COALITION FOR INNOVATION

CleanTech Blueprint for the Future

Coalition for Innovation, supported by LG NOVA

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The views and opinions expressed in the chapters and case studies that follow are those of the authors and do not necessarily reflect the views or positions of any entities they represent.

Senior Editor, Alfred Poor

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Preamble

The Coalition for Innovation is an initiative hosted by LG NOVA that creates the opportunity for innovators, entrepreneurs, and business leaders across sectors to come together to collaborate on important topics in technology to drive impact. The end goal: together we can leverage our collective knowledge to advance important work that drives positive impact in our communities and the world. The simple vision is that we can be stronger together and increase our individual and collective impact on the world through collaboration.

This "Blueprint for the Future" document (henceforth: "Blueprint") defines a vision for the future through which technology innovation can improve the lives of people, their communities, and the planet. The goal is to lay out a vision and potentially provide the framework to start taking action in the areas of interest for the members of the Coalition. The chapters in this Blueprint are intended to be a "Big Tent" in which many diverse perspectives and interests and different approaches to impact can come together. Hence, the structure of the Blueprint is intended to be as inclusive as possible in which different chapters of the Blueprint focus on different topic areas, written by different authors with individual perspectives that may be less widely supported by the group.

Participation in the Coalition at large and authorship of the overall Blueprint document does not imply endorsement of the ideas of any specific chapter but rather acknowledges a contribution to the discussion and general engagement in the Coalition process that led to the publication of this Blueprint.

All contributors will be listed as "Authors" of the Blueprint in alphabetical order. The Co-Chairs for each Coalition will be listed as "Editors" also in alphabetical order. Authorship will include each individual author's name along with optional title and optional organization at the author's discretion.

Each chapter will list only the subset of participants that meaningfully contributed to that chapter. Authorship for chapters will be in rank order based on contribution: the first author(s) will have contributed the most, second author(s) second most, and so on. Equal contributions at each level will be listed as "Co-Authors"; if two or more authors contributed the most and contributed equally, they will be noted with an asterisk as "Co-First Authors". If two authors contributed second-most and equally, they will be listed as "Co-Second Authors" and so on.

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The Coalition is intended to be a community-driven activity and where possible governance will be by majority vote of each domain group. Specifically, each Coalition will decide which topics are included as chapters by majority vote of the group. The approach is intended to be inclusive so we will ask that topics be included unless they are considered by the majority to be significantly out of scope.

We intend for the document to reach a broad, international audience, including:

- People involved in the three technology domains: CleanTech, AI, and HealthTech
- Researchers from academic and private institutions
- Investors
- Students
- Policy creators at the corporate level and all levels of government

Chapter 2:

Bridging the "Valleys of Death" in CleanTech Commercialization

Authors: Alex Fang, Darlene Damm, Julia Yan

In CleanTech, entrepreneurs often encounter not just one but two major valleys of death: pivotal and perilous gaps in the innovation lifecycle where companies frequently stall. The first valley of death emerges in the transition from academic research or lab discovery to a working prototype and functional business. The second, more treacherous valley arrives later: the climb from demonstrated prototype to a market-ready, scalable product.

While many innovators focus on proving their technology in a lab or through small pilots, crossing into full-scale commercialization is a much deeper and longer journey. This second valley is where critical decisions around scale, infrastructure, team, and funding converge. Together, these two valleys define the journey from scientific curiosity to transformative solution.

This chapter presents a unified view of these two inflection points. From transforming research into a venture to navigating the scale-up and market-access gauntlet, we explore the systemic challenges CleanTech startups face, along with the new tools, structures, and mindsets needed to help them survive and thrive.

The First Valley of Death: From Idea to Startup

Navigating the Early Transition

For many CleanTech ventures, the earliest challenges arise not in proving a technology's scientific merit, but in **translating that technology into a viable business**. This is the first valley of death: the fragile, under-resourced stage where ideas born in labs, garages, home kitchens, or coffee shops must become startups capable of attracting capital, navigating regulations, protecting intellectual property, and building teams. Despite the abundance of scientific ingenuity, many innovations stall here, never making it to their first customer. This is not just a funding gap, but a translation gap: one where technical talent must suddenly speak the language of business, navigate opaque capital markets, and convince others that their vision can hold up outside a lab. The barrier is less about feasibility and more about familiarity; **the systems designed to support academic research often stop short of venture readiness.**

Institutional Infrastructure: Incubators and Accelerators

A growing ecosystem of incubators and accelerators helps address this early-stage gap by offering support beyond the lab bench. These programs can provide **seed funding, legal guidance, and business training to emerging ventures**, often bundled with connections to investors and industry mentors. According to the International Business Innovation Association, there are over 7,000 incubators in the world, and, according to BetaBoom, 3,000 accelerators.

The function of these programs extends beyond capital. They offer a platform for entrepreneurs to **formalize their operations, pressure-test their value propositions, and build credibility with funders and other potential partners**. Their proliferation over the past decade has played a crucial role in making early venture formation more

accessible to scientists and engineers who might otherwise lack business experience. Yet even the best accelerators can only do so much. The real challenge lies in equipping founders not only to build products and services, but to build organizations. Founders must learn to make decisions with incomplete information, to set culture early, and to balance ambition with survival.

Alternative Capital Sources: Impact Investors, Prizes, and Fellowships

Unlike other sectors where capital often waits for commercial validation, CleanTech benefits from a broader universe of mission-aligned funding. This includes **impact investors, philanthropic foundations, public innovation funds, prize competitions, and fellowships**: all of which can help bridge early gaps in funding.

Impact investing in particular has become a major force. As of 2024, over 3,900 impact investors globally manage $1.571 trillion in assets, with the sector growing at 21% annually (according to GIIN). These investors expect both financial and measurable environmental or social returns. Some are willing to tolerate lower or longer-term returns in order to support solutions aligned with their values. The field traces its formal origins to a 2007 Rockefeller Foundation convening at the Bellagio Center, which catalyzed early thought leadership and capital deployment strategies. Today, platforms such as the Skoll World Forum, SoCap Global, the World Economic Forum, and Mercy Corps Ventures help organize and amplify this capital network by vertical segments.

Participants and members in these groups also form strong networks and communities, guiding and mentoring one another through the innovation and fundraising process.

Today, it's also interesting to see how the field is evolving. Given how technology has transformed the economics of solving social and environmental problems, we are now seeing some impact technology companies creating financial returns equal to or exceeding more traditional companies, and the line between impact and traditional investors is blurring. Electric vehicles, renewable fuels, and battery storage – all once fringe technologies – now draw mainstream capital. Impact Investors and traditional investors are now overlapping in their support of impact technology startups. **Early impact investors often act as "first movers,"** catalyzing market interest that later attracts institutional and venture capital at scale. This convergence has sparked new questions: What happens when a company's impact becomes its competitive edge? And what happens when markets begin to price in externalities, turning what was once mission-driven capital into a mainstream thesis?

It's also interesting to note that historically, many wealthy philanthropists also park their endowment funds in traditional venture capital funds as limited partners. While we often think of social impact and for-profit businesses as two distinct groups, the ties between them run deep in unexpected ways. CleanTech startups are well-positioned to take advantage of both.

Prize Funding: Visibility and Validation

Prize mechanisms have a long history of incentivizing breakthrough innovation. The 1919 Orteig Prize, for instance, spurred Charles Lindbergh's transatlantic flight. More recently, the X Prize Foundation has awarded over $500 million across 30+ challenges, including competitions focused on carbon capture, clean fuels, and sustainable materials. The Earthshot Prize and VinFuture Prize offer high-profile funding and global recognition for environmental innovators. Another form of prize competitions are pitch competitions, where startups come together for a day to pitch their solutions to an audience with a set of judges selecting the winner, with the winner often receiving funding or investment. While many universities, accelerators, businesses, and investment groups often host pitch competitions, one of the more well-known ones is Startup Battlefield, hosted by TechCrunch Disrupt. Winners receive a $100,000 equity-free prize.

In addition to financial awards, **prizes often offer exposure, third-party validation, and access to networks of funders and policymakers**. These outcomes can be particularly useful to early-stage startups navigating the credibility gap of the first valley. Prizes function not only as validation tools

but as narrative engines. They allow unknown ventures to enter global conversations, giving funders a signal of quality that may otherwise take years to establish. In this way, they accelerate not just capital access, but trust. However, they are not always suitable for proprietary or confidential technologies, which risk premature disclosure in open competition formats.

Fellowships and Educational Support

Fellowship programs provide another bridge, combining financial support with tailored mentorship and institutional backing. Programs such as Breakthrough Energy Fellows, Activate, 776 Foundation, and Labstart offer funding, lab access, and structured guidance for founders building solutions to climate-related challenges. Many of these programs are backed by leading climate investors and philanthropies, creating a seamless transition from fellowship to pre-seed funding for aligned ventures.

These programs are particularly valuable in CleanTech because they help decrease risk for technologies still in development, giving founders time and space to iterate without immediate commercial pressure. Fellowships also offer something rarer: space (Newlab Founder Fellowship). For many founders, they are one of the few environments where exploration is encouraged over optimization, and where failure is treated as data rather than disqualification. In some cases, fellows emerge from these programs with pilot partnerships, angel backing, or connections to impact funds positioned to support scale-up.

Grant Funding: Public and Philanthropic Channels

Given that CleanTech touches on many social and environmental issues, many foundations and humanitarian foundations might support relevant projects, including those that offer grants or loans to for profit startups. ClimateChange AI offers grants at the intersection of climate change and machine learning. The Unicef Venture Fund is open to startups working on climate and the well being of youth and some programs of The United Nations World Food Programme Innovation Accelerator are open to startups working on solving hunger and climate. Climateworks hosts a database of climate grants. Elemental Impact is a nonprofit investing in climate projects and created a "D-SAFE" modelled after Y Combinator's SAFE, specifically aimed at helping climate tech companies with impact missions overcoming their development risks.

As the climate crisis accelerates, **more grantmakers are broadening their definitions of eligibility**, experimenting with ways to support for-profit companies tackling public challenges. This signals a larger trend; the **lines between public good and private innovation are becoming increasingly porous**, and often intentionally so.

Early Planning for the Second Valley

While the primary goal early on is often to achieve proof-of-concept and organizational lift-off, **the most resilient startups also begin preparing for what comes next**. Strategic choices around legal structure, IP ownership, and product focus can significantly impact a venture's ability to navigate the second valley. Early collaboration with manufacturing partners, attention to cost modeling, and an awareness of policy landscapes can all shorten the path to scale later.

Smart startups also find creative ways to stretch their resources: leveraging open-source tools, partnering with universities, launching innovation challenges, or forming alliances with industry peers to tackle shared regulatory or infrastructure barriers. Startups can also track technological breakthroughs in adjacent industries that might be able to further lower their costs or speed up their timelines. For example, advances in computing can help startups run simulations before making expensive infrastructure investments. These tactics not only preserve capital but also build institutional memory and optionality.

Clean energy innovators often celebrate when they prove a new technology in a lab or build a successful prototype… but an even greater challenge looms next. Between a proven prototype and a market-ready, scalable product lies the notorious **"second valley of death."** This is the perilous gap in the deep tech lifecycle where many CleanTech startups falter or even fail. Unlike the first valley of death – the

early-stage gap between academic research and a working prototype – this second valley occurs **after** technical proof-of-concept, in the phase of demonstration and scale-up. (See "Across the "Second Valley of Death": Designing Successful Energy Demonstration Projects".) At this stage, the question is no longer *"Can we make it work once?"* but *"Can we build it at scale, reliably and economically, and find a market for it?"* Crossing this chasm is critical for climate innovation; technologies like solar panels, wind turbines, and electric vehicles all faced long, arduous journeys from lab to mass deployment, often spanning decades. (See "Climate Tech's Four Valleys of Death and Why We Must Build a Bridge".)

The Second Valley of Death: From Prototype to Commercial Product

Structural Challenges: Why the Second Valley Is Different

The second valley of death represents a fundamental shift in the innovation lifecycle. Early on, a startup's biggest hurdle is turning science into a prototype: often a singular focus on proving the technology works. By contrast, the **transition from prototype to commercial product** is a multifaceted challenge. It requires scaling up production, navigating real-world operating conditions, and integrating into existing industries and infrastructure. In deep tech (such as energy, materials, or biotech), this stage differs greatly from the first valley of death in scope and complexity.

As one analysis notes, a climate-tech entrepreneur must first translate research into a working product (first valley), *then* "cross the second 'valley of death' to find a way to scale their product and bring it to market," a journey **fundamentally different** from the quick growth of a software startup. Unlike a software app that can be distributed instantly at low cost, a clean energy solution might require **physical infrastructure, long development cycles, and compliance with strict standards** before it can be widely deployed. In short, the second valley is not just a bigger version of the first; it introduces new structural hurdles that include integrating into an established market, proving the economics at scale, and meeting safety or regulatory benchmarks. Many promising climate technologies stall here, never making it out of the pilot phase into commercial reality.

Deep tech startups often face extended timelines at this stage. An energy technology that works in one-off demonstrations may need **years of iteration and optimization** to become a product robust enough for everyday use. Incumbent technologies have the advantage of decades of manufacturing experience and economies of scale. By comparison, new CleanTech solutions frequently start at a cost disadvantage as high as 100x versus incumbent options, simply because they are not yet produced at scale. Overcoming that cost gap requires time and volume.

Moreover, CleanTech markets tend to be fragmented across geographies and sectors – unlike, say, a global software market – so achieving wide adoption means tackling **many markets and regulations**, not just one app store. These markets can span governments and countries with their own sets of laws and regulations. All of these factors make the second valley of death especially deep and wide. It is during this transition point that startups must evolve from a small team focused on invention into a **scalable enterprise** that can manufacture, deploy, and support their technology in the real world. It's a point where purely technical challenges give way to **scale-up challenges**, and where many founders discover that new skills, partners, and resources are needed to survive.

Misalignment Between Startups and Investors

One of the biggest barriers in the prototype-to-product phase is a **mismatch between what startups need and what investors are willing to fund.** CleanTech startups at this stage typically need significant capital, patience, and tolerance for risk, but traditional venture capital (VC) is often ill-suited to provide those. In conventional tech, investors expect a startup to find product-market fit and start generating revenue quickly, ideally yielding an exit (through acquisition or IPO) in just

a few years. CleanTech ventures typically don't fit that pattern. **Energy and climate hardware can require 10+ years and hundreds of millions of dollars to reach full commercial scale**, meaning returns (if they come at all) might play out over a decade or more. As former U.S. Energy Department official Dr. Steven Koonin observed, investors from the software world vastly **underestimated the time horizons** in energy: they sought returns on a **3–5 year schedule, when success in the energy sector can require waiting 20–30 years**. This fundamental misalignment in risk tolerance and capital horizon has historically made venture investors hesitant. Early-stage VCs looking at a climate startup see not just one valley of death to cross, but multiple successive challenges – and if they "have a hard time grasping how a startup can reasonably cross from one valley to the next and then the next, they fail to see a path to exit, and therefore hesitate to invest". The result is a financing gap exactly when the startup needs money the most.

Another misalignment lies in how investors gauge progress. A startup may have world-class technology (high *technical* readiness) but still lack evidence of *market* readiness: e.g. paying customers, reliable supply chains, proven unit economics. Many climate tech founders are engineers or scientists who naturally focus on perfecting the technology. Investors, however, might be more concerned with whether the startup can navigate business and market challenges. At the demonstration stage, a startup often needs to conduct pilot projects with industry partners, obtain certifications or regulatory approvals, and line up manufacturing; these activities that don't immediately show up as revenue growth.

Traditional investors may grow anxious during this period when **metrics look flat** even though important progress (de-risking manufacturing or securing a lead customer) is being made behind the scenes. This misalignment can lead to a breakdown in support; the startup feels it is proving the tech step by step, but investors see delays and rising risk. Indeed, after the early 2010's "Cleantech 1.0" bust when many VCs lost money on CleanTech ventures, investors became especially cautious. **Venture funding may pour into certain climate sectors** today (over $12 billion went into clean energy startups in 2022, a six-fold increase from 2019), but it tends to favor software or low-capital ventures. Capital-intensive hardware startups still struggle to find backers who truly understand and embrace the long road from prototype to market.

Infrastructure Barriers: Pilots, Permits, and People

Even with willing investors, CleanTech startups face **infrastructure and operational hurdles** when scaling up. Developing a successful prototype in a lab or small workshop is one thing; building *hundreds* or *thousands* of units or a full-size plant is entirely another. One key structural challenge is the lack of **pilot-scale facilities** and support infrastructure for demonstration. Startups often need access to specialized equipment, whether it's a chemical processing plant for a new fuel, a test grid for an energy storage system, or a manufacturing line for advanced materials. Such facilities are expensive to build and in short supply. Unlike software startups (which can iterate with just laptops and cloud services), climate hardware startups may have no choice but to invest tens of millions in a pilot plant or a small production line just to validate their design at scale. If they cannot find a government, corporate, or university facility to borrow, they must shoulder this cost themselves which can be prohibitive. In many cases, **private investors alone won't foot the bill for first-of-a-kind demonstration plants**, and yet without those demonstrations the technology cannot prove its commercial viability.

Regulatory and Permitting Burdens

Scaling a clean technology usually means entering heavily regulated domains: energy, transportation, construction, etc. Navigating the **maze of permits, safety standards, and regulatory approvals** can slow a startup's progress to a crawl. For example, connecting a new energy device to the electric grid may require regulatory certification and utility interconnection agreements; deploying a carbon capture project means securing environmental permits; selling an innovative fuel may involve meeting detailed government specifications. The **energy sector's high level of regulation is a known entry barrier for start-ups**, especially if their business model disrupts the status quo. Often,

existing regulations were written around incumbent technologies and practices, which means a new solution might not cleanly fit the rules. A small company can be overwhelmed by the time and expertise required to interpret and comply with these rules. In some cases, a technology that *works* might still be legally or logistically unable to deploy at scale due to outdated or mismatched regulations: effectively a bureaucratic valley of death. Startups at this stage need specialized legal and policy know-how, which many founding teams lack. Dealing with regulatory hurdles can also drain precious capital and time, further frightening investors who see the runway shrinking.

Specialized Talent Gaps

Another infrastructure challenge is human capital. Moving from prototype to production demands skills that many startup teams don't initially have. Early employees might be inventors and software developers; now the company needs **seasoned manufacturing engineers, supply chain managers, experts in quality control, and industry insiders** who understand how to scale operations. These people are hard to come by; they're often working at established companies or require high salaries that cash-strapped startups struggle to pay.

There is a stark difference between tinkering with one reactor in a lab and running a 24/7 manufacturing line with consistent output. Many deep-tech founders "fresh out of graduate school" lack the industry connections and practical experience to meet the rigorous specifications and standards of established industries. In short, *building* the first unit is a science problem; *building the thousandth unit* is an engineering and management problem. Without experienced talent to guide scale-up, startups can run into costly mistakes or delays. This is why we often see startups bring in a new CEO or COO, or a fractional C-level consultant, with manufacturing experience at this stage. It's a race to assemble the right team that can handle factory construction, vendor negotiations, and other scale-related tasks; failure to do so can sink the company even if the core technology is sound.

A better mousetrap design is no guarantee for success.

Financial Constraints and the Limits of Traditional VC

Perhaps the most defining barrier of the second valley of death is financial. **Scaling physical technology is expensive** and the funding models that carried a startup through prototyping often break down when faced with the capital needs of commercialization. Traditional venture capital – which might supply a few million dollars in seed and Series A funding – is not equipped to finance a $50 million pilot plant or a fleet of first-generation hardware units. By the time a climate tech startup needs serious scale-up capital (often in Series B or later rounds), many VCs pull back; the required check sizes are too large, the payback too distant, and the risks too high for their comfort.

The result is what many call the "**valley of death" in financing**. One industry analysis quantifies this mismatch starkly: **building a first-of-a-kind (FOAK) commercial facility** for a climate solution (say, a new hydrogen fuel plant or battery gigafactory) typically requires **$20–100 million and 12+ years** of development, whereas a typical VC fund might only invest on the order of **$1–10 million over a total span of 10 years**. In other words, the scale of funding needed is an order of magnitude beyond what most venture investors can commit within their fund timelines.

A few exceptional funds, such as Bill Gates's Breakthrough Energy Ventures (a $2 billion fund that operates on **20-year investment cycles**) or MIT's "tough tech" incubator The Engine (which accepts a **12–18 year horizon** for returns), have stepped up to fill this gap. But these are **minority players**. As a 2024 report noted, **most Series B and later dollars dry up just when startups need them most**: when it's time to finance **large-scale facilities to prove commercial viability**. Banks and traditional project financiers won't step in at that point either, because they require a de-risked, operating track record that most startups can't provide until they build the very facilities required, they seek to fund. This Catch-22 leaves many ventures stranded.

High Burn and Inadequate Funding Options

The financial strain of scaling can quickly become fatal. CleanTech history is littered with the corpses of companies that *had a great product but ran out of money* before they could scale it. A poignant example is **Aquion Energy**, a startup that developed an innovative saltwater battery. Aquion had working prototypes and even a small production line. It raised nearly $200 million from prominent investors (including Bill Gates) and was named one of MIT's smartest companies in 2016. Yet, despite this early promise, Aquion **fell into the second valley of death**. The company struggled to ramp up manufacturing and reduce costs while facing fierce competition from rapidly cheaper lithium-ion batteries. It needed more capital to scale its factory and refine its product – but that funding never materialized in time. By early 2017, Aquion had **burned through its cash and could not secure additional financing**, forcing it into bankruptcy.

Aquion's experience is a cautionary tale; even substantial venture funding can prove inadequate when the task is building factories and launching a new hardware product into the market. The traditional VC model expects to hand off a maturing company to either public markets or acquirers after a few funding rounds. This strategy just doesn't align with the *capital-intensive, long-duration needs* of CleanTech scale-ups. When a startup's survival hinges on a $50 million infusion to build a plant – and no VC is willing or able to write that check – the valley of death often claims another victim.

Catalytic Capital and Non-Dilutive Funding

To address this gap, new financing models are emerging. **Catalytic capital** refers to mission-driven, patient funding provided by entities such as foundations, government programs, or impact investors specifically to bridge these kinds of gaps. Such capital is willing to be **more patient, risk-tolerant, and flexible (even "concessionary")** compared to conventional VC. For example, catalytic investors might offer low-interest loans, loan guarantees, or equity investments that accept a longer timeline and lower return in order to help a promising clean technology reach commercialization. This isn't charity so much as **impact-driven investment**; the goal is to unlock environmental and social benefits (and eventually financial returns) by de-risking the technology for other investors.

Governments can also play a pivotal role through **non-dilutive funding**: grants, contracts, and other support that doesn't require giving up equity. In the U.S., programs such as ARPA-E's *SCALEUP* are explicitly designed to fund the scale-up of high-risk energy technologies beyond the lab prototype stage. The Department of Energy has provided **cost-shared demonstration grants and loan guarantees** to help companies build first-of-a-kind projects that private capital shuns .

One notable success story is **Tesla**. In 2010, as Tesla was preparing to scale up production of its electric vehicles, it received a $465 million low-interest loan from the DOE's Advanced Technology Vehicles Manufacturing program. This **public financing allowed Tesla to open its Fremont factory and build the Model S sedan**, at a time when private markets were unwilling to bet on an unproven electric car company. The loan famously paid off; Tesla repaid it early and went on to become one of the world's most valuable automakers. But it's important to note that **without that bridge funding, Tesla's story might have ended very differently**. Tesla's success was also built on other revenue streams, such as $2.7 billion earned by selling carbon credits.

Not every government-backed project succeeds (Solyndra, a solar startup that also received a federal loan, failed due to market shifts), yet the Tesla case shows what can happen when patient capital steps in to propel a startup through the valley of death. Today, founders and investors are exploring **blended finance** models, where public or philanthropic funds take the first risk so that private investors can follow. The idea is to use catalytic dollars to "de-risk" projects enough that traditional banks or investors feel comfortable coming on board.

Such models could unleash far more capital; one study suggests that strategic use of catalytic capital could mobilize several times more private investment for climate infrastructure . In summary,

bridging the financial gap requires moving beyond business-as-usual venture funding to assemble **larger, more patient funding streams**, through government support, novel investment funds, or partnerships that align capital to the needs of CleanTech scale-ups.

Barriers to Market Access: The First Customers Conundrum

Even if a CleanTech startup survives technical scale-up and secures funding to build a pilot plant or initial product run, it faces another daunting challenge: **finding willing customers and market entry points.** Major industries such as energy, transportation, and manufacturing are notoriously conservative about adopting new technologies… and for good reason. These sectors prioritize reliability, safety, and cost. A utility or factory will not rip out a proven incumbent solution in favor of an untested startup product without very strong assurances (or incentives).

Thus, CleanTech startups often struggle to secure their first commercial deployments. They may line up demonstrations or pilot projects but converting those into large repeat orders is hard. Entrepreneurs sometimes refer to this problem as "**death by pilot**"; the company spends time and money on one trial after another with big potential customers, but never gets a full rollout commitment. One founder quipped that "trying to get a pilot with a major oil company can bankrupt you" because large corporations can be so slow-moving and risk-averse that a startup exhausts its capital waiting for a contract that never comes.

This highlights a core market-access issue; **incumbent partners control the keys to scale (distribution channels, infrastructure, procurement budgets), but their timelines and risk tolerance often are misaligned with startups.** A power company or aviation firm might take years to evaluate a new technology, run it through internal tests, and obtain regulatory clearance before purchasing at any meaningful volume. For a startup that needs revenue now, this can be an excruciating – and potentially fatal – wait.

Anchor Customers and Procurement

Getting an *anchor customer* – a first big buyer or strategic partner – is often decisive in breaking through the second valley. An anchor customer not only provides vital revenue but also validates the technology for the rest of the market. However, attracting that first major customer requires overcoming the classic Catch-22; customers want proof the technology works at scale and is cost-effective, but the only way to get that proof is to deploy it at scale in the first place.

Many startups address this by aiming at **niche or early-adopter markets** initially, where the pain point is so acute that a customer is willing to tolerate the risks of a new solution. Others rely on **government or mission-driven procurement.** For instance, the U.S. military or city governments might agree to be early customers of a CleanTech innovation as part of their public mission, providing the startup an opportunity to demonstrate in a real-world setting. In renewable energy, *power purchase agreements (PPAs)* with utilities or corporations have often been crucial to give new technologies a guaranteed revenue stream for their first projects. Without such arrangements, even well-funded startups can languish because nobody wants to be the first to try the unproven product.

Incumbent Resistance

In many cases, startups need the cooperation of industry incumbents – whether as customers, suppliers, or distributors – to reach the market. Yet incumbents may **struggle with disruptive innovations** for multiple reasons. They often don't see the new technology's value, or they doubt it can make money; they don't know how it fits into their operations; and they may perceive it as a threat to their existing business model. For example, a utility invested in fossil fuel plants might be reluctant to purchase a novel grid-scale battery system that could displace gas peaker units that exist solely to handle peak demands. This resistance forces some startups to attempt an extremely costly route: **bypassing incumbents altogether by building a full-stack solution on their own**.

Tesla again provides us with a famous example. Instead of just making an electric powertrain and

selling it to incumbent automakers (who at the time weren't interested), Tesla built its own cars, its own retail network, and even its own charging infrastructure. This vertical integration approach eventually succeeded but required billions in capital and is not feasible for most startups. Most companies cannot afford to "go it alone" to create a new market from scratch; they need at least some incumbents to buy in or move aside. The absence of clear pathways for startups to engage with big industry players presents a significant barrier in the second valley of death. Startups can easily become stuck in **pilot purgatory** – endlessly proving their tech in small deployments without ever scaling up – if they can't crack the code of market entry.

The Struggle for Channels and Scale

Another facet of market access requires building out the *channels* and *infrastructure* to deliver the product to customers. For hardware, this might mean setting up distribution, maintenance, and support networks. A company selling a new type of industrial equipment, for instance, might need field service teams around the country, which can be hard to finance and organize when you only have a handful of initial deployments. Compare this with software startups that can distribute online and update products remotely; climate tech ventures often face boots-on-the-ground requirements that are costly and complex. The first few units of a climate technology are often essentially hand-crafted, and company supported. How does one make the leap to dozens, or hundreds of units deployed widely? Often it involves partnering with a larger firm for sales or maintenance, or outsourcing manufacturing/licensing. Those partnerships, again, can be tricky to secure until the startup has proven itself; a classic chicken-and-egg scenario.

In short, even after solving the technical problems, a CleanTech startup must overcome **commercialization problems**: convincing customers, aligning with, or disrupting incumbents, and building the machinery of business operations at scale. This is why the second valley of death is sometimes called the **"market adoption" valley** or the **commercialization valley**. It's not enough to have a great product; the company must also break into the market and grow, which requires as much savvy in strategy and business development as in science and engineering.

The Role of Policy and Ecosystem Support

If the second valley of death sounds daunting, it is… but it is not insurmountable. A growing movement of policymakers, investors, and industry leaders is focused on **building bridges across this valley**. These participants recognize that individual startups cannot overcome all these structural barriers on their own; they need a supportive ecosystem. **Public policy and collaborative programs** play a crucial role in easing the transition from demo to deployment:

Government Funding and Partnerships:

As discussed, government programs can inject capital where private investors won't. Beyond loans and grants, governments can sponsor **public-private demonstration projects** that share risk and expertise. For example, the U.S. Department of Energy in the late 2000s co-funded dozens of clean energy demo projects through the stimulus package, on the premise that such projects yield public benefits and will not happen without public support. Governments can also act as *first customers* through procurement programs (buying emerging tech for public facilities or defense) and implement policies such as production tax credits that create early markets.

Smart policy can directly tackle the second valley; one policy memo bluntly noted that federal dollars **often evaporate during the later stages of energy tech development – the very "second valley of death" that puts entrepreneurs at risk of failure**. In response, new initiatives such as the DOE's **Office of Clean Energy Demonstrations** (launched with billions in funding in 2022) aim to fund and shepherd first-of-a-kind projects in areas including advanced nuclear, carbon capture, and energy storage. These programs essentially build bridges by **providing the infrastructure and capital for pilot-to-commercial leaps**, underwritten by public funds in partnership with private firms.

Equally important to smart policy is the risk that high levels of policy uncertainty can create.

Regional Innovation Hubs

Innovation does not happen in a vacuum; **location-based ecosystems** can greatly aid CleanTech scale-ups. Regions that establish CleanTech hubs create clusters of innovation that include the ingredients startups need: labs and testing facilities, universities, investors, industry partners, and a talent pool of engineers and technicians. Examples include **Greentown Labs** in Massachusetts which is a CleanTech incubator with prototyping space; **Cyclotron Road (Activate)** at Lawrence Berkeley National Lab which hosts scientists working on energy hardware and provides them access to lab facilities; and new programs such as mHUB's Climate & Energy Pilot in the Midwest that won federal support to provide pilot-scale equipment and guidance to startups mhubchicago.com.

These hubs lower barriers by giving startups a place to build and test without having to invest in full facilities of their own. They also encourage networking; a startup in a hub has easier access to mentors, investors, and supply chain partners in the region. They also provide opportunities for collaboration and sharing of ideas among startups. Recognizing this, policymakers are investing in regional innovation centers. For example, the U.S. government's recent **Tech Hubs** program is directing funding to build up regional clusters in key technology areas, and several regions are positioning themselves as clean energy hubs. The presence of an ecosystem can significantly shrink the valley of death by connecting startups to the **right resources at the right time**.

Mission-Driven and "Patient" Capital

Another crucial piece is the rise of mission-focused investors who explicitly aim to bridge the scale-up funding gap. **"Patient capital"** funds such as Breakthrough Energy Ventures (BEV) or Prime Coalition's impact fund are willing to wait longer for returns and accept higher risk in exchange for climate impact. BEV, for example, offers capital on **20-year timelines** and is backed by philanthropic money that prioritizes decarbonization outcomes.

Such investors often coordinate closely with governments and industry. In the case of **Fervo Energy** – a geothermal energy startup – the company navigated the first valley of death by tapping an ecosystem of support It received a $50,000 grant from a university program to validate its concept, then joined the Cyclotron Road fellowship to access lab facilities and mentoring, and finally secured seed funding from Breakthrough Energy Ventures, whose **"patient capital" approach** fit the long development cycles of geothermal tech. BEV's involvement not only provided funding but also credibility and connections; BEV's team brought deep industry knowledge and introduced Fervo to partners) siliconvalley.um.dk.

This kind of **blended finance and mentorship model** – where philanthropic or government-linked investors lead then more traditional investors follow once risk is reduced – is increasingly seen as a way to get through the second valley. The Chicago Policy Review notes that while funds like BEV and The Engine are paving the way, they are still the minority, and scaling up such *catalytic capital* is necessary to cover most CleanTech projects. Encouragingly, more players are entering this space each year, from corporate venture arms with longer strategic outlooks to **family offices and foundations** willing to take "first loss" positions in climate investments.

Policy Pull: Standards and Market Creation

Governments can also **create markets** or demand for new technology through policy. This includes renewable portfolio standards, clean product procurement rules, or carbon pricing that makes dirty alternatives more expensive. Such demand-side policies are critical because they **signal to both startups and investors that a market will exist** for a better CleanTech mousetrap. For instance, alignment of regulations across states or countries can enlarge the addressable market for a startup's solution, making it more attractive to scale.

Experts argue that we need to "create bigger markets" through coordinated policies and procurement, so that cleantech startups don't have to tackle one fragmented region at a time. A classic

example is how feed-in tariffs and government contracts in the early 2000s created a market for solar and wind, which allowed many renewable energy companies to grow and drive down costs. Similar efforts today might involve government purchasing of green cement or steel, zero-emission vehicle mandates (guaranteeing a market for EVs and trucks), or subsidies for first-of-a-kind industrial decarbonization projects. By **de-risking demand**, policy can shorten the time a startup spends searching for those elusive first customers.

Ecosystem Coordination

Finally, a supportive ecosystem means all the pieces – investors, corporates, government, and startups – **communicate and collaborate**. Initiatives such as Third Derivative (a climate tech accelerator backed by RMI) explicitly integrate multi-stage venture funding with large corporates and market/regulatory insights to chart a path for startups across valleys of death. In other industries, such as biotech or medtech, these ecosystem connections are well-developed; big pharma and medtech companies routinely partner with or acquire startups, and specialized investors finance the risky early clinical trials knowing that if results are good, larger firms will step in.

In climate tech, we are starting to see the same kind of **ecosystem playbook**; oil and gas major corporations are investing in CleanTech ventures, utilities rung innovation programs, and public-private consortia are created for demonstration projects. CleanTech ecosystem actors realize that **no single entity can solve the commercialization puzzle alone**. Through regional innovation hubs, public-private partnerships, and mission-driven networks, the goal is to knit together a support system that can guide a startup from the lab bench all the way to the market.

Real-World Trials and Triumphs

The challenges of the second valley of death are not just theoretical; they manifest in real companies' stories. We've already touched on a few, but they bear summarizing to illustrate the stakes:

- **Pacific Fusion (Structured for Success):** Pacific Fusion's experience offers a bold example of using novel financing to cross the second valley. The company is developing a pulsed magnetic inertial fusion technology with the potential to unlock clean, limitless energy. In 2024, they raised a $900 million Series A round, structured so that capital is released only upon achieving specific technical milestones. This staged funding approach helped de-risk the investment while aligning expectations between the startup and its backers, which includes a mix of top climate and deep-tech investors. The deal also included penalty clauses for non-performing investors, providing accountability on both sides. Pacific Fusion's approach demonstrates how thoughtful deal structure can attract significant capital to extremely high-risk, long-duration technologies. (Sources: In Conversation: Will Regan, Pacific Fusion, Tammy Ma: Fusion Ignition and Beyond, Pacific Fusion website)

- **Aquion Energy (Struggled):** Aquion's fall highlights the structural and financial gauntlet of scaling a clean technology. Their novel battery worked, and it addressed a genuine need (safe, long-duration energy storage). But to compete, Aquion had to scale up manufacturing to cut costs… and do so just as mainstream lithium-ion batteries were rapidly getting cheaper. The company's overhead grew with a new factory and staff, but revenues were slow to ramp in the nascent storage market. When expected funding for expansion fell through, Aquion had no safety net and went bankrupt in 2017sunsethq.com.

  In autopsy, observers pointed to a high burn rate and the lack of a bridge to profitability. Aquion's technology was later acquired and lives on in some form, but the original company became a casualty of the second valley, underscoring how **even excellent technology can die without the right financial and market conditions**.

- **Tesla (Succeeded):** In contrast, Tesla's journey through the second valley shows the impact of strategic support and tenacity. Around 2008–2010, Tesla had proven it could build a slick electric sports car (the

Roadster) in small numbers. But skeptics abounded on whether Tesla could become a real car manufacturer with mass-market models. The company was burning cash and needed to build a factory for the Model S sedan. The U.S. government's $465 million loan in 2010 came at a critical juncture, effectively **bridging the financing gap to commercialization** reuters.com. With that backing, Tesla built its assembly plant and launched the Model S in 2012 to great acclaim.

Even then, it was not smooth sailing; Tesla faced "production hell" in later years when scaling production for the Model 3. But by then, having proven market demand and with some revenue flowing, it managed to raise capital from the markets. Tesla repaid the DOE loan early reuters.com and went on to dominate the EV market, in turn catalyzing the whole auto industry to invest in electric vehicles. It's a prime example of how **crossing the valley** can unlock tremendous societal benefits; a fledgling startup became an anchor of the global EV transition. Importantly, Tesla's success was not just due to the loan; it also had visionary leadership and benefited from early customers: enthusiasts and California policymakers who created a market via zero-emission vehicle mandates. But the **public-private partnership model** in Tesla's case is often cited to justify similar support for other CleanTech startups.

- **Fervo Energy (On the Path):** Fervo Energy, a geothermal startup founded in 2017, offers a blueprint for navigating the second valley by leveraging the ecosystem. Fervo's founders recognized that geothermal energy (drilling for heat) is capital-intensive and technically challenging (i.e., classic deep tech). They smartly tapped into **multiple support programs.** A university grant gave them seed funding and credibility siliconvalley.um.dk; a specialized incubator (Cyclotron Road) provided two years of salary, lab space, and an environment to develop their prototype; and a climate-focused VC (Breakthrough Energy Ventures) supplied early capital with the understanding that Fervo's timeline would be longer than a typical app startup siliconvalley.um.dk.

  With this support, Fervo was able to drill test wells and prove its enhanced geothermal technology on a pilot scale. It also forged partnerships with incumbents in the energy sector, benefiting from their expertise while keeping the startup agile. Fervo is now scaling up to its first commercial projects, and while it's still in progress, the company has avoided the common pitfalls so far. The Fervo story underscores how **an ecosystem approach – combining grants, fellowships, patient venture funding, and mentorship – can de-risk the path to market** for a tough clean technology.

- **Others:** Many other CleanTech companies' trajectories could be included here. Some biofuel startups in the 2000s, such as *KiOR*, failed in their scale-up phase due to technical and financial issues. (KiOR built a refinery to turn biomass into fuel but never achieved target yields and went bankrupt.) On the other hand, companies such as **First Solar** succeeded by mastering manufacturing scale-up of thin-film solar panels and securing early utility customers (aided by state renewable mandates and subsidies in the 2000s). **Opus 12 (now Twelve)**, a CO_2-to-fuels startup, leveraged government grants and corporate partnerships to build its first commercial-scale reactor units and recently started deploying systems with industrial partners. Each case is unique, but the pattern is clear: bridging the second valley of death requires a combination of *sufficient capital, strategic partnerships, market foresight,* and often a bit of luck with timing in the policy and market environment.

Conclusion: Building the Bridge to a CleanTech Future

CleanTech projects generally don't fail because of a lack of innovation. They fail in the in-between. Whether it is the leap from lab to startup or the climb from prototype to product, the valleys of death expose the limitations of how we support climate solutions today. These are not just funding gaps. The gaps are in infrastructure, in alignment, in patience, and in policy. We need investors to rethink models and embrace patience, governments to act as both funders and first customers, and incumbents to partner with startups rather than resist them. We also need the public to understand that CleanTech breakthroughs don't automatically leap from lab to market; they need support in the messy middle stages.

The good news is that a blueprint is emerging, and these barriers are beginning to be addressed through concerted effort. As we have seen, a new support architecture is emerging. From early-stage fellowships and university spinout programs to milestone-based financing and catalytic capital, we are building the bridges that CleanTech needs. Innovation hubs, first-customer procurement, and policy signals are helping more startups move from theory to impact.

Global climate innovation ecosystems are being built, and new bridges – from catalytic capital funds to regional testbeds – are under construction. Just as past generations built the infrastructure (physical and financial) that carried inventions including microchips and vaccines to the masses, our generation is learning to build the infrastructure for CleanTech commercialization. The stakes could not be higher; if we fail to help CleanTech startups through this valley, we risk stalling the deployment of solutions we desperately need to combat climate change and create a more sustainable energy future. If we succeed, we unlock not only environmental benefits but also economic growth in the industries of the future.

Still, the journey will never be easy. By its nature, it will always demand grit and ingenuity from entrepreneurs. With the right structural supports, that journey can be made survivable. It is in the first valley of death that brilliant concepts are tested not just for feasibility, but for resilience; *"Can they survive the transition to the real world?"*

CleanTech's second valley of death is deep, but it **need not be a graveyard** for innovation. With structural changes in how we finance and foster deep technologies, we can turn this valley of death into a valley of opportunity where breakthroughs successfully mature into industries, and the promise of clean technology becomes reality on a global scale. As one energy investor put it, not every investment will succeed – "cutting-edge clean energy technologies" carry risk – **but with smart support, we can tilt the odds so that the big ideas that the world truly needs have a fighting chance to reach the finish line reuters.com**. The climate challenge demands no less.

Suggested Reading

Supporting facts and examples in this report are drawn from a range of analyses and case studies, including reports by ITIF and Third Way on energy demonstration projects itif.org thirdway.org, insights from climate innovation experts at Third Derivative and Prime Coalition third-derivative.org primecoalition.org, data on venture capital and financing gaps from industry research chicagopolicyreview.org, and real-world company stories reported in both news outlets and retrospective case studies sunsethq.com reuters.com. These illustrate the pervasive challenges of the second valley of death and the emerging strategies to overcome it.

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For more information about the Coalition for Innovation, including how you can get involved, please visit coalitionforinnovation.com.

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