Whether industrial policy mobilizes private capital depends on the credibility of its commitments

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Governments struggle to make long-term commitments. Because today's policy can be revised by future legislatures and administrations, private investors may discount even generous public incentives, and the investment those incentives target may never materialize. We study this commitment problem in the U.S. Inflation Reduction Act (IRA), which directed approximately $369 billion toward climate and energy. Using financing histories for 7,271 climate-technology firms across 132,826 firm-quarter observations (Q1 2020–Q2 2025), we find that the IRA shifted venture investment toward firms whose technologies align most directly with statutory incentives and changed how firms finance growth: reliance on mixed venture–debt structures declined, while venture-only and non-dilutive financing expanded. To examine why, we introduce a Policy Credibility Index that scores each IRA provision on the specificity, durability, and enforceability of its commitment. Investment responds to both the size of incentives and the credibility of the commitment behind them. The 2025 "One Big Beautiful Bill" proposals offer a sharper test, because they threatened the durability of some provisions while leaving enacted incentives in force; venture activity contracted most in the sectors that depend on the threatened provisions. The results point to a market channel of policy feedback operating alongside the electoral one. Whether public commitments draw in private capital, and with it a constituency for the policy's survival, depends on how the commitment is built.

industrial policy | policy credibility | policy feedback | venture capital | climate technology

Significance

Governments promise long-term support to steer private investment, but those promises can be revised by future legislatures and administrations. Studying the Inflation Reduction Act, we show that where private capital moved depended on the credibility of each provision: its specificity, durability, and enforceability. When 2025 legislative proposals threatened to roll back particular provisions, investment fell in the sectors that relied on them, even though the enacted benefits were still in force. Recent work finds that clean-energy investments win policymakers little credit from voters. We identify a second feedback channel: credible commitments recruit investors whose capital is staked on a policy's survival. Durable design, as much as spending, is what mobilizes private capital.

Democratic governments face a familiar commitment problem: policies adopted today can be revised by the next coalition, so promises of long-term support may fail to move the investment they are meant to attract (1–4). The problem is acute in climate policy. Decarbonization requires private capital committed over horizons longer than electoral cycles (5, 6), and U.S. federal climate commitments have repeatedly been contested and revised across administrations (7, 8). Commercializing new climate technologies depends heavily on early-stage investors who supply patient capital under deep uncertainty (9, 10), and the value of their investments often rests on policy holding for a decade or more. When the United States enacted the Inflation Reduction Act (IRA), directing approximately $369 billion toward climate and energy, it was therefore not obvious that investors would treat those commitments as durable.

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Political scientists have long argued that major statutes can entrench themselves by creating constituencies invested in their survival (11). Recent evidence suggests the electoral version of this mechanism is weak for clean-energy policy: voters notice IRA-funded projects but do not credit the policymakers responsible (12). We examine a different channel. Investors, unlike voters, price policy durability directly, and institutional design is known to shape support for climate commitments among mass publics (13). Whether design shapes the behavior of capital has not been measured. A large literature documents industrial policy's effects on innovation and sectoral growth (14–19), and separate work shows how venture capital responds to market opportunities and institutional uncertainty (20–23). What neither literature provides is a measure of commitment credibility at the level where it operates, the individual statutory provision, or evidence on which provisions investors believe and what happens when a commitment comes under threat.

The IRA offers an unusually sharp setting in which to measure this. One of the largest climate-related industrial policy initiatives globally (24, 25), it introduced a comprehensive set of tax credits, subsidies, and incentives targeting a broad range of climate technologies, including clean energy generation, energy storage, electrification, and industrial decarbonization. By linking financial incentives to specific technological activities, the IRA altered the expected returns and risk profiles of private investments in these domains. Compared with similar programs in the EU, South Korea, and Japan, the IRA relies more heavily on technology-specific tax credits with long statutory horizons and automatic implementation through the tax code. These features generate sharp variation in how directly different technologies are supported, and they make policy commitments empirically tractable. The scale, scope, and institutional design of the IRA thus create a rare opportunity to examine how a large, clearly defined policy intervention reshapes venture capital decisions in a high-uncertainty technological environment.

Using firm-level venture capital financing data covering 7,271 climate technology companies across 132,826 firm-quarter observations spanning 22 quarters (Q1 2020–Q2 2025), we examine how the IRA affected venture investment across three dimensions. First, we study whether policy increased the likelihood that firms receive venture funding—the initial decision to invest. Second, we examine how investment shifts across technologies and investor types, revealing changes in the composition of capital rather than only its aggregate level. Third, we analyze firms' financing trajectories over time, assessing whether policy alters the mix of capital sources that fund climate firms across successive financing events. This dynamic perspective captures how policy shapes longer-run growth pathways. We make three contributions. First, we introduce the Policy Credibility Index (PCI), which scores IRA provisions on specificity, durability, and enforceability. The index operationalizes credible-commitment theory at the level of the individual provision. Second, we use the 2025 legislative proposals to roll back IRA provisions as a commitment-reversal test. Those proposals shifted credibility while enacted incentives remained in force, and investment contracted in the sectors that depend on the threatened provisions, a pattern consistent with a credibility channel distinct from cash flow. Third, we show that policy reshaped the structure of climate finance: which technologies and investors capital reaches, and the mix of venture, debt, and non-dilutive funding that firms rely on. We read this as a market channel of policy feedback operating alongside the electoral channel.

Results

IRA and venture capital entry. To measure policy exposure at the technology level, we use the Climate Tech Venture Capital (CTVC) taxonomy, which classifies climate technology firms into seven mutually exclusive subfields based on their primary technological focus. We classify a subfield as *directly targeted* by the IRA when at least one of the six focal provisions (45X, 45V, 45Q, 30D, 50141, 50144) designates the subfield's core technology development as the primary eligible activity. By this rule, two subfields are directly targeted. *Energy* captures the production-side credits that anchor the IRA's manufacturing push (45X for solar, wind, and battery components; 45V for clean hydrogen) together with Loan Programs Office authorities for energy infrastructure (50141, 50144), and *Carbon* captures the 45Q carbon-capture credit. The remaining five subfields (*Climate Management*, *Industrial*, *Food and Land Use*, *Built Environment*, and *Transportation*) are comparatively less exposed: IRA support for these technologies is absent, indirect, or channeled through downstream adoption rather than core-technology development.

The Transportation subfield warrants explicit treatment because it is home to the IRA's most visible provision, the Section 30D clean-vehicle tax credit. We classify Transportation as less-exposed for two reasons. First, 30D is an *adoption-side* rebate: it subsidizes end-user purchases of already-commercial electric vehicles and does not directly reduce the venture-stage technology risk that shapes early-stage investment decisions. This distinguishes it from 45X and 45V, which are *production-side* credits that change per-unit unit economics for upstream manufacturers. Second, upstream EV-relevant firms (battery manufacturers, advanced materials, power electronics, charging infrastructure) are classified as Energy in the CTVC taxonomy and are therefore already in the treated group; the Transportation residual in our panel consists primarily of mobility software, logistics, and autonomous-vehicle firms whose core technologies are not IRA-eligible. To verify that this classification choice does not drive our results, we re-estimate the main specification reclassifying Transportation as treated (*SI Appendix*, Section S8); the estimated treatment effects attenuate modestly (AnyVC: 0.0086 → 0.0079; VC deal count: 0.0090 → 0.0081; VC amount sum: 0.385 → 0.298) but remain statistically significant, consistent with Transportation being, on balance, a less-exposed subfield diluted by a small number of upstream-EV firms.

We use this distinction to construct a binary policy exposure design, classifying firms in the Energy and Carbon subfields as treated and firms in the remaining climate technology categories as controls. This approach exploits systematic variation in statutory targeting across climate technologies while holding constant broader sectoral trends, enabling a transparent comparison between policy-aligned and less-aligned technologies within the climate tech ecosystem. We note that treated and control categories may differ in baseline VC affinity, available capital pools, and investor familiarity; our specifications address this through firm fixed effects that absorb time-invariant differences across categories, and we verify robustness using the continuous exposure measures that exploit within-category variation (Table 2 and *SI Appendix*).

Our empirical approach compares changes in venture capital activity for technologies directly targeted by IRA incentives against changes for technologies in the same climate sector that were less directly supported. By examining both groups over the same time period, this design isolates the effect of policy targeting from broader trends, such as macroeconomic shifts or the post-pandemic venture capital cycle, that affected all climate technologies simultaneously.

We begin by examining how the IRA affected venture capital entry into U.S. climate technology firms. Focusing on the extensive margin (whether a firm receives any venture capital in a given quarter), we ask whether firms in technologies directly exposed to IRA incentives became more likely to receive venture financing after enactment. This margin captures the initial decision to invest, which is particularly consequential for early-stage and high-uncertainty technologies (26, 27).

Figure 1 presents event-study estimates under the continuous IRA-Index design, comparing venture deal activity for firms in policy-exposed technologies with those in less-exposed climate technology categories. Prior to the IRA, estimated coefficients are small and statistically indistinguishable from zero, providing no evidence of differential pre-trends between the two groups and supporting the validity of the identification strategy. Following the enactment of the IRA, however, firms in exposed technologies experience a sustained increase in venture deal activity. The effect emerges within one to two quarters after enactment and persists over subsequent periods, indicating a durable shift in investment behavior rather than a transitory response. The approximately three-to-six-month lag is consistent with the time required for investors to evaluate new policy provisions, adjust due diligence processes, and advance deals through funding pipelines, and aligns with prior evidence that corporate investment responds to policy-uncertainty shocks with a one- to two-quarter delay (28, 29). The corresponding binary-treatment event study yields a quantitatively similar pattern (*SI Appendix*, Section S8).

Table 1 corroborates these dynamic patterns using difference-in-differences specifications (30, 31). Across multiple model specifications with progressively richer fixed effects, exposure to the IRA is associated with a higher likelihood of receiving venture capital, an increase in the number of venture deals, and higher total investment amounts. These effects remain stable when firm and time fixed effects are included. Time fixed effects absorb aggregate investment trends, including the deployment of capital raised by the wave of new VC firms entering between 2018 and 2023. Such pent-up dry powder would flow to treated and control technologies alike, so the exposure-based design differences it out rather than confounding the policy effect.

The increase in venture capital entry is not uniform across the climate technology sector. The estimated effects

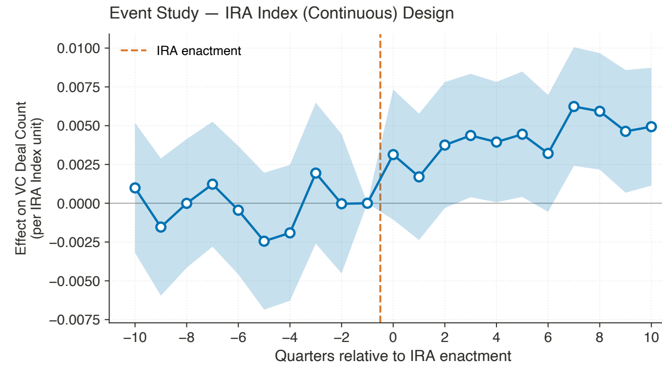

Fig. 1. Event-study estimates of the IRA's effect on venture deal activity (VC_Deal_Count) under the continuous IRA Index design. Each coefficient represents the interaction of an event-time indicator with the firm's IRA alignment score, relative to the omitted baseline period ($t = -1$). Vertical bars indicate 95% confidence intervals. The dashed vertical line marks the policy enactment quarter.

are concentrated in technologies most closely aligned with the IRA's incentive structure, particularly capital-intensive applications such as clean energy generation and carbon capture. We observe little change in entry rates for firms in adjacent or weakly exposed technologies. In one sense this validates the policy's targeting: investors responded to the incentives as intended. The selectivity is also informative in its own right, because it indicates that the IRA changed investors' screening and selection decisions rather than producing a broad expansion of venture investment.

Together, these findings provide causal evidence that large-scale industrial policy influences the likelihood that firms attract venture capital financing. The IRA did not simply raise overall investment activity; it reshaped the economics of targeted technologies. In some cases it lowered venture-stage entry barriers, in others it reduced lifecycle capital requirements or improved after-tax unit economics. These shifts set the stage for the reallocation and dynamic effects examined below.

Policy intensity and graded investment responses. The binary estimates establish that venture capital entry increased following the IRA for technologies directly exposed to policy incentives. We next examine whether these effects vary with the *intensity* of policy exposure. Rather than treating exposure as a discrete classification, we construct a continuous IRA exposure index that captures the degree to which a firm's technological focus aligns with the policy's incentive provisions.

The IRA exposure index is constructed using a supervised text-based classification approach (32). For each company, the index scores the alignment between the firm's business description and each IRA provision on a 0–7 scale, using a large language model prompted against the statutory language of the IRA (see *SI Appendix*, Section S3.2 for full construction details). The final index is the maximum alignment score across all evaluated provisions. This continuous measure captures within-category heterogeneity that the binary classification cannot: for example, within the Energy category, a solar panel manufacturer receives a higher score than an energy management software company, reflecting the former's more direct access to production tax credits.

Table 1. Difference-in-Differences Estimates for Venture Financing Outcomes (Binary Treatment)

	AnyVC			*VC Deal Count*			*VC Amount Sum*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post×Treated	0.007***	0.010***	0.009***	0.007***	0.011***	0.009***	-0.038	0.336***	0.385***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.079)	(0.099)	(0.128)
Post	-0.003*			-0.003**			-0.461***		
	(0.002)			(0.002)			(0.126)		
Treated	-0.009***	-0.011***		-0.010***	-0.012***		-0.295*	-0.280*	
	(0.002)	(0.002)		(0.002)	(0.002)		(0.161)	(0.162)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Firm FE	No	No	Yes	No	No	Yes	No	No	Yes
R^2	0.056	0.034	0.003	0.055	0.034	0.003	0.004	0.003	0.000
Obs.	132,826	132,826	132,826	132,826	132,826	132,826	132,826	132,826	132,826

***Note.* Columns (1)–(3), (4)–(6), and (7)–(9) report estimates for *AnyVC*, *VC Deal Count*, and *VC Amount Sum*, respectively. Specification (1)/(4)/(7) includes controls only; (2)/(5)/(8) adds time fixed effects; (3)/(6)/(9) further adds firm fixed effects. Controls include firm age and indicator controls for ownership and region categories (as constructed in the panel). Models are estimated using `PanelOLS`. Standard errors clustered at the firm level are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.**

Table 2. Difference-in-Differences Estimates for Venture Financing Outcomes (IRA Index Intensity)

	AnyVC			*VC Deal Count*			*VC Amount Sum*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post×IRA_Index	0.001***	0.004***	0.004***	0.001***	0.004***	0.004***	-0.022*	0.138***	0.066*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.012)	(0.029)	(0.038)
Post	-0.014***			-0.015***			-0.986***		
	(0.004)			(0.004)			(0.217)		
IRA_Index	-0.002***	-0.004***		-0.002***	-0.004***		0.005	0.041	
	(0.000)	(0.001)		(0.000)	(0.001)		(0.038)	(0.057)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Firm FE	No	No	Yes	No	No	Yes	No	No	Yes
R^2	0.056	0.021	0.018	0.055	0.020	0.018	0.004	-0.003	0.001
Obs.	132,826	132,826	132,826	132,826	132,826	132,826	132,826	132,826	132,826

***Note.* Columns (1)–(3), (4)–(6), and (7)–(9) report estimates for *AnyVC*, *VC Deal Count*, and *VC Amount Sum*, respectively. The treatment intensity is the continuous IRA exposure index. Specification (1)/(4)/(7) includes controls only; (2)/(5)/(8) adds time fixed effects; (3)/(6)/(9) further adds firm fixed effects. Controls include firm age and indicator controls for ownership and region categories (as constructed in the panel). Models are estimated using `PanelOLS`. Standard errors clustered at the firm level are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.**

To quantify how closely each company's technological focus aligns with IRA incentive provisions, we measure the semantic similarity between each firm's business description and the statutory language of each IRA provision. This computational approach weighs words by how distinctive they are across documents (common words receive low weight, technology-specific terms high weight), producing a continuous alignment score that captures finer-grained variation than the binary treated/control classification alone.

Table 2 reports difference-in-differences estimates using this continuous exposure measure. Across specifications, higher IRA exposure is associated with a larger post-policy increase in venture capital entry, deal counts, and investment amounts. The estimated coefficients remain positive and statistically significant after the inclusion of time and firm fixed effects, indicating that the results are not driven by aggregate investment cycles or time-invariant firm characteristics.

The presence of a graded response strengthens the causal interpretation of the policy effects. Rather than a uniform shift affecting all exposed firms equally, venture investment increases more strongly for firms whose technologies are more closely aligned with the IRA's incentive structure. This pattern is difficult to reconcile with explanations based solely on broad macroeconomic trends, contemporaneous shocks such as interest rate changes, or the post-pandemic technology investment cycle. If these aggregate factors were driving the results, we would expect uniform effects across technology categories rather than a dose-response relationship tied to policy alignment. The graded pattern instead suggests that investors respond to economically meaningful variation in the degree of policy support, consistent with a direct policy mechanism.

The continuous treatment results are also consistent with the binary treatment estimates in Table 1. Both approaches identify a selective policy effect concentrated in technologies most directly aligned with IRA incentives. The continuous measure adds that, even within treated categories, firms with stronger policy alignment respond more. This reinforces the causal reading and gives finer-grained evidence on how policy affects capital allocation.

Dynamic financing trajectories. The preceding analyses focus on whether and how much capital flows to policy-exposed firms. We now ask how the policy changed the way firms finance growth: the mix of instruments behind their financing events. We classify every financing event in the sample into observable phases using PitchBook deal classifications: accelerator and grant support, angel investment, seed rounds, early- and later-stage venture rounds, growth and private-equity investment, corporate investment, and debt (17,765 events across 7,194 firms; *Materials and Methods*).

Table 3 (panel A) compares the composition of financing events before and after the IRA. Venture rounds rise from 30.6% to 38.1% of events, with gains at every stage: seed (10.0% to 11.9%), early-stage (8.1% to 10.4%), and later-stage (12.5% to 15.8%). Accelerator and grant support rises from 32.8% to 35.6%. Debt moves the other way, falling from 17.6% to 8.3% of events, while corporate and growth-equity shares are roughly flat.

The same shift appears at the firm level (Table 3, panel B), where it speaks directly to how firms combine instruments. Among firms with at least one venture round in a given window, the share financing exclusively through venture rounds rose from 48.2% to 56.9%, while the share that also used debt fell from 16.2% to 5.5%. The share combining venture rounds with accelerator or grant support was essentially unchanged (32.1% to 32.2%). The contraction is therefore specific to the venture–debt combination rather than to hybrid financing in general.

Transitions between consecutive events tell the same story. The probability that a later-stage venture round is followed by a debt deal halved after the IRA (14.9% to 7.7%). Stage progression strengthened: the probability that an early-stage round is followed by a later-stage round rose from 11.9% to 18.6%, while seed-to-early progression was little changed (21.2% to 19.4%). Debt became increasingly confined to debt-reliant firms, with the probability that a debt event is followed by another debt event rising from 24.0% to 54.7%.

This reallocation is consistent with two complementary mechanisms. First, the IRA's tax credits (Sections 45X, 45V, 45Q, 30D) and grant programs reduce policy-aligned firms' need for debt complementarity: the present value of statutory incentives partially substitutes for project- and working-capital debt, allowing firms to finance growth through equity rounds alone. Second, the IRA's grant and loan-program authorities (Sections 50141 and 50144) directly expand the pool of non-dilutive capital available to climate-technology firms. Two caveats apply. Shares are computed over deal counts rather than dollars, and debt deals are larger on average, so the dollar composition shifts less sharply than the event composition. And the post-2022 rise in interest rates raised the cost of debt for all firms; the time pattern alone cannot separate the policy contribution from the rate environment, which is one reason we read these shifts alongside the exposure-based designs above.

The partition into financing phases is imposed by us rather than estimated. As a check, a four-state hidden Markov model fitted to the same event sequences recovers the same structure from the data alone: a pure-venture regime that expands after the IRA (16.9% to 25.7% of firm-events), a mixed venture–debt regime that contracts to 5.5%, and a non-dilutive-led regime that expands (48.2% to 55.4%). Model details, state characterizations, and transition estimates appear in *SI Appendix*, Section S5.

Table 3. Composition of Climate-Technology Financing Before and After the IRA

	Pre-IRA (%)	Post-IRA (%)	Change (pp)
A. Share of all financing events			
Accelerator/grant	32.8	35.6	+2.8
Angel	5.7	6.1	+0.4
Seed	10.0	11.9	+1.9
Early-stage venture	8.1	10.4	+2.3
Later-stage venture	12.5	15.8	+3.3
Growth/PE	3.6	3.5	−0.1
Corporate	9.4	8.3	−1.2
Debt	**17.6**	**8.3**	**−9.3**
B. Instrument mix among venture-backed firms			
Venture only	48.2	56.9	+8.7
Venture + accel./grant	32.1	32.2	+0.1
Venture + debt	**16.2**	**5.5**	**−10.7**

Note. **Pre-IRA = Q1 2020–Q2 2022; Post-IRA = Q3 2022–Q2 2025. Panel A shares are over deal counts (may not sum to 100 due to rounding and a negligible uncategorized-venture share); Panel B is over venture-backed firms (those with $\geq$1 venture round in the window), where "+ accel./grant" and "+ debt" are not mutually exclusive. Phases are classified from PitchBook deal classes and types; terminal events, secondary transactions, and hedge-fund deals are excluded. Sample: 17,765 events across 7,194 firms. Bold rows mark the venture–debt substitution.**

Mechanisms

Financial incentive channel: policy alignment and incentive capture. If policy operates primarily through direct financial incentives, firms whose technologies more directly match IRA provisions should exhibit stronger investment responses. These firms are better positioned to capture tax credits and subsidies that improve their economic profile: reduced tax liability on the income statement, transferable credits that can be monetized directly, or production incentives that improve unit economics. A hydrogen producer can claim production tax credits that directly improve per-unit profitability, while a software platform for carbon accounting cannot. Investors recognizing this heterogeneity should direct capital toward firms with greater incentive capture potential.

We test this prediction using a text-based exposure score, S_c, that measures semantic alignment between firm business descriptions and IRA statutory language describing eligible activities (32, 33). This approach captures policy alignment at a granular level: firms developing technologies explicitly named in IRA provisions (e.g., clean hydrogen, carbon capture, battery manufacturing) receive higher scores than firms in adjacent but less directly supported areas.

Difference-in-differences estimates using S_c as the treatment intensity (*SI Appendix*, Table S3) confirm that higher text-based policy alignment is associated with larger post-IRA increases in VC financing: a one-standard-deviation increase in S_c corresponds to a 0.3 percentage-point increase in the probability of receiving VC ($p < 0.01$) and approximately \$122,000–\$147,000 in additional VC investment per firm-quarter (lower bound: controls plus firm and time fixed effects; upper bound: controls plus time fixed effects). The graded response strengthens the causal interpretation: firms cannot select into higher S_c scores after observing the policy, ruling out reverse causality.

Credibility channel: policy durability and long-horizon investment. While the cash-flow channel explains cross-sectional variation in policy response, it does not fully account for how investors evaluate long-horizon climate investments. Venture capital in climate technologies requires commitments spanning 7–10 years or longer (34, 35), during which policy regimes may shift. If investors doubt whether IRA incentives will persist, the present value of expected subsidies declines even if current policy remains unchanged (3, 36). This credibility channel generates predictions distinct from the cash-flow mechanism: investment should be sensitive not only to policy levels but also to signals about policy durability and the political economy of commitment.

We conceptualize policy credibility as the degree to which investors believe that enacted incentives will remain in force over the time horizons relevant to their investment decisions. Several features of the IRA's design bear on credibility: the use of uncapped tax credits with ten-year statutory horizons, automatic implementation through the tax code rather than annual appropriations, and transferability provisions that create broad constituencies for policy preservation. These design features are intended to make policy reversal politically costly, thereby enhancing credible commitment (1, 2). The logic parallels credibility effects documented in other policy domains, from monetary rules that anchor inflation expectations to constitutional commitments that enable long-run public finance, and echoes empirical work showing that perceived durability, as well as the scale of support, shapes renewable-energy investment responses to policy mixes (37, 38).

Measuring policy credibility: the Policy Credibility Index. A direct test of the credibility channel requires measuring institutional design features that underpin credible commitment, independent of market sentiment. Drawing on the policy-mix credibility literature (37, 39), we construct a Policy Credibility Index (PCI) that scores individual IRA provisions along three dimensions: *specificity* (rule-based eligibility criteria versus discretionary delegation), *durability* (multi-year statutory horizons versus annual reauthorization), and *enforceability* (clear agency assignment with specified procedures versus discretionary funding allocation). Each dimension is scored on a 1–5 scale, and the PCI is the simple average of the three dimensions. The index is conceptually analogous to institutional quality indices used in political science and development economics, but applied at the level of individual policy provisions rather than countries. The three dimensions capture the institutional architecture that determines whether a commitment is likely to persist over the multi-year horizons relevant to venture investment. Because the PCI is built from the statutory and regulatory text itself, rather than from media coverage or investor sentiment, it provides a lens that is complementary to news-based measures of policy uncertainty. Provisions are scored independently by two researchers and reconciled through discussion, with inter-rater agreement above 85% before reconciliation, and the resulting scores are cross-validated against an independent news-based measure of climate policy uncertainty (*SI Appendix*, Section S6). A blind re-scoring of all six provisions by large-language-model judges, given only the rubric and neutral provision descriptions, reproduces the provision ranking ($\rho = 0.86$) and the direction of every OBBBA shock, including a null for the unamended 45Q placebo (*SI Appendix*, Section S7.7). Full construction details appear in *SI Appendix*, Section S7.

Table 4 reports baseline PCI scores at IRA enactment (August 2022) for six focal provisions spanning the IRA's climate technology incentive structure. Tax-based production credits, Advanced Manufacturing (Section 45X, PCI = 4.67) and Clean Hydrogen (Section 45V, PCI = 4.33), score highest because they are self-executing through the Internal Revenue Service: eligibility criteria are codified in statute, credit values are formula-determined, and implementation requires no annual appropriation or agency discretion. Carbon Capture (Section 45Q, PCI = 4.33) and Clean Vehicles (Section 30D, PCI = 4.00) also score highly, though with slightly lower enforceability due to more complex compliance requirements. By contrast, Department of Energy Loan Programs Office authorities (Sections 50141 and 50144, PCI = 3.00–3.33) score substantially lower: loan approvals are discretionary, funding depends on congressional appropriations, and program priorities can shift with changes in agency leadership. This heterogeneity in institutional design quality implies that not all IRA incentives are equally credible, and investors attuned to policy risk should differentiate accordingly.

Stress test: the OBBBA credibility shock. The 2025 legislative proposals under the "One Big Beautiful Bill Act" (OBBBA) framework provide a natural stress test of the credibility channel. These proposals introduced specific statutory amendments that degraded the institutional design quality of several IRA provisions without immediately changing enacted incentives, which created variation in credibility shocks across provisions. We distinguish two types of shocks. *Design shocks* directly altered statutory parameters: the Advanced Manufacturing credit (45X) faced elimination of wind energy components and stricter domestic content requirements (ΔPCI $= -1.00$); the Clean Hydrogen credit (45V) faced an accelerated construction deadline from indefinite eligibility to 2027 (ΔPCI $= -1.00$); and the Clean Vehicle credit (30D) faced early termination in September 2025, seven years ahead of its original 2032 sunset (ΔPCI $= -1.00$). *Political shocks* targeted program operations rather than statutory text: the Loan Programs Office saw rescission of unobligated balances (Section 50141, ΔPCI $= -0.67$) and mission rebranding with revised selection criteria under heightened executive discretion (Section 50144, ΔPCI $= -1.33$). The Carbon Capture credit (45Q) was unaffected by OBBBA proposals (ΔPCI $= 0.00$) and provides a within-provision comparison.

This variation in credibility shocks generates testable predictions: technologies aligned with provisions experiencing larger PCI declines should exhibit stronger investment contractions, holding current incentive levels constant. We test this prediction using a difference-in-differences design restricted to the post-IRA period (Q4

Table 4. Policy Credibility Index: Baseline Scores at IRA Enactment (August 2022)

IRA Provision	Description	Specificity	Durability	Enforceability	PCI
Section 45X	Advanced Manufacturing Production Credit	5	4	5	4.67
Section 45V	Clean Hydrogen Production Credit	5	4	4	4.33
Section 45Q	Carbon Capture Credit	5	4	4	4.33
Section 30D	Clean Vehicle Credit	4	4	4	4.00
Section 50144	Energy Infrastructure Reinvestment (LPO)	4	3	3	3.33
Section 50141	Loan Programs Office Funding	3	3	3	3.00

Note. **PCI is the simple average of three dimensions, each scored 1–5. Specificity: rule-based eligibility (5) versus discretionary allocation (1). Durability: multi-year statutory horizon with insulation from annual reauthorization (5) versus short-term or annually reauthorized (1). Enforceability: clear agency assignment with specified procedures (5) versus discretionary selection with flexible criteria (1). Scores reflect institutional design at enactment (August 2022); subsequent OBBBA changes are captured separately as △PCI in the stress-test analysis below. See *SI Appendix*, Section S7 for scoring protocol.**

2022–Q2 2025), in which the two OBBBA quarters (Q1–Q2 2025) serve as the treatment period and earlier post-IRA quarters as the comparison period. Two specifications probe the intensive margin of exposure: a continuous IRA-index interaction and a text-based exposure interaction.

Consistent with the credibility channel, firms with higher IRA alignment exhibit significant declines in venture activity during the OBBBA window. The IRA-index specification yields a negative interaction coefficient ($\text{IRA\_Index} \times \text{OBBBA} = -0.0020$, $\text{SE} = 0.0009$, $p < 0.05$) for both the probability of receiving venture capital and the number of venture deals: each one-unit increase in IRA alignment corresponds to a 0.20 percentage-point reduction in the quarterly probability of receiving VC during OBBBA. The text-based exposure specification yields comparable results ($S_c \times \text{OBBBA} = -0.0035$, $\text{SE} = 0.0016$, $p < 0.05$ for AnyVC; -0.0037, $\text{SE} = 0.0016$, $p < 0.05$ for VC deal count). Firm-level trends reinforce this pattern: during the OBBBA quarters, the share of treated firms receiving venture capital fell from 3.9% to 2.5%, a 36% decline, while control firms contracted by 20% (4.5% to 3.6%) over the same window. The observation window is short and these estimates should be interpreted with caution, but the concentration of the contraction among policy-aligned firms and the dose-response pattern in the continuous specifications are jointly consistent with the credibility channel. The distinction between design shocks (which reduce durability and specificity) and political shocks (which reduce enforceability) further suggests that different dimensions of institutional credibility may affect investor behavior through distinct channels. As an external triangulation, a complementary news-based Climate Policy Uncertainty analysis (*SI Appendix*, Section S6) yields directional patterns broadly consistent with the credibility channel; we report it as supporting co-movement evidence rather than primary identification.

Discussion

Our contribution can be read as a construct, its measurement, and its identification. The construct is policy credibility: the believability that a statutory commitment will persist, which we separate from both the magnitude of incentives and the choice of instrument that prior work has emphasized. The measurement is the Policy Credibility Index, which reads credibility off statutory text at the level of the individual provision, scoring specificity, durability, and enforceability. The identification comes from treating the enactment of the Inflation Reduction Act and its attempted 2025 rollback as paired natural experiments, the rollback a shock to credibility while enacted incentives still stood, traced through venture capital, a forward-looking form of finance whose returns depend on a policy regime persisting for a decade.

These contributions organize what we find. The IRA raised the likelihood that firms in targeted clean energy and carbon technologies received venture financing, but selectively: the response concentrated in technologies most directly aligned with statutory incentives rather than expanding investment across the sector. It also changed how firms finance growth, as venture-only and non-dilutive financing expanded while mixed venture–debt funding contracted, consistent with the IRA's tax credits and grants substituting for the project- and working-capital debt that capital-intensive climate firms had relied on. Prior work on optimal staging (26) and on R&D-grant spillovers into later venture financing (17) shows that grant awards, investor learning, and cohort effects can reshape a firm's path through funding stages; we extend that logic to a large-scale industrial-policy shock that reweights the financing ecosystem along an equity-versus-debt dimension.

The credibility channel rests on two design-based analyses. The Policy Credibility Index shows that IRA provisions vary widely in institutional design quality, with self-executing tax credits scoring highest and discretionary loan programs lowest. The OBBBA stress test shows that the 2025 proposals degraded credibility unevenly across provisions, and that venture activity contracted most where credibility fell most, even as enacted incentive levels held. A news-based Climate Policy Uncertainty index co-moves with sector-level venture activity in the same direction, with deal activity persistently lower under elevated uncertainty in policy-dependent sectors such as Food & Land Use and Built Environment (*SI Appendix*, Section S6); we read it as descriptive corroboration rather than identification.

Alternative explanations and limitations. Several alternative explanations merit consideration. First, the period 2020–2025 coincided with a broader venture capital cycle, including rapid entry of new firms between 2018 and 2023 driven by limited-partner capital availability. As noted in the Results section, time fixed effects absorb such aggregate cycles, including pent-up deployment of capital raised in earlier vintages. The selective nature of the trajectory shifts, concentrated in policy-aligned technologies, further supports a policy mechanism rather than a uniform cyclical pattern.

Second, our identification strategy relies on differential exposure across climate technology categories, which may not fully capture heterogeneity within each category in policy alignment, baseline venture capital affinity, or available capital pools. We address this concern through the continuous exposure measures (Table 2 and *SI Appendix*), which exploit within-category variation and yield consistent results.

Third, observable team quality and founder experience may correlate with both selection into IRA-aligned technologies and venture capital outcomes. The entrepreneurship literature consistently emphasizes founder characteristics as a determinant of commercialization success in capital-intensive sectors. Although our firm fixed effects absorb time-invariant team characteristics and the OBBBA stress test exploits political shocks orthogonal to founder formation, we cannot rule out that experienced teams disproportionately pivoted toward policy-aligned categories around enactment. Direct evidence on team formation, capability matching, and founder mobility under industrial-policy regimes is a productive direction for future qualitative work.

Fourth, the mechanism analysis drawing on institutional design measures and market-level uncertainty correlations characterizes co-movement patterns rather than identifying causal effects; we cannot definitively rule out alternative explanations for the observed patterns, and the OBBBA observation window is too short for conclusive inference.

Finally, our findings are set in the U.S. context, where the IRA represents one of the largest national-level industrial policies for climate technology to date. Whether similar credibility-mediated dynamics arise in other institutional settings, such as the EU's Green Deal, China's coordinated industrial subsidies, or appropriations-driven public investment programs in other developed economies, is an empirical question we leave to future work, alongside the longer-run effects on technology commercialization and emissions outcomes.

Implications for policy design. These limitations notwithstanding, our findings carry direct implications for the design of climate industrial policy. The central finding is that the institutional architecture of policy commitments shapes their effectiveness in mobilizing private capital, over and above their financial magnitude. Large incentive packages may fail to mobilize private capital if investors doubt their durability, while design features such as long statutory horizons, automatic implementation through the tax code, and insulation from annual appropriations may amplify policy effectiveness.

Our findings extend a literature linking renewable-energy investment to policy design and instrument choice (37, 38), but we differ from that work on three dimensions. First, the construct: prior studies operationalize policy as design features or instrument type, measuring the balance and evolution of national policy mixes (37) or the presence of feed-in tariffs, quotas, and tax incentives (38). Neither isolates credibility, the believability that a commitment will persist. The IRA-to-OBBBA sequence illustrates why the distinction matters: much of the statutory design remained intact on paper while credibility was the margin that moved. Second, the measurement: where prior work relies on expert coding or categorical variables drawn from secondary sources, we extract credibility properties directly from statutory text at the provision level, capturing sunset clauses, contingency triggers, claw-back conditions, and phase-down schedules that no instrument-type label records. Third, identification and outcome: the cross-country evidence is observational panel variation in aggregate renewable-energy asset finance, whereas we exploit the enactment and subsequent modification of a single statute as natural experiments, with the OBBBA functioning as a credibility shock to an otherwise-standing policy, and we study venture capital, a forward-looking form of innovation finance whose returns depend on a policy regime persisting over a decade.

This design trades breadth for identification. The cross-country literature spans many economies over long horizons (37, 38); ours is a within-country design centered on one statute in one institutional context, and external validity to other polities is an open question for future work. The tradeoff is deliberate: only within a single legal system, with provision-level text and identifiable political shocks, can credibility be separated from instrument design and tied causally to firm-level investment.

The Policy Credibility Index offers policymakers a practical tool for evaluating the credibility properties of proposed legislation along the dimensions of specificity, durability, and enforceability before enactment. As governments worldwide design industrial policy packages to accelerate the energy transition, these findings suggest that attention to institutional design features deserves at least as much consideration as the scale of financial incentives.

Materials and Methods

Data. We construct a firm-level panel of climate technology companies using the Climate Tech Venture Capital (CTVC) database, which provides comprehensive coverage of venture-backed firms operating in climate-related technologies. The sample includes 132,826 firm-quarter observations spanning Q1 2020–Q2 2025. Financing events are sourced from PitchBook and include venture capital rounds, corporate investments, debt financing, and private equity transactions. Full details of data sources, sample construction, and variable definitions appear in *SI Appendix*, Section S1.

Policy Exposure. We measure policy exposure using three complementary approaches. First, we construct a binary treatment indicator based on the CTVC taxonomy, classifying firms in the Energy and Carbon subfields as directly exposed to IRA incentives (*SI Appendix*, Section S3.1). Second, we develop a continuous IRA exposure index using supervised text classification that scores firm descriptions against statutory language (*SI Appendix*, Section S3.2). Third, we compute a text-based exposure score (S_c) using TF-IDF cosine similarity to capture semantic alignment with policy provisions (*SI Appendix*, Section S3.3). Details of the technology classification methodology appear in *SI Appendix*, Section S2.

Empirical Strategy. We estimate difference-in-differences specifications (30, 40) comparing outcomes for policy-exposed and less-exposed firms before and after IRA enactment (August 2022). Event-study specifications allow for dynamic effects and test for differential pre-trends. All models include firm and time fixed effects and cluster standard errors at the firm level. Robustness checks using Poisson PPML, log-linear, and logit specifications are reported in *SI Appendix*, Section S4.3.

Financing Trajectories. We classify each financing event into observable phases from PitchBook deal classes and types (accelerator/grant, angel, seed, early-stage venture, later-stage venture, growth/private equity, corporate, debt), excluding terminal events, secondary transactions, and hedge-fund deals. We compare the composition of events, firm-level instrument combinations, and next-event transition rates before and after IRA enactment (boundary: Q3 2022). As corroboration, a four-state Hidden Markov Model estimated on the same deal sequences recovers an equivalent partition without imposing the phase classification; model details and state characterizations appear in *SI Appendix*, Section S5.

Data, Materials, and Software Availability. The Climate Policy Uncertainty index, Policy Credibility Index scores, IRA exposure scores, and all replication code are publicly available at https://github.com/Yikai-Cao/climate-tech-vc-paper. Company-level data from the Climate Tech Venture Capital (CTVC) database and PitchBook are available under institutional license agreements; details on obtaining access are provided in the repository README. The repository includes complete code for reproducing all tables and figures from the licensed source data, along with a de-identified analytical dataset containing all constructed variables sufficient for replicating the main statistical analyses.

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