. Main results: Renewable energy supply

Table 3 presents the main results for the share of renewable energy consumption in total final energy supply, which constitutes the principal finding of this study. All models include country fixed effects, year fixed effects, and country-specific linear time trends.

In the baseline specification without control variables (column 1), the ban dummy is statistically insignificant ($\beta = -0.418$, SE = 4.897). This is because, in the absence of controls, the treatment effect is confounded by omitted macroeconomic and institutional factors. The coefficient becomes positive and marginally significant once banking controls are introduced (column 2: $\beta = 9.268$, $p < 0.10$), and achieves high significance with the addition of GDP per capita and trade openness (column 3: $\beta = 15.299$, $p < 0.01$). In the full specification (column 4), the fossil fuel finance restriction dummy is positive and statistically significant at the 5% level ($\beta = 11.542$, SE = 4.469, $p = 0.011$). This implies that the adoption of restrictions on export credits and public finance for fossil fuels is associated with an increase of approximately 11.5 percentage points in the share of renewable energy in total final energy consumption. The coefficient remains marginally significant in the extended model with broad money (column 5: $\beta = 9.534$, $p = 0.099$).

Among the control variables, the log of GDP per capita exerts a strong negative effect ($\beta = -17.454$, $p < 0.001$), indicating that, after controlling for country-level trends, wealthier countries with large fossil fuel infrastructure experience declining renewable shares unless offset by policy intervention, in contrast to patterns in newly democratic economies where growth objectives dominate environmental enforcement (Triarchi et al., 2023). Regulatory quality is positive and highly significant ($\beta = 11.600$, $p < 0.001$), echoing prior

Table 3. Renewable energy consumption (% of total final energy)

Variable	(1)	(2)	(3)	(4)	(5)
ban_dummy	–0.418	9.268*	15.299***	11.542**	9.534*
	(4.897)	(5.164)	(4.608)	(4.469)	(5.740)
credit_banks_gdp		–0.231***	0.050	–0.018	0.235***
		(0.047)	(0.043)	(0.035)	(0.083)
ln_gdp_pc			–12.694***	–17.454***	–17.691***
			(1.626)	(1.687)	(1.800)
trade_openness			–0.040	–0.056*	–0.078*
			(0.030)	(0.030)	(0.044)
reg_quality				11.600***	7.341**
				(2.753)	(2.960)
broad_money_gdp					–0.229***
					(0.082)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country trends	Yes	Yes	Yes	Yes	Yes
Observations	1,524	1,524	1,524	1,524	1,277
R^2	0.000	0.138	0.422	0.469	0.538

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Clustered standard errors at the country level in parentheses. All models include country FE, year FE, and country-specific linear time trends. The within R2 reflects the share of residual variation explained after absorbing country fixed effects and individual linear trends, and is not directly comparable to R2 from standard FE models.

evidence that stronger governance frameworks facilitate renewable energy expansion (Mukhtarov et al., 2023). Trade openness is negative and marginally significant (β = –0.056, $p < 0.10$), consistent with the interpretation that more open economies may face competitive pressures that slow the energy transition. Domestic credit to the private sector by banks is not significant in the full model (β = –0.018, $p = 0.610$) but becomes significant and negative without institutional controls (column 2: β = –0.231, $p < 0.001$), suggesting that this variable captures governance-related channels in the absence of explicit institutional quality measures. In the extended model (column 5), broad money enters with a negative and highly significant coefficient (β = –0.229, $p < 0.01$), suggesting that the composition of financial intermediation matters more than its volume: monetary depth financing energy-intensive industry rather than clean energy may slow the transition. This compositional reading is in line with broader arguments on aligning institutional resources with sustainability objectives (Tessema, 2025).

3.5. Main results: Renewable electricity generation

Table 4 reports the results for the share of renewable electricity in total electricity generation. In the preferred specification (column 4), the fossil fuel finance restriction dummy is positive and significant at the 10% level (β = 13.563, SE = 7.077, $p = 0.058$). The coefficient is stable across all five specifications, ranging from 13.56 to 17.07, and achieves significance at the 5% level with macroeconomic controls (column 3: β = 17.067, $p = 0.019$). Regulatory quality is positive and significant (β = 10.762, $p = 0.011$). In the extended specification, broad money is negative and highly significant (β = –0.304, $p < 0.01$), while its inclusion increases the ban coefficient to 15.534 ($p = 0.058$).

The marginally weaker significance for the electricity generation measure, compared with the energy supply measure, is consistent with the observation that renewable electricity shares exhibit greater inertia due to the large installed base of hydroelectric capacity. The broader energy supply measure captures changes across electricity, heating, and transport sectors, where policy-induced shifts may manifest more readily.

3.6. Robustness checks

Table 5 presents a comprehensive set of robustness checks for the renewable electricity generation outcome. The standard fixed effects model without country trends (R1) yields a highly significant coefficient (β = 7.595, $p < 0.001$, $N = 1{,}536$), serving as a benchmark. As discussed in the identification

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Table 4. Renewable electricity generation (% of total)

Variable	(1)	(2)	(3)	(4)	(5)
ban_dummy	13.842*	15.383**	17.067**	13.563*	15.534*
	(7.048)	(6.943)	(7.158)	(7.077)	(8.110)
credit_banks_gdp		−0.037	0.046	−0.017	0.310***
		(0.055)	(0.062)	(0.060)	(0.101)
ln_gdp_pc			−3.667	−8.086**	−8.410***
			(2.603)	(3.095)	(3.170)
trade_openness			−0.015	−0.030	−0.055
			(0.055)	(0.055)	(0.050)
reg_quality				10.762**	6.865
				(4.190)	(4.640)
broad_money_gdp					−0.304***
					(0.085)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country trends	Yes	Yes	Yes	Yes	Yes
Observations	1,536	1,536	1,536	1,536	1,289
R^2	0.009	0.012	0.031	0.062	0.153

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Clustered standard errors at the country level in parentheses. All models include country FE, year FE, and country-specific linear time trends.

section, this estimate is likely biased upward due to differential pre-trends.

The first-difference estimator (R2) tests whether fossil fuel finance restrictions accelerate year-on-year changes. For renewable electricity generation, the coefficient is positive and marginally significant ($\beta = 1.799$, SE = 1.025, $p = 0.082$), indicating that restrictions increase annual growth by approximately 1.8 percentage points. Importantly, the first-difference result for renewable energy consumption (not shown in Table 5) is stronger and statistically significant at the 5% level ($\beta = 0.908$, SE = 0.361, $p = 0.013$), providing additional

Table 5. Robustness checks

Variable	R1	R2	R3	R4	R5	R6	R7
	No trend	FD	Glasgow	Comply	Ex.hydro	+CO_2	Interact.
ban_dummy	7.595***				15.051**	8.376	−6.646
	(2.178)				(5.968)	(7.034)	(13.731)
d_ban_dummy		1.799*					
		(1.025)					
glasgow_ dummy			11.346*				
			(6.603)				
compliance_ dummy				18.536			
				(11.835)			
ban_x_credit							0.219
							(0.132)
CO_2_pc						−1.544***	
						(0.557)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	–	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country trends	No	–	Yes	Yes	Yes	Yes	Yes
Observations	1,536	1,408	1,536	1,536	1,536	1,488	1,536
R^2	0.960	0.033	0.060	0.061	0.218	0.126	0.063

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Clustered SE in parentheses. R1: standard FE without country trends (DV: renew_elec_pct). R2: first-difference estimator with year FE only (DV: Δrenew_elec_pct). R3-R7: with country FE, year FE, and country-specific linear trends. DV for R5: renew_elec_exhydro_pct; all others: renew_elec_pct. Control variables (credit_banks_gdp, ln_gdp_pc, trade_openness, reg_quality) included in all specifications. First-difference result for renewable energy consumption (β = 0.908**, p = 0.013) reported in text.

robust confirmation of the main finding reported in Table 3. The full first-difference results for both dependent variables are reported in Appendix D.

Using the Glasgow Statement dummy as an alternative treatment variable (R3) yields a consistent estimate (β = 11.346, SE = 6.603, p = 0.088). The compliance-based dummy, restricted to countries that fully implemented their commitments (R4), produces a larger but imprecisely estimated coefficient (β = 18.536, SE = 11.835, p = 0.120), suggesting that actual policy implementation may amplify the effect, although the small number of fully compliant countries in the sample (5: Denmark, Finland, France, Sweden, and the United Kingdom) limits statistical power.

When the dependent variable is redefined as renewable electricity excluding hydroelectric sources (R5), the coefficient is positive and significant at the 5% level (β = 15.051, SE = 5.968, p = 0.013, N = 1,536), confirming that the policy effect operates primarily through the expansion of solar and wind technologies. Adding CO_2 emissions per capita (R6) reduces the ban coefficient to 8.376 (p = 0.236), as the carbon intensity variable absorbs part of the variation associated with fossil fuel dependence; CO_2 itself is highly significant (β = –1.544, p < 0.01). A leave-one-out sensitivity analysis confirms that no single treated country drives the main result; the coefficient remains statistically significant at the 5% level in all 20 iterations, ranging from 9.20 to 12.99 (Appendix F, Table F1). The interaction specification (R7) is discussed in the following subsection.

The principal effect – an increase in the renewable energy share of 11.5–15.3 percentage points – aligns with the argument that removing public finance for fossil incumbents creates competitive conditions favoring renewables (Sovacool, 2017; Aguirre & Ibikunle, 2014) and with stranded-asset reallocation pressures that redirect capital toward the renewable sector (Semieniuk et al., 2022). Unlike incentive-based instruments that may impede investment through design failures (Aguirre & Ibikunle, 2014), restrictions operate through the withdrawal of public finance for incumbents, which explains the consistently positive estimates across specifications. The growing event-study trajectory in the post-treatment years suggests a cumulative reallocation process; at the firm level, this is consistent with prior evidence that macro-level policy signals operate partly through eco-innovation responses (Živković & Štrbac, 2025). The concentration of the effect on non-hydro technologies (15.1 pp, p = 0.013) indicates that solar and wind, having experienced the sharpest cost declines, absorb redirected investment disproportionately. A parallel mechanism documented elsewhere is the maturation of financial infrastructure for these technologies as institutional investors increasingly channel capital toward them (Lyeonov et al., 2025a).

Table 6. Subsample analysis and interaction effects

Variable	Full	OECD	Non-OECD	OECD int.	Bank int.
ban_dummy	13.563*	4.944	1.647	0.776	–4.413
	(7.077)	(10.137)	(16.313)	(16.160)	(6.999)
ban_x_oecd				15.838	
				(17.659)	
ban_x_credit					0.173**
					(0.080)
credit_banks_gdp					–0.022
					(0.034)
Controls	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country trends	Yes	Yes	Yes	Yes	Yes
Observations	1,536	408	1,128	1,536	1,524
R^2	0.062	0.073	0.109	0.062	0.470

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Clustered SE in parentheses. All models include country FE, year FE, country-specific linear trends, and full controls (credit_banks_gdp, ln_gdp_pc, trade_openness, reg_quality). DV: renew_elec_pct for columns 1–4; renew_energy_pct for the Bank interaction column.

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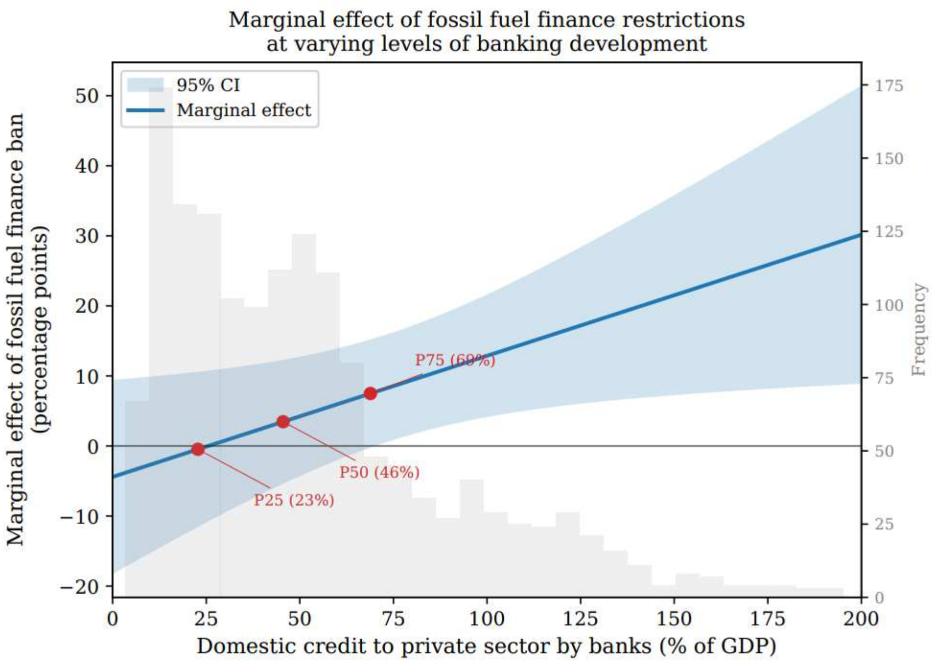
3.7. Country-level effects: Subsample and interaction analysis

Table 6 examines heterogeneity across country groups. In the OECD subsample (N = 408), the ban dummy is positive but statistically insignificant (β = 4.944, SE = 10.137, p = 0.629). The non-OECD subsample yields a similarly insignificant estimate (β = 1.647, SE = 16.313, p = 0.920). The loss of significance reflects the substantially reduced number of treated units in each subsample (15 OECD and 5 non-OECD treated countries), which severely limits statistical power. The interaction between the ban and OECD membership is not statistically significant (β = 15.838, SE = 17.659, p = 0.371), indicating no detectable difference in the treatment effect between the two groups.

Turning to the primary outcome variable (renewable energy consumption), the interaction between the ban dummy and domestic bank credit to the private sector provides statistically significant evidence of a moderating effect of banking system development. For the primary outcome (renewable energy consumption), the interaction term is positive and significant at the 5% level (β = 0.173, SE = 0.082, p = 0.032), confirming that the effect of fossil fuel finance restrictions increases with banking intermediation. The marginal effects are economically meaningful: at low banking development (domestic credit = 25% of GDP), the estimated ban effect is close to zero (–0.09 percentage points); at the sample median (50% of GDP), it rises to 4.23 percentage points; and at high banking development (100% of GDP), it reaches 12.87 percentage points (Figure 2). This pattern is consistent with the theoretical expectation that developed banking systems facilitate the reallocation of capital from fossil fuel to renewable energy projects when public finance restrictions are imposed. A descriptive analysis of the 20 treated countries reveals that 15 experienced an increase in renewable energy consumption following policy adoption (Appendix F, Table F2). The predicted marginal effects, computed from the interaction model using the delta method, are statistically significant for 11 countries – all with domestic credit exceeding 73% of GDP (Appendix F, Table F3). The corresponding interaction for renewable electricity generation is consistent in sign (β = 0.219) but less precisely estimated (p = 0.101), reflecting the greater inertia of the electricity generation measure.



Note: The solid line represents the marginal effect of the ban dummy at varying levels of domestic credit to the private sector by banks (% of GDP). Shaded area: 95% CI via delta method. Grey histogram: distribution of the banking variable. Dots: marginal effect at P25, median, and P75. DV: renew_energy_pct.

Figure 2. Marginal effect of fossil fuel finance restrictions by banking system development

This moderating role of banking system depth – among the most policy-relevant findings of this study – is consistent with the consensus that renewable energy deployment depends on financial market development (Trinh, 2025; Bhandary et al., 2021). The apparent tension with evidence that financial inclusion may increase emissions (Fatur Šikić et al., 2025) is resolved by distinguishing between the volume of financial intermediation and its regulatory direction; our interaction captures the latter, not merely credit availability. In countries with shallow banking systems, even a clear policy signal cannot translate into renewable investment because the institutional capacity for capital reallocation is absent – a pattern resonating with evidence that gaps between commitments and expenditure outcomes reflect capacity constraints (Megbowon & Zerihun, 2025; Gondauri & Chedia, 2025).

CONCLUSION

This study investigated whether restrictions on international public finance for fossil fuels promote renewable energy development and whether banking system depth conditions this effect, using a balanced panel of 128 countries over 2010–2021 with fixed effects models augmented by country-specific linear time trends.

Three main conclusions emerge from the evidence. First, restrictions on international public finance for fossil fuels produce measurable renewable energy growth. The first-difference estimator confirms roughly one additional percentage point of annual growth in the renewable share ($\beta = 0.908$, $p = 0.013$), and the level effect ranges from 11.5 to 15.3 percentage points on the consumption-based outcome, a 40-53% relative increase above the sample mean. This establishes that supply-side restrictions on carbon-intensive finance are a substantive, not merely symbolic, environmental policy instrument. Second, the policy operates primarily through the technological frontier: solar and wind absorb the bulk of redirected investment (15.1 percentage points, $p = 0.013$), while hydropower remains unaffected, indicating that public finance restrictions accelerate the diffusion of the cleanest available technologies rather than reshuffling output among existing ones. Third, the effectiveness of the policy is conditional on the depth of the domestic banking system: the estimated effect is virtually zero where domestic credit is below 25% of GDP and rises to 12.9 percentage points where credit exceeds 100% of GDP, identifying banking intermediation as the institutional precondition that determines whether international climate commitments translate into energy-transition outcomes.

These findings carry several implications for environmental policy. Commitments to end international public finance for fossil fuels can meaningfully accelerate the energy transition, but their effectiveness depends critically on domestic financial conditions. Governments should therefore combine international climate commitments with reforms that strengthen the capacity of banks to finance renewable energy, particularly in countries with shallow banking systems, where the policy effect is close to zero. For financial regulators, the results imply that prudential and disclosure tools – green lending incentives, climate-related disclosure requirements, and risk-weight adjustments for fossil fuel exposures – should be explicitly aligned with climate objectives, since the composition and depth of financial intermediation determine whether public-finance commitments translate into energy-transition outcomes. The findings also reinforce the centrality of regulatory quality: countries with stronger institutional governance show systematically higher renewable energy shares, suggesting that climate policy effectiveness is inseparable from broader institutional reform.

These findings are subject to several limitations that motivate future research. Most treated countries are observed only one-year post-adoption, constraining medium-term inference; extending the panel through the 2022–2023 energy price crisis would address this and reveal whether the crisis amplified or moderated the policy effect. The binary treatment captures neither policy intensity nor compliance, so granular stringency measures and direct analysis of export credit agency portfolios would sharpen

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causal identification. Concurrent pro-renewable policies – carbon pricing, feed-in tariffs, subsidies – confound the isolated effect of fossil fuel finance restrictions; disentangling these channels requires comprehensive policy-level data. Finally, the banking depth result invites further investigation into which specific financial instruments most effectively redirect capital from fossil fuels to renewables.

AUTHOR CONTRIBUTIONS

Conceptualization: Muslum Mursalov, Victoria Kovalenko.
Data curation: Muslum Mursalov.
Formal analysis: Victoria Kovalenko.
Funding acquisition: Muslum Mursalov, Victoria Kovalenko.
Investigation: Muslum Mursalov, Victoria Kovalenko.
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Software: Victoria Kovalenko.
Supervision: Muslum Mursalov, Victoria Kovalenko.
Validation: Victoria Kovalenko.
Visualization: Victoria Kovalenko.
Writing – original draft: Muslum Mursalov, Victoria Kovalenko.
Writing – review & editing: Muslum Mursalov, Victoria Kovalenko.

DATA AVAILABILITY

The data used in this study are publicly available. Macroeconomic, banking, energy, and emissions indicators were obtained from the World Bank's World Development Indicators (World Bank, n.d.a). Institutional quality data were sourced from the Worldwide Governance Indicators (World Bank, n.d.b). The treatment variable was constructed from the Glasgow Statement on International Public Support for the Clean Energy Transition (Clean Energy Transition Partnership, 2021) and the Oil Change International "Promise Breakers" report (Oil Change International, 2023).

REFERENCES

1. Aguirre, M., & Ibikunle, G. (2014). Determinants of renewable energy growth: A global sample analysis. *Energy Policy, 69,* 374-384. https://doi.org/10.1016/j.enpol.2014.02.036
2. Aleknevičienė, V., Kazilionienė, A., & Bendoraitytė, A. (2025). Does the green bond premium exist in the secondary market? Evidence from Nordic countries. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 20*(1), 327-355. https://doi.org/10.24136/eq.3389
3. Ameli, N., Kothari, S., & Grubb, M. (2021). Misplaced expectations from climate disclosure initiatives. *Nature Climate Change, 11*(11), 917-924. https://doi.org/10.1038/s41558-021-01174-8
4. Avlogiaris, G., Farmaki, P., & Kataracha, A. (2023). State and entrepreneurship on the road to green growth in a post lignite era: Friends or foes? *European Journal of Interdisciplinary Studies, 15*(2), 90-96. https://doi.org/10.24818/ejis.2023.18
5. Baghirzade, M., & Kosormyhin, T. (2025). Investigation of impact of oil, gold and natural gas prices on clean energy stock prices. *Financial Markets, Institutions and Risks, 9*(3), 101-119. https://doi.org/10.61093/fmir.9(3).101-119.2025
6. Bhandary, R. R., Gallagher, K. S., & Zhang, F. (2021). Climate finance policy in practice: A review of the evidence. *Climate Policy, 21*(4), 529-545. https://doi.org/10.1080/14693062.2020.1871313
7. Budhathoki, P. B., Karki, M., Lama, P. B., & Chataut, M. K. (2025). Financial access and its socio-economic dilemmas: Assessing the impact on bank performance. *SocioEconomic Challenges, 9*(1), 58-69. https://doi.org/10.61093/sec.9(1).58-69.2025
8. Burrell, D. N., Wansi, T., Morin, S. L., Rahim, E., Tessema, D. B., Alemu, B. A., Harris, N., & Conley, L. (2025). Harnessing behavioral economics, green promotions, and financial incentives as catalysts for sustainable practices. *Green Transition and Sustainable Development, 1*(1), 1-16. https://doi.org/10.61093/gtsd.1(1).1-16.2025
9. Callaway, B., & Sant'Anna, P. H. C. (2021). Difference-in-differences with multiple time periods. *Journal*

of Econometrics, 225(2), 200-230. https://doi.org/10.1016/j.jeconom.2020.12.001

10. Clean Energy Transition Partnership (CETP). (2021). *Statement on international public support for the clean energy transition*. Glasgow, United Kingdom: COP26. Retrieved from https://ukcop26.org/statement-on-international-public-support-for-the-clean-energy-transition/
11. Dilanchiev, A., Urbański, M., Ahmed, D., & Valiyev, O. (2024). Balancing economic growth and environmental management: The role of CO2 efficiency and renewable energy in the EU. *Polish Journal of Management Studies, 30*(1), 66-81. https://doi.org/10.17512/pjms.2024.30.1.04
12. Fatur Šikić, T., Hodžić, S., & Čeh Časni, A. (2025). Do financial inclusion, regulatory quality and government effectiveness matter for green development? Evidence from new EU countries. *Engineering Economics, 36*(3), 334-346. https://doi.org/10.5755/j01.ee.36.3.34801
13. Filipava, L., & Murshudli, F. (2023). The development of the global green finance market: The role of banks and non-banking institutional investors. In N. Naifar & A. Elsayed (Eds.), *Green Finance Instruments, FinTech, and Investment Strategies* (pp. 27-46). Springer. https://doi.org/10.1007/978-3-031-29031-2_2
14. Gondauri, D., & Chedia, N. (2025). Integrated application of Navier–Stokes, Ricci Flow, and EVA frameworks for modelling systemic risks, shock scenarios, and resilience to socioeconomic challenges: The case of critical railway corridors. *SocioEconomic Challenges, 9*(4), 12-24. https://doi.org/10.61093/sec.9(4).12-24.2025
15. Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics, 225*(2), 254-277. https://doi.org/10.1016/j.jeconom.2021.03.014
16. Halynskyi, D., & Telizhenko, O. (2024). Fair business leadership: Is protecting minority investors important to the development of start-ups in clean and digital energy? *Business Ethics and Leadership, 8*(4), 57-68. https://doi.org/10.61093/bel.8(4).57-68.2024
17. Havrylenko, O., & Myroshnychenko, I. (2025). Does renewable energy enhance energy security? Evidence from a Granger causality analysis of countries in the context of geopolitical risks and socioeconomic challenges. *SocioEconomic Challenges, 9*(2), 207-219. https://doi.org/10.61093/sec.9(2).207-219.2025
18. IEA. (2025). *Global energy review 2025*. International Energy Agency. Retrieved from https://www.iea.org/reports/global-energy-review-2025
19. Johnstone, N., Haščič, I., & Popp, D. (2010). Renewable energy policies and technological innovation: Evidence based on patent counts. *Environmental and Resource Economics, 45*(1), 133-155. https://doi.org/10.1007/s10640-009-9309-1
20. Jones, N., O'Manique, C., McGibbon, A., & DeAngelis, K. (2024). *Out with the old, slow with the new: Countries are underdelivering on the fossil fuel to clean energy finance pledge*. International Institute for Sustainable Development. Retrieved from https://www.iisd.org/publications/report/countries-underdelivering-fossil-clean-energy-finance-pledge
21. Kovalenko, V., & Serhieieva, O. (2025). Zelenyi bankinh: Suchasna traiektoriia staloho rozvytku natsionalnoi ekonomiky [Green banking: The modern trajectory of sustainable development of the national economy]. *Problems and Prospects of Economics and Management, 1*(41), 287-300. (In Ukrainian). https://doi.org/10.25140/2411-5215-2025-1(41)-287-300
22. Kurbatova, T., Sotnyk, I., Kubatko, O., Prokopenko, O., Pysmenna, U., & Kozmenko, Y. (2025). Convergence and divergence patterns in Ukraine's household solar energy development: Policy implications. *Problems and Perspectives in Management, 23*(4), 326-340. https://doi.org/10.21511/ppm.23(4).2025.24
23. Kuzior, A., Kovalenko, Y., Tiutiunyk, I., & Hrytsenko, L. (2025). Assessment of the energy security of EU countries in light of the expansion of renewable energy sources. *Energies, 18*(8), Article 2126. https://doi.org/10.3390/en18082126
24. Kuzior, A., Samusevych, Y., Lyeonov, S., Krawczyk, D., & Grytsyshen, D. (2023a). Applying energy taxes to promote a clean, sustainable and secure energy system: Finding the preferable approaches. *Energies, 16*(10), Article 4203. https://doi.org/10.3390/en16104203
25. Kuzior, A., Vakulenko, I., Kolosok, S., Saher, L., & Lyeonov, S. (2023b). Managing the EU energy crisis and greenhouse gas emissions: Seasonal ARIMA forecast. *Problems and Perspectives in Management, 21*(2), 383-399. https://doi.org/10.21511/ppm.21(2).2023.37
26. Lyeonov, S., & Moroz, A. (2025). Financial instruments for renewable energy incentives: A cluster-based analysis of feed-in tariffs and power purchase agreements. *Financial Markets, Institutions and Risks, 9*(1), 123-139. https://doi.org/10.61093/fmir.9(1).123-139.2025
27. Lyeonov, S., Artyukhov, A., Bokenchina, L., Sitenko, D., Yehorova, Y., Zhytar, M., & Moroz, A. (2025a). The role of feed-in tariffs in encouraging insurance companies to invest in renewables. *Insurance Markets and Companies, 16*(1), 115-130. https://doi.org/10.21511/ins.16(1).2025.10
28. Lyeonov, S., Kulawiecka, E., Krawczyk, D., & Oláh, J. (2025b). Decarbonisation and informality: Empirical evidence on the shadow economy response to climate policy mix. *Economics & Sociology, 18*(3), 274-295. https://doi.org/10.14254/2071-789X.2025/18-3/15
29. Lyeonov, S., Mielczarek, L., Krawczyk, D., & Popp, J. (2025c). The role of government AI readiness in shaping renewable electricity capacity and output. *Human Technology, 21*(3), 668-693. https://doi.org/10.14254/1795-6889.2025.21-3.9

http://dx.doi.org/10.21511/ee.17(2).2026.15

30. Lyeonov, S., Moroz, A., Wenerska, B., & Tangl, A. (2025d). The impact of feed-in tariffs and power purchase agreements on public investments in renewable energy. *Journal of International Studies, 18*(3), 179-218. https://doi.org/10.14254/2071-8330.2025/18-3/10

31. Lyeonov, S., Okhrimenko, O., Artyukhov, A., Saiensus, M., Myroshnychenko, I., Yehorova, Y., & Havrylenko, O. (2025e). Does fiscal decentralization foster renewable electricity generation? A panel data study of OECD countries. *Public and Municipal Finance, 14*(2), 130-145. https://doi.org/10.21511/pmf.14(2).2025.12

32. Lyeonov, S., Vakulenko, I., Avetikyan, V., & Levchenko, K. (2025f). Renewable energy investments: Exploring the financial landscape through a bibliometric analysis. *Investment Management and Financial Innovations, 22*(4), 357-379. https://doi.org/10.21511/imfi.22(4).2025.28

33. Mammadov, Z., & Murshudli, F. (2023). The effect of international green banking practices on environmental sustainability: An empirical study. *Green Economics, 1*(1), 46-61. Retrieved from https://jomardpublishing.com/UploadFiles/Files/journals/GE/V1N1/Mammadov_et_al.pdf

34. Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change, 127*, 8-22. https://doi.org/10.1016/j.techfore.2017.05.021

35. Megbowon, E. T., & Zerihun, M. F. (2025). Government health expenditure gap analysis: A study on the commitment to international agreement and the role of economic and institutional factors. *Health Economics and Management Review, 6*(1), 96-110. https://doi.org/10.61093/hem.2025.1-06

36. Mukhtarov, S., Aliyev, J., Borowski, P. F., & Disli, M. (2023). Institutional quality and renewable energy transition: Empirical evidence from Poland. *Journal of International Studies, 16*(3), 208-218. https://doi.org/10.14254/2071-8330.2023/16-3/12

37. Mursalov, M. (2025). Regulation of banking activities is an important tool for stimulating green investments: Case by selected upper middle-income countries. *Financial and Credit Activity: Problems of Theory and Practice, 5*(64), 11-24. https://doi.org/10.55643/fcaptp.5.64.2025.4877

38. Murshudli, F. F. (2023) Green banking for sustainable development. *Foresight and STI Governance, 17*(2), 82-94. https://doi.org/10.17323/2500-2597.2023.2.82.94

39. Nkwaira, C., & Van Der Poll, H. M. (2024). Does climate news sway investors away from large financiers of fossil fuel projects? *Investment Management and Financial Innovations, 21*(1), 185-197. https://doi.org/10.21511/imfi.21(1).2024.15

40. Noor, A. S., Alam, S., Nohong, M., & Sobarsyah, M. (2024). Investigating the impact of corporate governance and investment decisions on financial performance and firm value in insurance and banking sectors. *Insurance Markets and Companies, 15*(2), 122-132. https://doi.org/10.21511/ins.15(2).2024.11

41. OECD. (2025). *OECD inventory of support measures for fossil fuels 2025: Policy trends*. OECD Publishing. https://doi.org/10.1787/6fff0cb7-en

42. Oil Change International. (2023). *Promise breakers: Assessing the Impact of Compliance with the Glasgow Statement Commitment to End International Public Finance for Fossil Fuels*. Oil Change International. Retrieved from https://www.oilchange.org/wp-content/uploads/2023/03/PROMISE-BREAKERS.pdf

43. Okunevičiūtė Neverauskienė, L., Dirma, V., Danilevičienė, I., Gudelytė-Žilinskienė, L., & Tvaronavičienė, M. (2025). How investments into renewable sources affect economic development: A case of the EU countries. *Journal of International Studies, 18*(4). https://doi.org/10.14254/2071-8330.2025/18-4/12

44. Popescu, G. H., Fortea, C., Nica, E., Antohi, V. M., Andrei, J. V., & Szpilko, D. (2025). Investments in the green transition and their impact on economic growth and competitiveness in the European Union. *Oeconomia Copernicana, 16*(4), 1665-1725. https://doi.org/10.24136/oc.3963

45. Prokopenko, O., Järvis, M., Shahnazaryan, N., Chechel, A., Sapiński, A., & Batsenko, L. (2025). Bridging risk ethics and sustainability: A data-driven study of ethical leadership practices in risky business environments. *Business Ethics and Leadership, 9*(2), 211-224. https://doi.org/10.61093/bel.9(2).211-224.2025

46. Raboshuk, A., Serhiienko, R., Myroshnychenko, I., Kobylnik, D., Moroz, A., & Lyeonov, S. (2025). Public and fiscal policy instruments for supporting renewable electricity development: Evidence from a cross-country study. *Public and Municipal Finance, 14*(3), 74-92. https://doi.org/10.21511/pmf.14(3).2025.06

47. Semieniuk, G., Holden, P. B., Mercure, J.-F., Salas, P., Pollitt, H., Jobson, K., Vercoulen, P., Chewpreecha, U., Edwards, N. R., & Viñuales, J. E. (2022). Stranded fossil-fuel assets translate to major losses for investors in advanced economies. *Nature Climate Change, 12*(6), 532-538. https://doi.org/10.1038/s41558-022-01356-y

48. Sitnicka, S., Xinyang, L., Serhiienko, R., & Babaiev, D. (2025). Determinants affecting bank profitability: A broad and comparative analysis across regions and income groups. *Financial Markets, Institutions and Risks, 9*(3), 120-158. https://doi.org/10.61093/fmir.9(3).120-158.2025

49. Sovacool, B. K. (2017). Reviewing, reforming, and rethinking global energy subsidies: Towards a political economy research agenda. *Ecological Economics, 135*, 150-163. https://doi.org/10.1016/j.ecolecon.2016.12.009

50. Streimikiene, D., Mikalauskas, I., Lėckienė, V., Pisula, T., & Mikalauskiene, A. (2024). The

role of sustainable finance in the context of the European Green Course. *Economics and Sociology, 17*(2), 54-79. https://doi.org/10.14254/2071-789X.2024/17-2/3

51. Tessema, D. B. (2025). Pillars of organizational transformation and sustainability: Leadership, learning, culture, and knowledge management as key success factors in environmental public health. *Health Economics and Management Review, 6*(1), 1-21. https://doi.org/10.61093/hem.2025.1-01

52. Triarchi, E., Kolias, G., & Kypriotelis, E. (2023). Exploring the role of institutional governance in climate action in the Western Balkans economies. *European Journal of Interdisciplinary Studies, 15*(2), 97-117. https://doi.org/10.24818/ejis.2023.19

53. Trinh, L. D. (2025). Renewable energy and sustainable development: Evidence from lower middle-income countries. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 20*(3), 905-926. https://doi.org/10.24136/eq.3440

54. Vasylieva, T., Derkacz, A., Popp, J., & Horsch, A. (2025). From energy dependency to energy security: How the war in Ukraine accelerated renewable deployment in Europe. *Economics & Sociology, 18*(3), 229-253. https://doi.org/10.14254/2071-789X.2025/18-3/13

55. Wojciechowski, W., Niewiadomski, A., & Bilan, Y. (2025). Ecological and secure electricity microgrids – Monitoring and forecasting challenges. *Human Technology, 21*(3), 469-473. https://doi.org/10.14254/1795-6889.2024.21-3.0

56. World Bank. (n.d.a). *World Development Indicators* [Database]. The World Bank. Retrieved from https://databank.worldbank.org/source/world-development-indicators

57. World Bank. (n.d.b). *Worldwide Governance Indicators* [Database]. The World Bank. Retrieved from https://databank.worldbank.org/source/worldwide-governance-indicators

58. World Bank. (2021). *World Bank country and lending groups* [Database]. The World Bank. Retrieved from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

59. Yefimenko, A., Boronos, V., Serpeninova, Y., & Koldovskyi, A. (2025). Innovative and technological determinants of corruption reduction: How do knowledge and technology contribute to public integrity and transparency? *Knowledge Economy and Lifelong Learning, 1*(1), 21-34. https://doi.org/10.61093/kell.1(1).21-34.2025

60. Zábojník, S., & Branch, J. D. (2025). EU decarbonization and industrial export competitiveness in a small open economy: A surprising resilience. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 20*(4), 1339-1385. https://doi.org/10.24136/eq.4035

61. Zapotichna, R. (2023). Green trend in international banking business: Opportunities for Ukraine. *Economy of Ukraine, 66*(3), 58-72. https://doi.org/10.15407/economyukr.2023.03.058

62. Zheng, M., Feng, G.-F., & Chang, C.-P. (2023). Is green finance capable of promoting renewable energy technology? Empirical investigation for 64 economies worldwide. *Oeconomia Copernicana, 14*(2), 483-510. https://doi.org/10.24136/oc.2023.013

63. Živković, L., & Štrbac, D. (2025). Business leadership in the adoption of eco-innovation in manufacturing: Evidence from firm-level microdata. *Business Ethics and Leadership, 9*(4), 32-44. https://doi.org/10.61093/bel.9(4).32-44.2025

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APPENDIX A

Table A1. Countries included in the analytical sample

ISO3	Country	Income Group	Classification
DZA	Algeria	Upper middle income	Non-OECD
AGO	Angola	Lower middle income	Non-OECD
ARG	Argentina	Upper middle income	Non-OECD
ARM	Armenia	Upper middle income	Non-OECD
ABW	Aruba	High income	Non-OECD
AUS	Australia	High income	OECD
AUT	Austria	High income	OECD
AZE	Azerbaijan	Upper middle income	Non-OECD
BHS	Bahamas, The	High income	Non-OECD
BGD	Bangladesh	Lower middle income	Non-OECD
BLR	Belarus	Upper middle income	Non-OECD
BEL	**Belgium**	**High income**	**OECD, Treated**
BLZ	Belize	Upper middle income	Non-OECD
BEN	Benin	Lower middle income	Non-OECD
BTN	Bhutan	Lower middle income	Non-OECD
BOL	Bolivia	Lower middle income	Non-OECD
BIH	Bosnia and Herzegovina	Upper middle income	Non-OECD
BWA	Botswana	Upper middle income	Non-OECD
BRA	Brazil	Upper middle income	Non-OECD
BRN	Brunei Darussalam	High income	Non-OECD
BGR	Bulgaria	High income	Non-OECD
BFA	**Burkina Faso**	**Low income**	**Non-OECD, Treated**
CPV	Cabo Verde	Upper middle income	Non-OECD
KHM	Cambodia	Lower middle income	Non-OECD
CAF	Central African Republic	Low income	Non-OECD
TCD	Chad	Low income	Non-OECD
CHL	Chile	High income	OECD
CHN	China	Upper middle income	Non-OECD
COL	Colombia	Upper middle income	OECD
COM	Comoros	Lower middle income	Non-OECD
COG	Congo, Rep.	Lower middle income	Non-OECD
CRI	**Costa Rica**	**High income**	**OECD, Treated**
CIV	Cote d'Ivoire	Lower middle income	Non-OECD
CYP	Cyprus	High income	Non-OECD
CZE	Czechia	High income	OECD
DNK	**Denmark**	**High income**	**OECD, Treated**
DOM	Dominican Republic	Upper middle income	Non-OECD
ECU	Ecuador	Upper middle income	Non-OECD
EGY	Egypt, Arab Rep.	Lower middle income	Non-OECD
SLV	El Salvador	Upper middle income	Non-OECD, Treated
GNQ	Equatorial Guinea	Upper middle income	Non-OECD
EST	Estonia	High income	OECD
FIN	Finland	High income	OECD, Treated
FRA	**France**	**High income**	**OECD, Treated**
GEO	Georgia	Upper middle income	Non-OECD
DEU	**Germany**	**High income**	**OECD, Treated**
GHA	Ghana	Lower middle income	Non-OECD
GRC	Greece	High income	OECD
GTM	Guatemala	Upper middle income	Non-OECD
GIN	Guinea	Lower middle income	Non-OECD
GNB	Guinea-Bissau	Low income	Non-OECD
HTI	Haiti	Lower middle income	Non-OECD
HND	Honduras	Lower middle income	Non-OECD

Table A1 (cont.). Countries included in the analytical sample

ISO3	Country	Income Group	Classification
HKG	Hong Kong SAR, China	High income	Non-OECD
HUN	Hungary	High income	OECD
IND	India	Lower middle income	Non-OECD
IDN	Indonesia	Upper middle income	Non-OECD
IRQ	Iraq	Upper middle income	Non-OECD
IRL	**Ireland**	**High income**	**OECD, Treated**
ISR	Israel	High income	OECD
ITA	**Italy**	**High income**	**OECD, Treated**
JPN	Japan	High income	OECD
JOR	**Jordan**	**Lower middle income**	**Non-OECD, Treated**
KAZ	Kazakhstan	Upper middle income	Non-OECD
KEN	Kenya	Lower middle income	Non-OECD
KOR	Korea, Rep.	High income	OECD
XKX	Kosovo	Upper middle income	Non-OECD
KWT	Kuwait	High income	Non-OECD
KGZ	Kyrgyz Republic	Lower middle income	Non-OECD
LVA	Latvia	High income	OECD
LSO	Lesotho	Lower middle income	Non-OECD
LBY	Libya	Upper middle income	Non-OECD
LTU	Lithuania	High income	OECD
LUX	Luxembourg	High income	OECD
MDG	Madagascar	Low income	Non-OECD
MYS	Malaysia	Upper middle income	Non-OECD
MLI	**Mali**	**Low income**	**Non-OECD, Treated**
MLT	Malta	High income	Non-OECD
MUS	Mauritius	Upper middle income	Non-OECD
MEX	Mexico	Upper middle income	OECD
FSM	Micronesia, Fed. Sts.	Lower middle income	Non-OECD
MDA	**Moldova**	**Upper middle income**	**Non-OECD, Treated**
MNG	Mongolia	Upper middle income	Non-OECD
MNE	Montenegro	Upper middle income	Non-OECD
MAR	Morocco	Lower middle income	Non-OECD
MOZ	Mozambique	Low income	Non-OECD
NLD	**Netherlands**	**High income**	**OECD, Treated**
NIC	Nicaragua	Lower middle income	Non-OECD
NER	Niger	Low income	Non-OECD
MKD	North Macedonia	Upper middle income	Non-OECD
NOR	Norway	High income	OECD
OMN	Oman	High income	Non-OECD
PAK	Pakistan	Lower middle income	Non-OECD
PAN	Panama	High income	Non-OECD
PER	Peru	Upper middle income	Non-OECD
PHL	Philippines	Lower middle income	Non-OECD
POL	Poland	High income	OECD
PRT	**Portugal**	**High income**	**OECD, Treated**
QAT	Qatar	High income	Non-OECD
ROU	Romania	High income	Non-OECD
RUS	Russian Federation	High income	Non-OECD
RWA	Rwanda	Low income	Non-OECD
WSM	Samoa	Upper middle income	Non-OECD
SEN	Senegal	Lower middle income	Non-OECD
SRB	Serbia	Upper middle income	Non-OECD
SYC	Seychelles	High income	Non-OECD
SVK	Slovak Republic	High income	OECD
SVN	**Slovenia**	**High income**	**OECD, Treated**

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Table A1 (cont.). Countries included in the analytical sample

ISO3	Country	Income Group	Classification
SLB	Solomon Islands	Lower middle income	Non-OECD
ZAF	South Africa	Upper middle income	Non-OECD
ESP	**Spain**	**High income**	**OECD, Treated**
SDN	Sudan	Low income	Non-OECD
SWE	**Sweden**	**High income**	**OECD, Treated**
TZA	Tanzania	Lower middle income	Non-OECD
THA	Thailand	Upper middle income	Non-OECD
TLS	Timor-Leste	Lower middle income	Non-OECD
TON	Tonga	Upper middle income	Non-OECD
TUN	Tunisia	Lower middle income	Non-OECD
TUR	Turkiye	Upper middle income	OECD
UKR	Ukraine	Upper middle income	Non-OECD
ARE	United Arab Emirates	High income	Non-OECD
GBR	United Kingdom	High income	OECD, Treated
USA	**United States**	**High income**	**OECD, Treated**
URY	Uruguay	High income	Non-OECD
VUT	Vanuatu	Lower middle income	Non-OECD
VNM	Viet Nam	Lower middle income	Non-OECD
PSE	West Bank and Gaza	Lower middle income	Non-OECD
ZWE	Zimbabwe	Lower middle income	Non-OECD

Note: Bold entries indicate treated countries (ban_dummy = 1 during the sample period). OECD membership as of 2021. Income classification: World Bank Atlas method, fiscal year 2021. Of the 128 countries, 34 are OECD members and 94 are non-OECD. Twenty countries are treated (15 OECD, 5 non-OECD) and 108 serve as the control group. The table lists all 128 countries in the strictly balanced panel (2010–2021). Treated countries (bold) adopted fossil fuel finance restrictions during the sample period. Income classification follows the World Bank (2021).

Table A2. Variable definitions and sources

Variable	Description	Source	Role
renew_elec_pct	Renewable electricity output (% of total)	WDI: EG.ELC.RNEW.ZS	Dependent (DV1)
renew_energy_pct	Renewable energy consumption (% of total final energy)	WDI: EG.FEC.RNEW.ZS	Dependent (DV2)
renew_elec_exhydro	Renewable electricity excl. hydroelectric (% of total)	WDI: EG.ELC.RNWX.ZS	Dependent (robustness)
ban_dummy	Fossil fuel finance restriction (1 = post-adoption)	CETP, OCI reports	Key independent
glasgow_dummy	Glasgow Statement signatory (1 = post-signing)	CETP	IV (robustness)
compliance_dummy	Full compliance with Glasgow (1 = post-adoption)	OCI: Promise Breakers	IV (robustness)
credit_banks_gdp	Domestic credit to private sector by banks (% GDP)	WDI: FD.AST.PRVT.GD.ZS	Banking control
broad_money_gdp	Broad money (% GDP), winsorised at P99	WDI: FM.LBL.BMNY.GD.ZS	Banking control
npl_pct	Bank nonperforming loans (% gross loans)	WDI: FB.AST.NPER.ZS	Robustness control
ln_gdp_pc	Log GDP per capita (constant 2015 USD)	WDI: NY.GDP.PCAP.KD	Macro control
trade_openness	Trade (exports + imports, % GDP)	WDI: NE.TRD.GNFS.ZS	Macro control
energy_use_pc	Energy use per capita (kg of oil equivalent)	WDI: EG.USE.PCAP.KG.OE	Robustness control
reg_quality	Regulatory Quality estimate (–2.5 to +2.5)	WGI: RQ.EST	Institutional control
co2_pc	CO_2 emissions excl. LULUCF per capita (t CO_2e)	WDI: EN.GHG.CO2.PC.CE.AR5	Robustness control
Oecd	OECD membership dummy	OECD members list	Subsample dummy

Note: WDI = World Development Indicators (World Bank). WGI = Worldwide Governance Indicators (World Bank). CETP = Clean Energy Transition Partnership. OCI = Oil Change International.

Table A3. Treatment timing: Fossil fuel finance restriction adoption

Year of policy adoption	Countries
2019	Denmark, France
2020	United Kingdom, Sweden
2021	Belgium, Burkina Faso, Costa Rica, El Salvador, Finland, Germany, Ireland, Italy, Jordan, Mali, Moldova, the Netherlands, Portugal, Slovenia, Spain, United States

Note: Sources are CETP signatories list, OCI "Promise Breakers" (2023), and national policy documents. The table lists only signatories included in the analytical sample (20 of 34 original Glasgow Statement signatories). Australia and Norway (joined CETP in 2023) fall outside the panel period.

APPENDIX B

Table B1. Pairwise correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Renewable electricity (%)	1.000											
(2) Renewable energy cons. (%)	0.526	1.000										
(3) Fossil fuel ban dummy	0.072	–0.001	1.000									
(4) Credit by banks (% GDP)	–0.043	–0.368	0.119	1.000								
(5) Broad money (% GDP)	–0.215	–0.449	0.054	0.797	1.000							
(6) Bank NPL (%)	–0.098	0.087	–0.084	–0.160	–0.337	1.000						
(7) Log GDP per capita	–0.126	–0.638	0.126	0.643	**0.518**	–0.251	1.000					
(8) Trade openness (% GDP)	–0.070	–0.307	0.005	0.349	0.393	–0.075	0.375	1.000				
(9) Energy use p.c.	–0.225	–0.439	0.038	0.318	0.251	–0.169	0.693	0.227	1.000			
(10) Regulatory quality	–0.002	–0.400	0.143	0.694	**0.521**	–0.339	0.818	0.406	0.504	1.000		
(11) CO_2 per capita	–0.298	–0.497	–0.001	0.327	0.295	–0.146	0.647	0.237	0.961	0.469	1.000	
(12) FDI net inflows (% GDP)	–0.054	–0.077	–0.015	0.195	0.184	0.082	0.110	0.256	–0.022	0.124	0.006	1.000

Note: Pearson pairwise correlation coefficients. Bold values indicate $|r| \geq 0.50$. N varies from 1,187 to 1,536 due to partial coverage of some variables. The high correlation between energy_use_pc and co2_pc ($r = 0.961$) reflects their shared dependence on fossil fuel intensity; these variables do not enter the same specification simultaneously.

APPENDIX C

Table C1. Pre-treatment balance: Treated vs. control countries (2010–2018)

Variable	Mean (T)	SD (T)	Mean (C)	SD (C)	t-stat	p-value	Sig.
Renewable electricity (%)	33.911	24.125	29.371	29.785	2.230	0.027	**
Renewable energy cons. (%)	25.637	21.864	29.458	26.609	–2.075	0.039	**
Credit by banks (% GDP)	83.585	44.390	47.959	38.424	10.090	< 0.001	***
Broad money (% GDP)	68.121	36.757	58.771	41.291	2.271	0.025	**
Log GDP per capita	9.739	1.395	8.565	1.256	10.527	< 0.001	***
Trade openness (% GDP)	90.200	44.163	90.317	54.792	–0.032	0.975	
Energy use p.c. (kg o.e.)	3,100.1	1,813.9	2,152.5	2,583.1	5.713	< 0.001	***
Regulatory quality	0.934	0.772	–0.029	0.851	15.125	< 0.001	***
CO_2 per capita (t CO_2e)	5.973	3.915	4.971	6.842	2.726	0.007	***
FDI net inflows (% GDP)	4.910	10.314	6.721	26.909	–1.559	0.119	
Bank NPL (% gross loans)	5.976	5.418	7.032	7.523	–1.963	0.051	*

Note: Welch's two-sample t-test (unequal variances). T = treated countries (20 countries). C = control countries (108 countries). Pre-treatment period: 2010–2018. The number of observations varies across variables due to partial data coverage. Significant differences across most variables confirm that treated countries differ systematically from the control group, justifying the use of country fixed effects and country-specific linear time trends. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

APPENDIX D

Table D1. First-difference estimation: Renewable electricity (DV1) vs. renewable energy consumption (DV2)

Variable	β (DV1)	SE (DV1)	p (DV1)	β (DV2)	SE (DV2)	p (DV2)
Δban_dummy	1.799*	(1.025)	0.082	0.908**	(0.361)	0.013
Δcredit_banks_gdp	–0.017	(0.023)	0.463	–0.029**	(0.012)	0.014
Δln_gdp_pc	–3.052	(2.254)	0.178	–5.413***	(1.851)	0.004
Δtrade_openness	0.018	(0.017)	0.277	0.010*	(0.006)	0.075
Δreg_quality	–0.656	(1.056)	0.536	–0.933*	(0.517)	0.073
Year FE	Yes			Yes		
Observations	1,408			1,397		
R^2	0.033			0.078		

Note: First-difference estimator with year fixed effects. Clustered standard errors at the country level in parentheses. DV1: Δrenew_elec_pct. DV2: Δrenew_energy_pct. All variables are first-differenced (Δ). The first-difference estimator removes country-specific levels and trends, providing a robust check on the preferred specification. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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APPENDIX E

Table E1. Placebo tests: Shifting treatment dates backward

Placebo shift	β	SE	p-value	Sig.	N
1 year	7.075	4.026	0.081	*	1,152
2 years	6.839	4.395	0.122		1,152
3 years	3.734	1.754	0.035	**	1,152
4 years	2.972	1.810	0.103		1,152
5 years	2.930	1.529	0.058	*	1,152

Note: Three of the five placebo shifts yield significant coefficients (1-year, 3-year, and 5-year), reflecting pre-existing upward trends in renewable energy among treated countries. The 2-year and 4-year shifts are insignificant ($p = 0.122$ and $p = 0.103$). These pre-trends are absorbed by country-specific linear time trends in the preferred specification (Equation 2), which is why the main results rely on the trend-augmented model.

APPENDIX F

Table F1 reports the results of a leave-one-out sensitivity analysis for the preferred specification (DV2: renewable energy consumption as a share of total final energy supply, with country fixed effects, year fixed effects, and country-specific linear time trends). Each row presents the estimated coefficient on the fossil fuel finance restriction dummy when the indicated country is excluded from the sample.

The full-sample estimate is $\beta = 11.542$ (SE = 4.469, $p = 0.011$). Across all 20 leave-one-out iterations, the coefficient ranges from 9.197 to 12.986 and remains statistically significant at the 5% level in every case. The largest shifts occur when Denmark ($\Delta\beta = -2.09$) or Sweden ($\Delta\beta = -2.34$) are excluded, consistent with their role as early adopters with the longest post-treatment periods. No single country drives the aggregate result.

Table F1. Leave-one-out sensitivity analysis (DV2: Renewable energy consumption)

Excluded	Country	β	SE	p-value	Sig.	Δβ	5% sig.
Full sample	–	11.542	4.469	0.011	**	–	–
BEL	Belgium	11.763	4.598	0.012	**	+0.221	Yes
BFA	Burkina Faso	11.568	4.641	0.014	**	+0.026	Yes
CRI	Costa Rica	11.629	4.610	0.013	**	+0.088	Yes
DEU	Germany	11.820	4.591	0.011	**	+0.278	Yes
DNK	Denmark	9.448	4.535	0.039	**	−2.093	Yes
ESP	Spain	11.828	4.596	0.011	**	+0.287	Yes
FIN	Finland	11.325	4.643	0.016	**	−0.217	Yes
FRA	France	12.743	4.811	0.009	***	+1.201	Yes
GBR	United Kingdom	12.378	4.686	0.009	***	+0.836	Yes
IRL	Ireland	11.219	4.579	0.016	**	−0.322	Yes
ITA	Italy	11.678	4.608	0.013	**	+0.137	Yes
JOR	Jordan	12.986	4.372	0.004	***	+1.444	Yes
MDA	Moldova	12.670	4.474	0.005	***	+1.129	Yes
MLI	Mali	11.299	4.627	0.016	**	−0.243	Yes
NLD	Netherlands	11.768	4.589	0.012	**	+0.226	Yes
PRT	Portugal	11.487	4.629	0.014	**	−0.055	Yes
SLV	El Salvador	12.350	4.554	0.008	***	+0.808	Yes
SVN	Slovenia	11.477	4.606	0.014	**	−0.064	Yes
SWE	Sweden	9.197	4.225	0.031	**	−2.344	Yes
USA	United States	11.884	4.574	0.011	**	+0.342	Yes

Note: Dependent variable: renewable energy consumption (% of total final energy). All models include country FE, year FE, and country-specific linear time trends. Clustered SE at the country level. Δβ = deviation from the full-sample estimate (11.542).

Table F2 provides descriptive statistics for each of the 20 treated countries. For each country, the table reports the treatment year, the pre- and post-treatment mean of renewable energy consumption (% of total final energy), the raw change in percentage points, the average level of domestic credit to the private sector by banks (% of GDP), and the predicted marginal effect from the interaction model.

Fifteen out of 20 treated countries experienced an increase in renewable energy consumption following policy adoption, with an average raw change of +2.4 percentage points. The five countries that experienced a decline – Mali (–8.7 p.p.), Burkina Faso (–6.1 p.p.), El Salvador (–3.3 p.p.), Costa Rica (–2.2 p.p.), and Moldova (–1.9 p.p.) – are characterized by relatively lower levels of banking system development. The three countries with the lowest credit-to-GDP ratios in the treated group (Mali: 19.6%, Burkina Faso: 23.6%, Moldova: 25.5%) all recorded negative changes, which is consistent with the finding that banking intermediation moderates the policy effect.

Table F2. Treated countries: Pre/post renewable energy shares and predicted effects

Country	Year	Pre mean	Post mean	Δ (p.p.)	Credit/%GDP	Pred. effect	N pre	N post
DNK	2019	29.2	38.7	+9.5	171.2	+25.18	9	3
FRA	2019	13.1	16.2	+3.0	101.2	+13.08	9	3
GBR	2020	6.9	12.9	+6.0	144.5	+20.57	10	2
SWE	2020	49.3	57.8	+8.5	130.7	+18.17	10	2
BEL	2021	9.0	11.7	+2.7	62.4	+6.38	11	1
BFA	2021	77.3	71.2	−6.1	23.6	−0.33	11	1
CRI	2021	36.4	34.2	−2.2	53.2	+4.78	11	1
DEU	2021	14.6	17.6	+3.0	79.7	+9.37	11	1
ESP	2021	16.4	19.0	+2.6	124.8	+17.15	11	1
FIN	2021	41.3	50.2	+8.9	94.0	+11.84	11	1
IRL	2021	9.2	12.7	+3.5	68.0	+7.33	11	1
ITA	2021	15.9	17.5	+1.6	84.3	+10.15	11	1
JOR	2021	5.0	11.5	+6.5	73.4	+8.27	11	1
MDA	2021	23.3	21.4	−1.9	25.5	−0.00	11	1
MLI	2021	79.9	71.2	−8.7	19.6	−1.02	11	1
NLD	2021	6.2	12.2	+6.0	108.3	+14.30	11	1
PRT	2021	28.1	32.3	+4.2	121.9	+16.67	11	1
SLV	2021	25.2	21.9	−3.3	49.1	+4.07	11	1
SVN	2021	21.0	23.4	+2.4	56.9	+5.43	11	1
USA	2021	9.2	10.9	+1.7	51.5	+4.49	11	1

Note: Pre mean and Post mean refer to the average share of renewable energy consumption (% of total final energy) before and after the treatment year, respectively. Δ = Post mean − Pre mean. Pred. effect = predicted marginal effect from the DV2 interaction model (β_ban + β_interaction × Credit/GDP). Countries sorted by treatment year, then alphabetically.

Table F3 reports the predicted marginal effect of fossil fuel finance restrictions for each treated country, calculated from the interaction model: Marginal effect = βban + $\beta interaction$ × Credit/GDP. The standard errors and 95% confidence intervals are computed using the delta method, based on the variance-covariance matrix of the interaction model (DV2 with country-specific linear time trends).

Seventeen out of 20 treated countries have a positive predicted effect. For 11 countries – all with domestic credit exceeding 73% of GDP – the 95% confidence interval excludes zero, indicating a statistically significant positive effect. The predicted effects range from –1.02 percentage points for Mali (credit/GDP = 19.6%) to +25.18 percentage points for Denmark (credit/GDP = 171.2%). This gradient reinforces the central finding that the effectiveness of fossil fuel finance restrictions is conditional on the depth of the domestic banking system.

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Table F3. Predicted marginal effect of fossil fuel finance restrictions by country

Country	Credit/GDP (%)	Pred. effect	SE	95% CI	Sig.
MLI	19.6	−1.02	5.76	[−12.31, +10.27]	
BFA	23.6	−0.33	5.53	[−11.17, +10.50]	
MDA	25.5	−0.00	5.42	[−10.62, +10.62]	
SLV	49.1	+4.07	4.31	[−4.37, +12.52]	
USA	51.5	+4.49	4.23	[−3.80, +12.77]	
CRI	53.2	+4.78	4.17	[−3.40, +12.96]	
SVN	56.9	+5.43	4.07	[−2.54, +13.40]	
BEL	62.4	+6.38	3.95	[−1.36, +14.11]	
IRL	68.0	+7.33	3.87	[−0.26, +14.92]	
JOR	73.4	+8.27	3.85	[+0.73, +15.81]	**
DEU	79.7	+9.37	3.88	[+1.77, +16.98]	**
ITA	84.3	+10.15	3.94	[+2.42, +17.88]	**
FIN	94.0	+11.84	4.18	[+3.64, +20.04]	**
FRA	101.2	+13.08	4.44	[+4.38, +21.77]	**
NLD	108.3	+14.30	4.74	[+5.01, +23.60]	**
PRT	121.9	+16.67	5.45	[+5.98, +27.35]	**
ESP	124.8	+17.15	5.61	[+6.15, +28.15]	**
SWE	130.7	+18.17	5.96	[+6.49, +29.86]	**
GBR	144.5	+20.57	6.84	[+7.16, +33.98]	**
DNK	171.2	+25.18	8.68	[+8.17, +42.19]	**

Note: Marginal effect = β_ban + β_interaction × Credit/GDP, where β_ban = −4.413 and β_interaction = 0.173 ($p = 0.032$). SE computed via the delta method. ** indicates that the 95% CI excludes zero. Countries sorted by Credit/GDP (ascending).