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1.5°C WAYFINDER

Systems Change for a Sustainable Future

Rethinking corporate climate action in an era of rapid disruption

A JOINT REPORT BY DELOITTE AND RMI

Contents

Introduction

Climate change and the global response to it are fundamentally altering the business landscape everywhere. Already, policies and market forces are driving innovations that are cascading across industrial systems and supply chains, opening new avenues for value creation. The pace of change is almost certain to accelerate even further as governments, companies, employees, communities, and investors rise to meet the urgency of the climate crisis, aiming to hold global warming to around 1.5°C to avoid triggering critical planetary tipping points.[1] All of this points to a collective effort to transform the economy at unprecedented speed and scale. The climate-aligned economy is the economy of the future—and its design is vastly different from today's.

The rapidly transforming energy system is becoming a prominent driver of the new business landscape. In the last decade, photovoltaic solar costs have declined 89%, wind costs have declined 60%, and battery costs have declined 83%.[2] These reductions, particularly in photovoltaics, occurred faster than leading analysts and modelers predicted, challenging the notion that transitions are necessarily slow and gradual.[3] Transitions in key systems have also cross-pollinated quickly: Cheaper renewables and storage have not only catalyzed the rapid expansion of clean electricity capacity but have begun to change the mobility and building ecosystems, accelerating and amplifying the emissions impacts of electrification.

> "Business as usual is over. We all have to change."
>
> **Andrew Forrest**, founder of Fortescue Metals Group

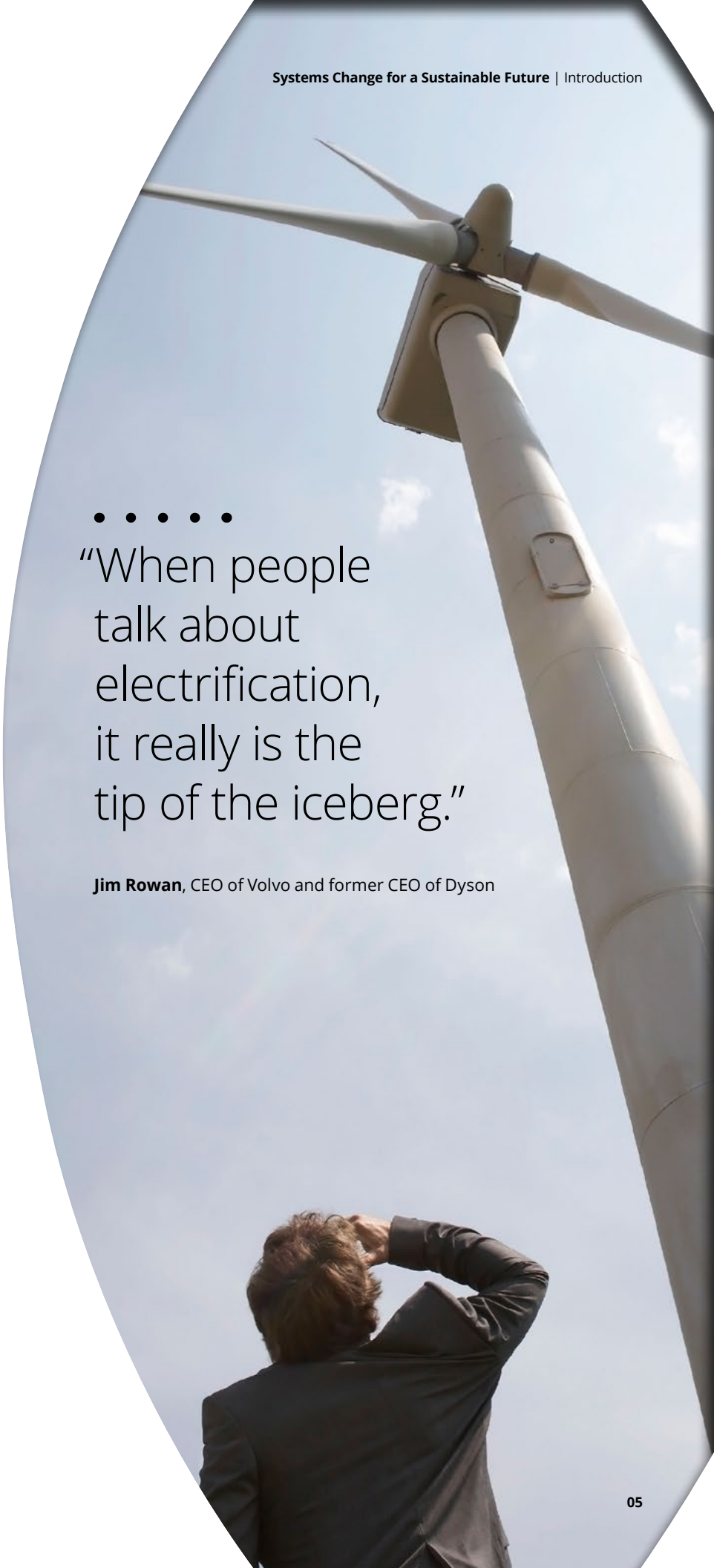
This transition offers tremendous business opportunity—and risk. Deloitte analysis suggests that rapid global decarbonization could yield an economic dividend of US$43 trillion by 2070 compared to a world of unchecked climate change.[4] In addition to reducing climate damages, a swift transition to clean energy could save trillions of dollars in avoided energy costs—capital that companies and governments might use to power new business investment and faster economic development.[5] Policy and regulatory changes around the world are likely to shift the near-term calculus about the economic viability of lower-emission products, services, and business models. In the United States, the 2021 Infrastructure Investment and Jobs Act, the CHIPS and Science Act, and the Inflation Reduction Act will add at least US$3.5 trillion in new cumulative capital investments over the next decade.[6] Globally, climate finance jumped to US$850 billion in 2021 and increased further in 2022 with new US and European commitments.[7] The momentum behind rapid deployment of climate change-mitigating technologies only looks to be growing.

FIGURE 1.
Costs and opportunities of climate action in the global economy

Source 1: Deloitte, Turning Point; Source 2: 2070 report

Which companies are likely to be best positioned to create and capture this new value? Those that challenge the existing systems underlying their industries. Leading businesses operate with a vision of the future that spans their value chains and that is based on tomorrow's transformed economy. These early movers, which could become market leaders, are not necessarily the companies designing new technologies—they are as likely to be those that leverage opportunities to implement new technologies and processes in rapidly changing market environments. These dynamics may be familiar: In the early days of the Information Revolution, as companies competed to build 16-bit personal computers, IBM chose to invest in PC clones and component compatibility, helping the company swiftly take advantage of developments in PC technology and come to dominate the market over rivals such as Commodore and Atari.[11] Today's climate-aligned transformation echoes Information Revolution dynamics, only at a much faster pace.

This report provides the language and logic of system transformation to help leaders develop new corporate *emergence strategies* that adapt to far-reaching system transformations and capture their opportunities. This approach challenges and expands upon conventional corporate strategy that often focuses on competitive advantage, incremental efficiency, and cost-reduction. Emergence strategy is based on a systems understanding, is focused on transformational change, creates new and bold collaborations, and is grounded in creativity and a beginners' mindset.



"When people talk about electrification, it really is the tip of the iceberg."

Jim Rowan, CEO of Volvo and former CEO of Dyson

Why business leaders should explore a different approach to climate action

Climate change has become a fixture of the business agenda. Despite a global pandemic, rising inflation, economic uncertainty, and an energy crisis prompted by Russia's invasion of Ukraine, corporate leaders show few signs of retrenching. When asked to rank the issues most pressing to their organizations, 42% of CxOs surveyed in late 2022 rated climate change as a "top three issue", with only economic outlook ranking higher.[12] Perhaps more telling: 75% say their organizations have increased their sustainability investments over the last year, and nearly 20% say they've increased investments "significantly."[13]

Despite this groundswell of ambition, the evidence indicates that we are collectively falling short. 2022 global GHG emissions are likely to be at or near record highs.[14] Existing private sector climate *commitments* (not *actions*) in the G7 countries would lead to roughly 2.7°C of warming as of September 2022, according to CDP.[15] The New Climate Institute found that, among the sample of 25 large companies they studied, most envisioned only modest cuts in total emissions and near-term (2030) targets fell well short of alignment with Paris Agreement goals.[16] Investor consortium Climate Action 100+ reported that, among nearly 160 benchmarked companies, only 10% had set short-term targets (to 2025) aligned with a 1.5°C scenario and encompassing the full suite of emissions.[17]

Part of the problem likely lies in many organizations' tendency to treat corporate climate action strategies as incremental bolt-ons, disconnected from what is needed to check rising temperatures and lagging the pace at which key energy systems and technologies are changing. A typical sustainability roadmap looks almost exclusively inward, taking stock of the existing emissions footprint, setting mitigation targets, and then developing a plan to achieve them. Even the leading commitments often stop at pledges to influence direct suppliers or reduce Scope 3 emissions (indirect emissions across the value chain).[18]

Overly cautious approaches to climate action can be rooted in ambiguous long-term goals and a tendency to plan through the lens of compliance or stakeholder management. CxOs surveyed by Deloitte in 2022 most often cited improved brand recognition and customer satisfaction as benefits from corporate climate action.[19] Far fewer expected direct financial benefits from decarbonization, and less than half were developing climate-aligned products or working across their supply chains to decarbonize.

For those with legacy business models built on carbon-intensive processes, inertia can be a powerful force to overcome. Shifting away from proven and still-profitable activities into new and uncertain areas can be daunting or even seemingly prohibitive. Understandably, incumbents across a range of industries have sought to manage the transition to a low-carbon future by taking small steps, creating optionality, and extending the timeline over which the shift will play out.

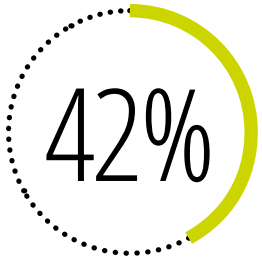
Many corporate leaders continue to underestimate the speed and scale with which the shift to a low-emissions economy is likely to unfold—and they are failing to recognize the substantial business opportunity associated with the transition. A decade ago, a go-slow strategy might have been justifiable from a business perspective; today, that approach is fraught with risk, as the economy-wide transformation to reduce emissions accelerates.[20] The economics of one critical segment—electricity generation—have already tipped critically in favor of renewable sources in many markets, to the detriment of incumbent coal and, to a lesser extent, natural gas generation.[21] Other areas are likely not far behind: Electric powertrains will soon surpass their internal combustion counterparts on nearly every relevant performance dimension, for example.[22] We are seeing the beginnings of a sea change in financial markets. As capital allocations accelerate from both the public and private sectors, a host of nascent solutions could move rapidly down the cost curve, creating opportunities for value creation.

As the shift to a climate-aligned economy unfolds at pace, there is a window for companies to both accelerate the transition and position themselves for long-term advantage. Responding with incremental or compartmentalized initiatives could lead to missed business opportunities, investment in stranded assets, or even the failure of the enterprise.

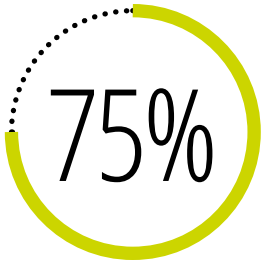
The language and logic of systems transformation is part of an invaluable toolkit for companies navigating the energy transition and adapting to the new economy. It is critical for business leaders to identify when systems change is happening and understand how to respond, especially when forces such as climate change are disrupting the economy on many levels simultaneously.

Embracing systems thinking can bring numerous advantages, allowing corporate leaders to understand how transitions unfold, holistically and dynamically and across traditional industry boundaries. This opening of the aperture can expand the range of available strategic actions and business opportunities. For example, several automakers are entering the power and energy space in different ways—moves only made possible by thinking outside of the traditional automotive industry and envisioning a more complex, interconnected system of electric vehicles (and their batteries), charging infrastructure, grid connectivity, renewable energy, and consumer demand.[23] The business case for those actions may become clearer, as well, as new revenue models and funding sources (such as public investment and tax credits) become available.

Ultimately, acting through the lens of systems transformation can position companies for long-term value creation. Actions informed by systems thinking often tend to lie at the interstices of existing industries or aim to develop markets that will grow in importance as the low-carbon transition unfolds. Early movers can shape these transformations and position themselves to create significant new financial and societal value.[24]



of CxOs surveyed in late 2022 rated climate change as a "top three issue," with only economic outlook ranking higher



say their organizations have increased their sustainability investments over the last year

What is systems transformation?

To capitalize on the opportunity—and to catalyze the urgent systems-level changes we need—requires corporate leaders to adopt a different approach to tackling the climate crisis.

We must collectively break free from linear, business-as-usual mindsets, where tomorrow looks nearly identical to yesterday. To do so, leaders should ground themselves in the "what" and "why" of systems transformation.

Systems are sets of interconnected elements that are organized such that the elements work together to achieve an objective.[25] Actors in a system can be connected via both social infrastructure (e.g., networks, information flows) and physical infrastructure (e.g., highways, bridges), drawing on a variety of resources—natural, human, and financial—and interacting to produce outcomes. Whether a value chain, a forest, or a human body, each system interacts with others, and the sociotechnical and socioeconomic systems responsible for the bulk of planet-warming emissions—energy, transportation, industrials, food, and land use—are part of a larger *system of systems*.[26] For companies, example elements could include their client base, suppliers, and assets.

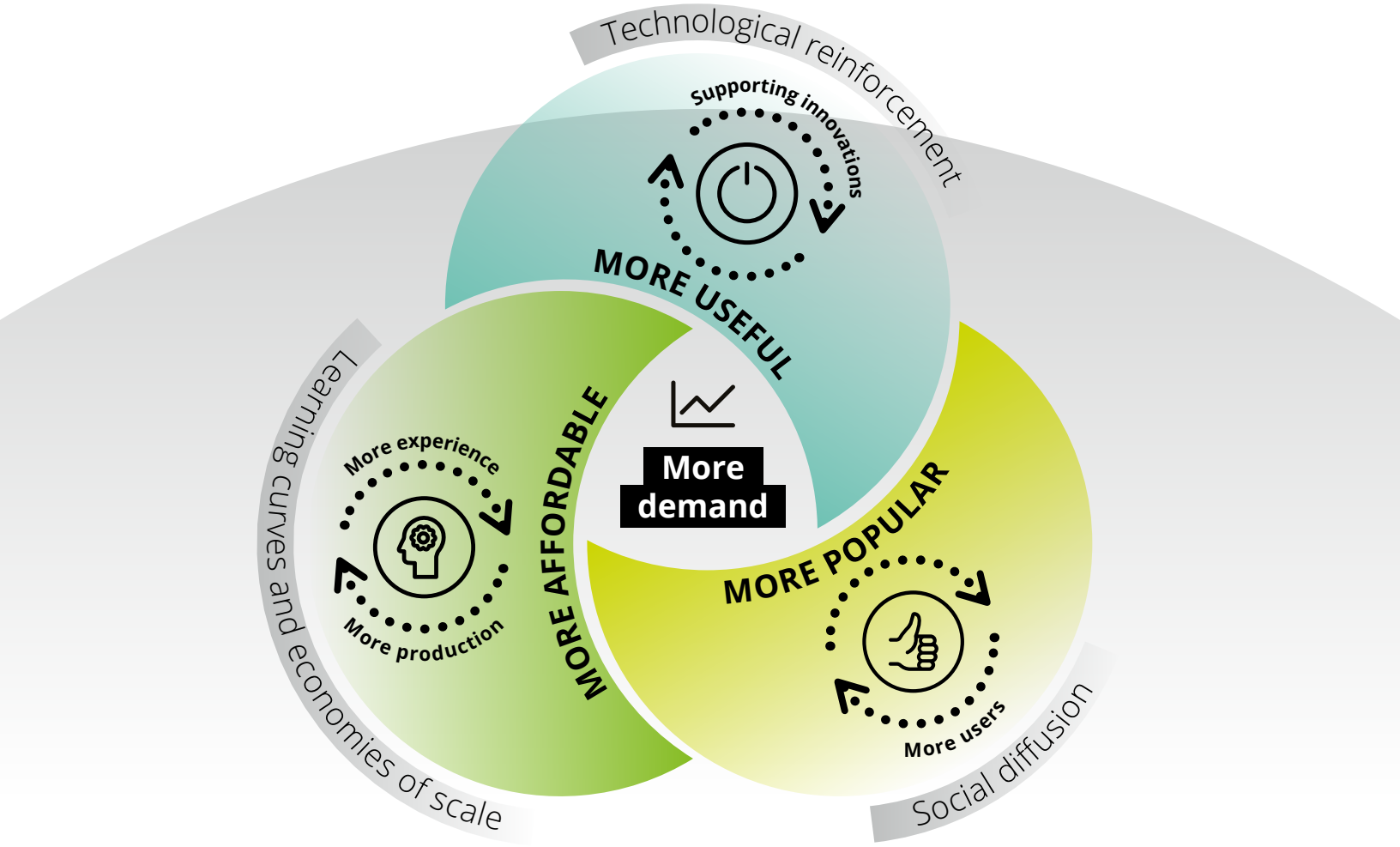
In this context, an **innovation** is a change to the system and can be technology-based (e.g., electric vehicles), idea-based (e.g., smoking bans), or a combination of both (e.g., social media). To scale, innovations often need to break some existing tradeoff between price and one or more dimensions of performance—for instance, speed, durability, or emissions.[27]

A **reinforcing feedback loop** is the process through which the impact of a small change can be amplified, making change elsewhere more likely. For example, a change in one part of the system might reinforce the performance and adoption of innovations.[28] If feedback loops fail, innovations can stall before reaching their potential to change systems. Because the private sector often plays a key role in creating and boosting these feedback loops, a central component of systems-aligned emergence strategy is recognizing which of these reinforcing feedback processes are in play and understanding how companies can work to accelerate them:

- **Learning curves:** Learning curves describe "technological progress as a function of accumulating experience."[29] In other words, the more experience producers accumulate with a technology, the more productivity improves, and the cheaper—and often, faster and better—the technology becomes. Falling costs tend to incentivize more production, often driving further learning. *Learning rates* describe the reduction in cost for each doubling of cumulative production.[30] In the United States, for example, the learning rate for utility-scale solar has been approximately 23 percent, meaning that for every doubling of solar capacity additions, costs have fallen by nearly a quarter.[31]

- **Economies of scale:** Higher output allows fixed costs to be spread more broadly and can unlock other operational efficiencies, bringing down per-unit costs and in turn spurring demand and greater scale. For example, offshore wind farms allow for bigger turbines, reducing the cost per megawatt-hour by spreading balance-of-system and maintenance costs.[32]
- **Technological reinforcement:** Often, the more an innovation is deployed, the more supporting innovations emerge that make it even more useful. For example, rising smartphone adoption incentivized app developers to create more and more useful products—the availability of which makes owning a smartphone more attractive. Similarly, more electric vehicles on the road would necessitate more charging infrastructure, which may make EV ownership more appealing.
- **Social diffusion:** Because our choices are profoundly shaped by their context—by what our friends, family, colleagues, and communities do—an individual action's impact can extend to influence others' behaviors. We are often more likely to adopt a new behavior or technology if we see peers and neighbors doing the same. In the aggregate, such social contagion effects can have dramatic impacts on attitudes and behaviors, as seen on issues such as smoking and marriage equality.[33]

FIGURE 2.
Reinforcing feedback loops drive the adoption of innovations[34]

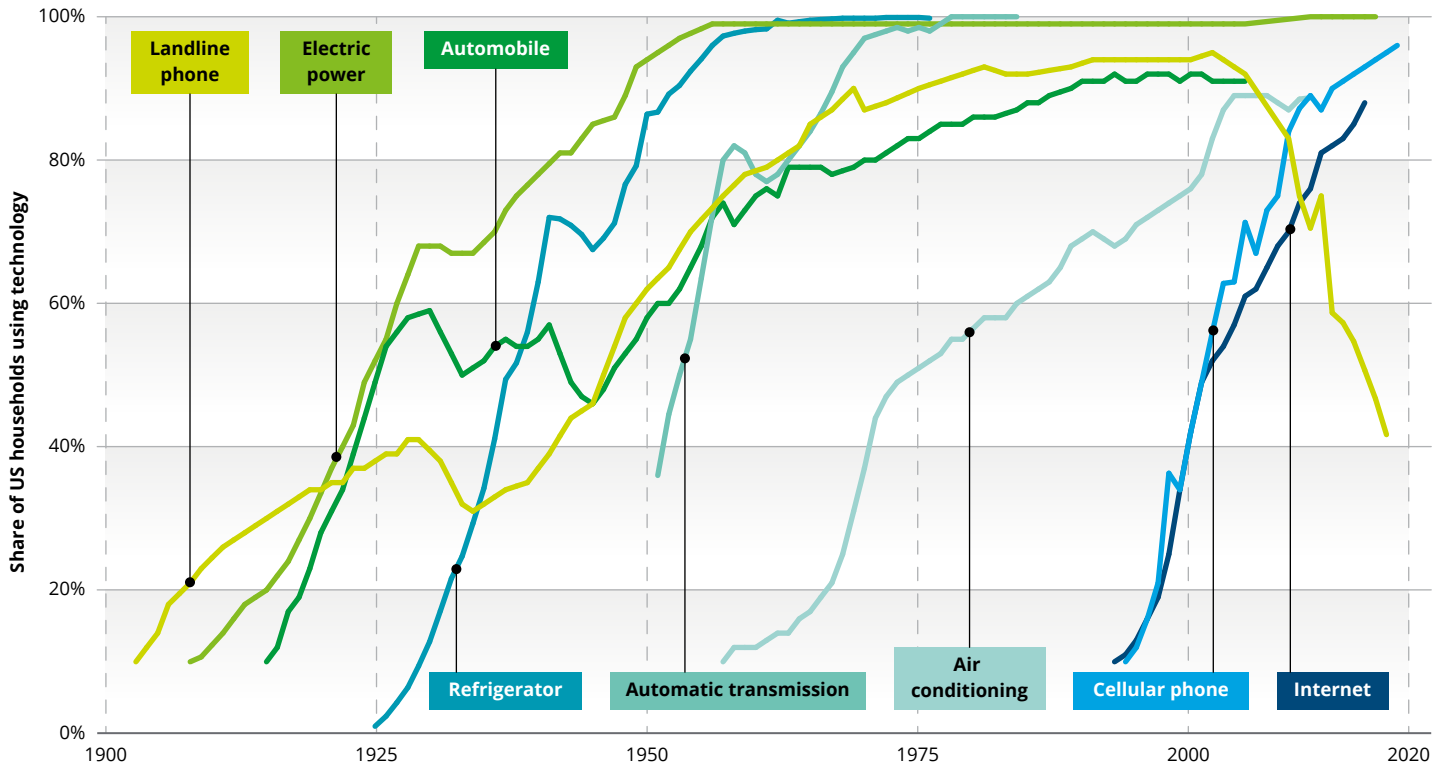


Source: RMI, "Harnessing the power of S-Curves," October 2022

If feedback loops take hold, they can create a "runaway" effect. The points where this happens are **tipping points**. Both the climate system and the new economy are approaching multiple tipping points. **Vicious feedback loops** (reinforcing feedback loops with negative outcomes) threaten to further warm the planet and endanger the natural and built environments. These include permafrost thaw in the Arctic, ice sheet collapse in the West Antarctic, and biodiversity loss.[35] We may also be nearing positive tipping points in the global economy, with **virtuous feedback loops** (reinforcing feedback loops with positive outcomes) forming to rapidly shift systems toward net-zero emissions. For example, in the United States, the recent passage of the Infrastructure Investment and Jobs Act, the CHIPS and Science Act, and the Inflation Reduction Act (IRA) has injected over US$500 billion in investments, which collectively have the potential to put the US economy on track to net zero.[36] Together, they can enable companies and government agencies to build supportive infrastructure and stimulate rapid deployment that could then lead to further cost reductions via economies of scale and technology learning. This may be particularly apparent for domestic battery supply chains, which are set to receive both a supply-side push in the form of the Advanced Manufacturing Production Credit (IRC Section 45X) and a demand-side pull in the form of electric vehicle tax credits (IRC Section 30D)[37]. These incentives, in combination with additional supply chain targeted infrastructure investments, will likely increase demand for energy storage, which can increase demand for clean electricity, which can increase renewables deployment and further reduce costs for all technologies – a virtuous feedback loop.

Innovations that reach scale typically follow an S-curve pattern of adoption: slow at first, then rapidly rising, before flattening out again as they reach market saturation. The shape of the S-curve is influenced by feedback loops and market tipping points. S-curve dynamics may be simultaneously a warning to slow movers and an opportunity for leaders. Business analysts and strategists often underestimate the rate of change in the S-curve's "steep" part, leading to higher capital costs and overestimation of future sales and prices for legacy products, as well as a higher risk of stranded assets in a shrinking market. Early movers willing to take initial risks may be rewarded with rapidly growing market opportunities. While many leaders are likely familiar with S-curve processes as they relate to the adoption of specific technological innovations, the transition toward a climate-aligned global economy entails *systems-level* changes. S-curve processes are occurring simultaneously across many interlinked innovations within and across systems.

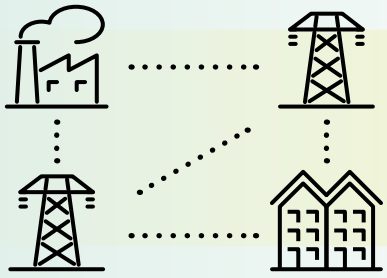
FIGURE 3.
Adoption of key historical technologies in US market[38]



Source: Hannah Ritchie and Max Roser, "Technology adoption", Our World in Data 2017

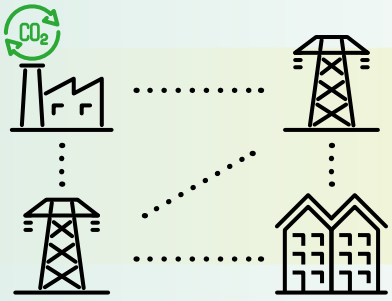
Finally, **system transformation** is a fundamental reconfiguration of the social and physical infrastructure—just think of the Industrial Revolution, the agricultural Green Revolution, and the Information Revolution, each with a cluster of new and interdependent innovations changing economic and societal dynamics.[39] In the 19th century, the water wheel and wage labor helped allow for advancements in machinery, factory production, and canal transport, paving the path for the Industrial Revolution. A century later, microprocessors and "knowledge as capital" gave rise to advancements in computer hardware, the internet, and social media. The transition to a sustainable, low-emission future will likely necessitate even more innovation on the way to a global system transformation playing out at a far faster pace than previous revolutions.

FIGURE 4.
Innovations can, but do not necessarily, lead to system reconfiguration and transformation[40]



A **system** is a set of interconnected elements that collectively fulfill a specific function or purpose...

For example, the electricity grid in the US.

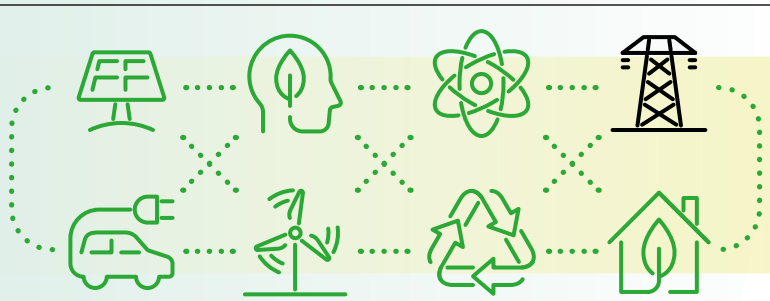


...an **innovation** may transform system components, but not the system itself...

For example, carbon capture and sequestration impacts fossil fuel based generating units but not the grid itself.

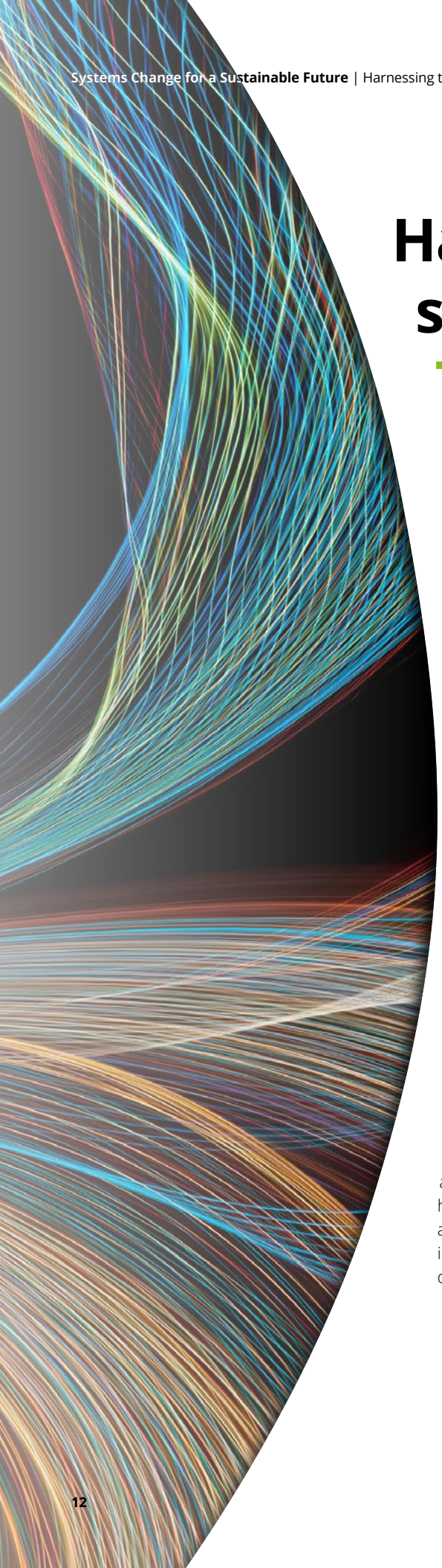
...**system transformation** is a fundamental reconfiguration.

For example, a redesign of the grid to allow for rapid increases in variable renewable electricity (VRE).



The current transition toward a climate-aligned economy requires and entails a **cross-systems transformation** with changes occurring at an unprecedented speed and scale.

Source: RMI and Deloitte analysis



Harnessing the power of system transformation: The five phases

The transition to a climate-aligned economy won't just *happen*. Facing severe climate disruption with worse to come, global actors are deliberately and proactively—albeit disparately—working to reconfigure the energy, transportation, industrial, and food systems. For instance, whereas energy transitions have historically taken place over decades, the International Energy Agency's net-zero emissions scenario relies on emerging clean energy technologies maturing over only a decade.[41] Companies have the power to drive virtuous, reinforcing feedback loops to help make this happen. Often this requires collaboration across the value chain. For example, in the early days of an innovation's commercialization, high costs and limited availability may understandably deter customers. Shortsighted producers often interpret this as a lack of market demand and fail to make the investments necessary to bring down costs—a balancing feedback loop that may stall the innovation. To solve this problem, a group of first movers can form a buyers' coalition to aggregate demand, helping send a market signal to producers and giving them confidence to invest in the innovation, increase production, and bring down costs.

All transitions can be harnessed, as they follow the same pattern of shifting dynamics in five phases. Barriers and system dynamics to accelerate the transition to a climate-aligned economy are often predictable, manageable, and solvable through each of these phases. As transitions unfold, then, stakeholders with a solid understanding of innovations and their related phases can develop targeted strategies to stay ahead and take advantage of rapidly changing conditions.

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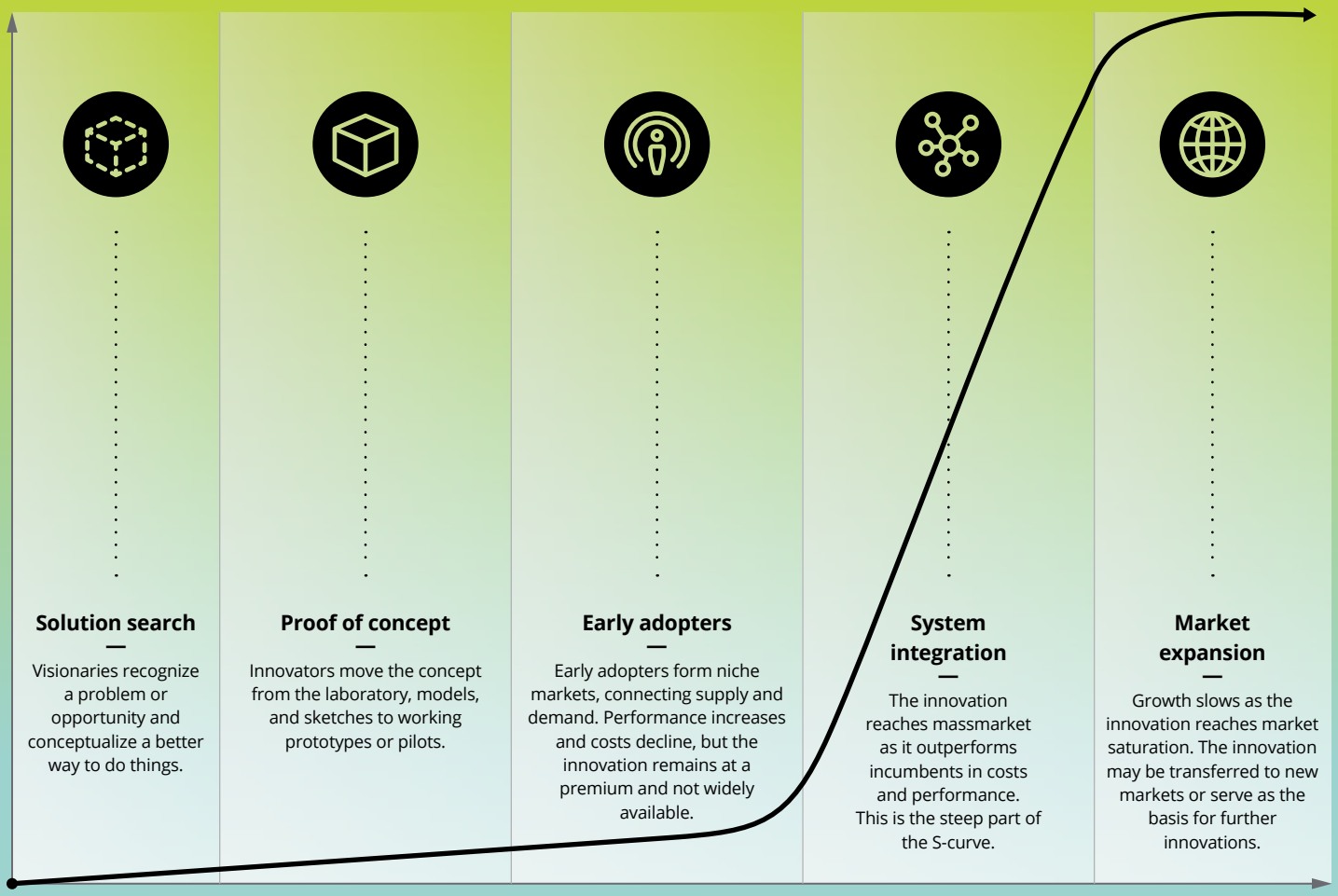
FIGURE 5.
The five phases of S-curve growth[42]



Source: RMI, "Harnessing the power of S-curves," October 28, 2022

Phase 1: Solution search

Early-stage research drives development of new innovations

This phase is often initiated by an event, disaster, or scientific discovery that generates attention or other momentum. In the sustainability transition, the first step has been a broad acceptance of responsibility for the causes of the climate crisis, and a commitment to finding and making the changes necessary for a sustainable 1.5°C future.

In any transition, the first phase involves experimentation and learning to define problems, market opportunities, and available solutions. The research community often plays an important role in clarifying the scope of the problem and development of initial solutions; alternatively, an innovation—technological or otherwise—drives exploration for potential markets and applications. Research results in startup formation and involvement of companies that are reorienting themselves, but it can sometimes be too early to test and pilot solutions on a significant scale. Governments, philanthropies, and early investors often subsidize research. Research institutions typically execute and help shape research agendas, while nongovernmental organizations (NGOs) help mobilize public pressure and urgency for further resource allocation.

Challenges to progress often come from a general lack of motivation or limited understanding of the problem. Almost by definition, solutions are not readily available, which necessitates exploration and a willingness to try and fail. To address these challenges, companies can set ambitious voluntary targets and commitments to signal support for research. They can also consider investing in early-stage R&D activities through funding and partnerships with researchers and startups, while also voicing support for public investment. In the United States, much of the solution search occurs with government backing in universities and national labs.[43]

EV case study: Phase 1

ENERGY SECURITY CONCERNS DRIVES A REVAMPED SOLUTION SEARCH IN MOBILITY ELECTRIFICATION

The first electric vehicle was developed back in the 19th century and began on an S-curve that ultimately failed. Its manufacturing costs could not compete with its new gas-powered counterpart, and the discovery of Texas crude meant an abundant source of cheap gasoline. The current EV S-curve begins in earnest at Phase 1 in the United States with the 1970s energy crisis, when price spikes and gasoline shortages renewed interest in EVs, pushed by federal policies such as the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976. [44] In 1979, the first commercially viable rechargeable lithium cell was made available, boosting battery-powered mobility.[45]

Phase 2: Proof of concept

Innovations are piloted, often through public-private partnerships

This phase is characterized by new market dynamics, in which increasing amounts of capital are directed to the development of pilots, prototypes, and demonstrations. These may be developed by spinoffs from early research, entrepreneurs, or larger corporates that are looking to reinvent themselves, often financed by subsidies, philanthropic capital, and early private investors. Idea-based innovations are more likely than technological breakthroughs to involve civil society, public sector, and private-sector projects. Research and development could continue to further define the scope of the solutions' potential, and civil society will likely continue to stress urgency. Incumbents may face reputational risk for not investing in projects.

Promising innovations can become stuck in the "valley of death," a gap in available resources and apparent market demand for innovations to make the jump from R&D to commercial product development. Companies can engage research organizations to tap early-stage innovations, providing funding and support systems via incubator programs and public-private partnerships.

EV case study: Phase 2

POLICY INCENTIVIZES EV PILOTS, BUT A LACK OF INVESTMENT STYMIES COMMERCIALIZATION

Initial battery and vehicle research activity laid the groundwork for the development of early EVs in the 1990s, such as the GM EV1, marking Phase 2 of the EV S-curve.[46] The 1990 Clean Air Act Amendment and the 1992 Energy Policy Act, as well as emissions regulations passed by the California Air Resources Board, pushed the development of numerous pilot and demonstration EV models. However, high costs, low performance, and limited range prevented broader adoption, and major automakers were unable or unwilling to commit the resources to overcoming those challenges.

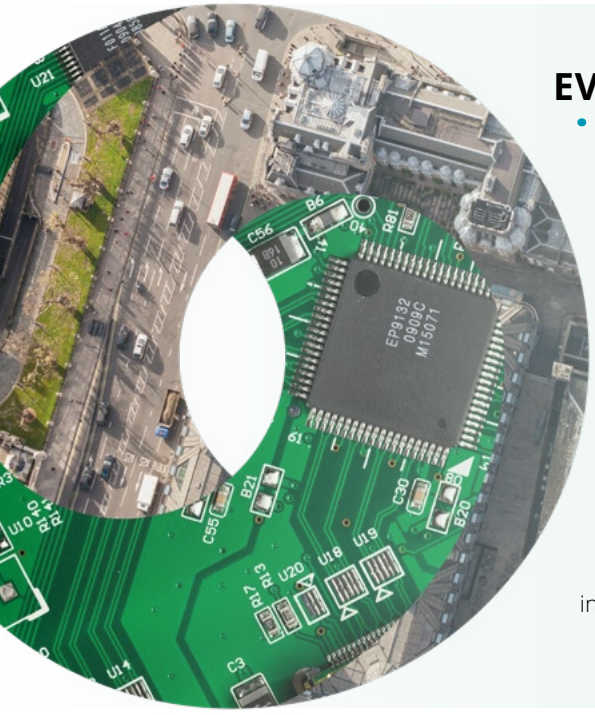
Phase 3: Early adopters

Innovations are scaled by frontrunners and established in niche markets

This phase is characterized by the formation of niche markets, connecting supply with demand. Initial demand, often including a set of customers willing to pay a premium, encourages frontrunner companies to invest in these innovations and attempt to capture early-mover advantages in niche markets. Reinforcing feedback loops scale the solution, lower costs, and improve performance as customer demand builds.

Even the most promising solutions can languish in Phase 3. Producers may be unwilling to ramp up capacity because they lack confidence there will be customers willing to purchase it, and would-be customers perceive insufficient supply to meet their needs. At this phase, innovations typically come with a price premium, which can further deter producers concerned about their competitiveness.

To break this impasse, companies can explore various mechanisms to signal demand for climate-aligned innovations. Engaging with private-sector peers, competitors, and governments can help kick off positive feedback loops of increased market confidence and activity. Offtake agreements, book-and-claim accounting, and buyers' coalitions can help give producers the confidence needed to accelerate production. In addition, knowledge-building and -sharing among competitors remains valuable while the innovation is in the process of reaching maturity.



EV case study: Phase 3

AUTO MANUFACTURERS TARGET NICHE MARKETS FOR ELECTRIC VEHICLES

The first mass-produced highway-legal EV was introduced in 2008. Nissan followed two years later with the Leaf.[47] These early adopters developed a niche market by first targeting high-income and enthusiast customers while investing in proprietary charging networks, then closely following with a more affordable option. Together these steps helped to shift consumer perceptions about what an EV could be. In the mid- to late 2010s, EV range and affordability improved dramatically, aided by plummeting battery costs—in part a spillover from learning effects in laptop and smartphone production.[48] By 2016, EVs became more cost-effective than conventional internal combustion vehicles over their lifetimes.[49] Other major automakers began to enter the market, offering options for a growing consumer base, along with companies specializing in enabling innovations, such as charging networks.[50]

Phase 4: System integration

Supply- and demand-side frontrunners push to strengthen the enabling environment

Once it has reached Phase 4, the innovation becomes viable for a mass market audience as it reaches the steep part of the S-curve. Subsidies and incentives are no longer needed to make the business case, and the focus shifts to building up the enabling environment (for example, supporting infrastructure, workforce development, complementary products and services, and regulations), which can struggle to keep pace with the rapid adoption of the innovation itself.

Companies can address market growing pains by collaborating with governments and value chain partners to invest in infrastructure, worker reskilling, and other market supports. As agencies engage in rulemaking and standardization, companies can also lobby for regulations that support the innovation's development and growth. Investors can increasingly direct private capital toward strengthening key enablers.

EV case study: Phase 4

MAJOR AUTOMAKERS ENTER THE EV MARKET

In the last several years, an increasing number of automakers have joined the EV market, with early adopters continuing to leverage key system integration dynamics to grow the market. While EVs still represent roughly 6% of new US passenger vehicle sales, EVs are clearly entering Phase 4.[51] This phenomenon helps illustrate how market penetration can sometimes lag technological maturity and the system dynamics at play. In this instance, Phase 4 dynamics address infrastructure gaps, particularly those related to charging and supply chain readiness. The US government has injected critical funding into advanced manufacturing and charging infrastructure with passage of the Inflation Reduction Act and the Infrastructure Investment and Jobs Act, with the latter including a pledge to build out a national network of 500,000 charging stations.[52] Battery manufacturing capacity costs are forecast to fall over 50% from 2018 to 2023, accelerating the supply of lithium-ion batteries and the development of smaller, faster-charging, and more efficient battery technologies.[53]

Phase 5: Market expansion

The innovation reaches scale and is widely adopted or met with broad compliance

In this final phase, new cultural conventions help both consumers and ecosystem players view the innovation as "normal." Frontrunner companies that led the growth of the innovation may be firmly established as market leaders. Legacy incumbents that failed to adapt may find themselves with stranded assets, rising costs, and dwindling profit as consumers adopt the new option. The reconfigured system can begin to inform similar transitions in other sectors and geographies.

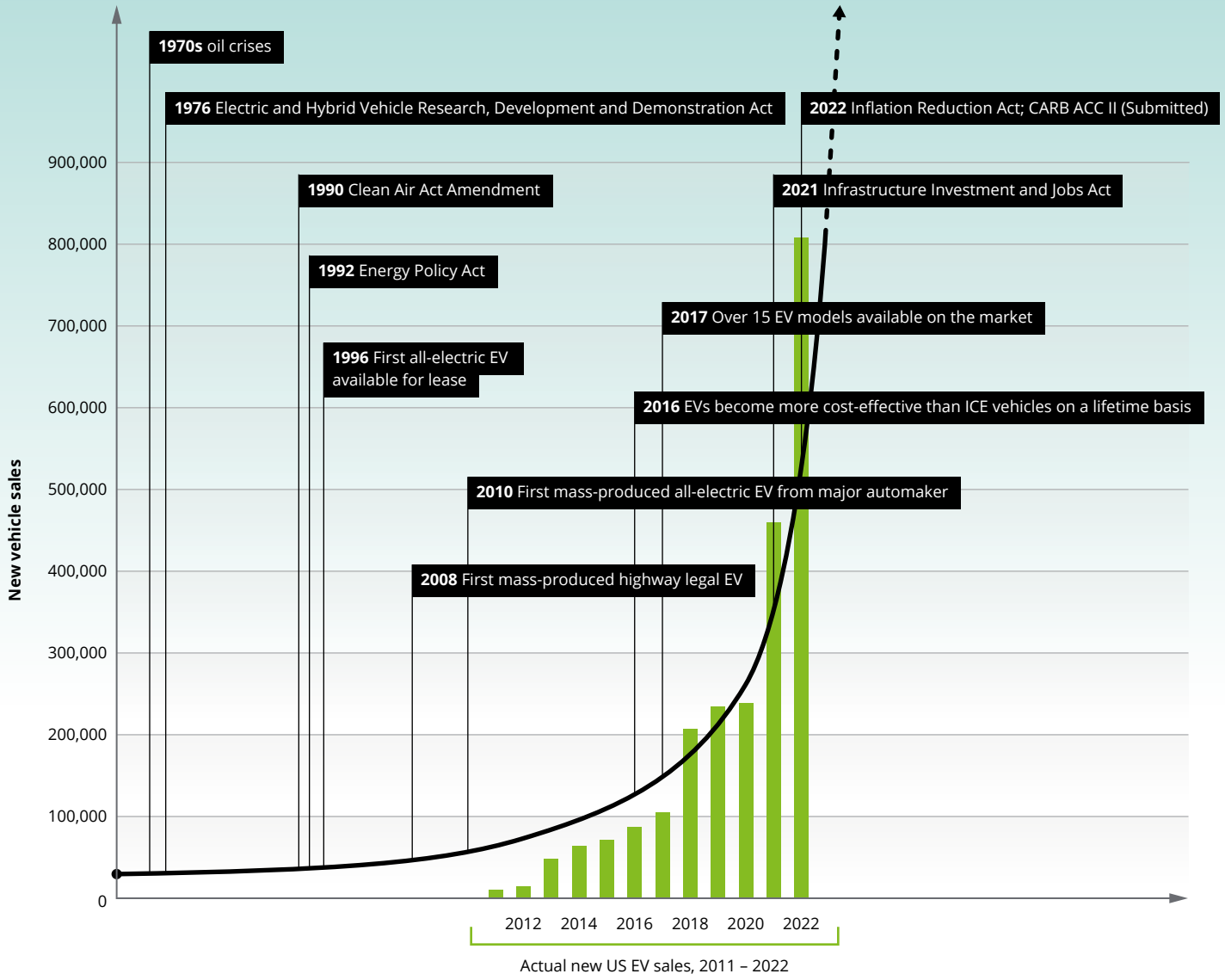
Building on Phase 4 approaches, companies may collaborate with governments to create rules and regulations that ensure robust adoption of the innovative solutions and an organized phase-out of the incumbent. They can also turn to development of new markets, supporting technology and knowledge transfer, and engaging in transition risk management practices.

EV case study: Phase 5

EV MANUFACTURERS LOOK TO EXPAND THEIR REACH INTO NEW GEOGRAPHIES AND USE CASES

The EV system is exhibiting early indicators of Phase 5 dynamics, as companies begin to form private partnerships to distribute risk and bring vehicles to market segments across new sectors. As EVs enter this phase, we will likely see companies expand beyond the mobility market and into the energy sector, as leaders consider the opportunity that EVs present for backup power and smart-grid management.[54] This could further normalize EVs through system integration and into the S-curve's final market-expansion phase.

FIGURE 6.
Growth of the electric vehicle market in the United States[55]



Source: Bureau of Transportation Statistics; *Wall Street Journal*, January 6, 2023; RMI and Deloitte analysis

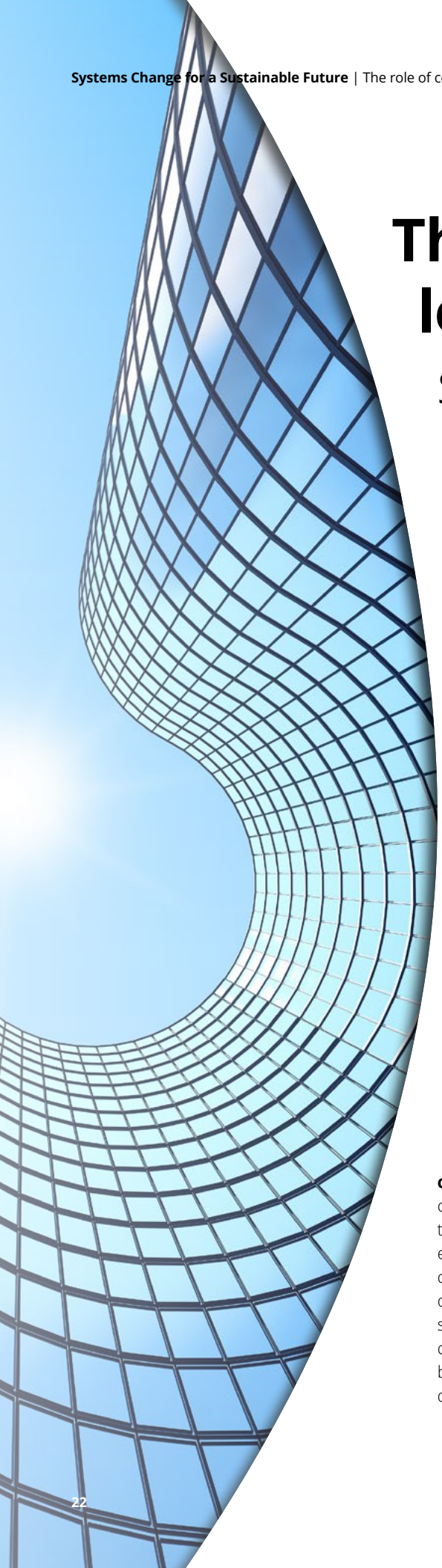
Actions to help accelerate the transition

Change can happen fast when actors tune their strategies to the phase of system transformation and one other. Table 1 describes the unique roles that actors can play in accelerating transitions and lists guidance for coordinating action. This provides a basic handbook to help identify where transitions are along the five phases of the S-curve and understand common barriers and trends. Corporate leaders can identify where an innovation lies on the S-curve and evaluate appropriate strategies and collaborations to help accelerate its development. This can ultimately allow leaders to capture the economic and climate benefits an innovation brings.

TABLE 1.
Action table for system transformation[56]

	Solution search	Proof of concept	Early adopters	System integration	Market expansion
Who is involved?	Visionaries	Innovators	Early adopters	Early and late majority	Laggards
Innovation moves to the next phase when…	Problem or opportunity is matched to one or more innovations	Feasibility is demonstrated, niche market is established	Clear business case for mass market, plans for value chain build-out	Enabling environment (e.g., infrastructure, regulation) is established	Innovation has become the norm
Common barriers	• Limited understanding • Lack of leadership • Lack of resources for early research	• The "valley of death" • Low regulatory support and flexibility • Low commercial viability • Decentralized stakeholders	• Low demand or business case • High cost • Resistance from incumbents	• Lack of (funding for) infrastructure • Low standardization, risk of misinformation • Continued resistance from incumbents	• Challenges adapting to new markets • Limited resources for capacity building in new markets
How can actors drive an innovation through the S-curve?					
Governments	**R&D funding and regulatory 'sandboxes'** **Road maps and commitments** **Demand pull policies and financial risk mitigation** **Infrastructure development** **Regulatory standards and just transition**				
Private sector	**Experimentation and target setting** **Targets and commitments** **Market creation and lobbying** **Scale and marketing** **Workforce development**				
Civil society	**Awareness raising and vision creation** **Knowledge building and sharing** **Opportunity and impact validation** **Certification schemes** **Tracking and monitoring**				
Financial sector	**Climate-aligned finance (transparency, disclosure, portfolio alignment)** **Venture capital and private equity** **Transition finance** **Asset owner and stakeholder engagements** **Financial incentives, performance-based loans** **Risk assessments**				
Multi-stakeholder coalitions	**First-mover coalitions (vision creation, knowledge building)** **Financial coalitions (e.g. blended finance)** **Value chain partnerships (new market structures, infrastructure)** **Buyers coalitions** **Technology transfer programs**				

Source: RMI, "Harnessing the power of S-curves," October 28, 2022



The role of corporate leaders: Emergence strategy for a new economy

The transition to a climate-aligned economy requires urgent and coordinated action by businesses and other stakeholders. The response to climate change is already driving significant changes across many sectors of the economy simultaneously, including transformational shifts in energy, industry, mobility, buildings, agriculture, forestry and other land use, and waste. To understand and respond to changes that are so widely interconnected and dynamic, businesses should strengthen their capabilities to apply systems analysis approaches and integrate systems-level insights into their planning. Many leading companies are increasingly looking to build influential and diverse coalitions of key actors that can activate positive feedback loops in the adopting and scaling of new low carbon technologies and solutions with explicit consideration of the system-level dynamics that drive change.

This implies a new approach to corporate strategy. In stable times, companies could succeed by outperforming their competitors through operational excellence. Efficiency, cost reduction, supply chain integration, and market position are often the order of the day. But in times of systems-level disruption, recognizing and capitalizing on the opportunities presented by these fundamental shifts demands a different approach to strategy.

Transformational change increases risks for incumbents with legacy technologies and business models. Conventional strategy processes often take an overly narrow and linear view, causing companies to miscalculate the likelihood and speed of transformative change, especially when the forces for transformation are coming from outside the current industry structure. These forces may include shifting customer expectations, regulatory pressures, or new business models and technologies advanced by competitors. Systems thinking can provide a framework for diagnosing and responding to systemic change in ways that can be adapted to periods of disruptive change.

"Our sustainability program is completely embedded in our strategy. We are focusing on five clear domains that we believe are critical for the sustainability of the planet in the coming years. This is where we are investing."

Eric Rondolat, CEO of Signify

FIGURE 7.
Examples of corporate systems leaders tuning their approaches to phase dynamics[57]

Phase 1: Solution Search | Holcim

Holcim, a global construction company, is searching for solutions across technologies and processes to radically reduce emissions in the construction industry. Holcim's Startup Accelerator Program challenges startups to accelerate sustainable construction with new solutions. Startups from around the world are invited to apply to one of nine Accelerator challenges, ranging from circular construction to green building solutions.[58]
This investment in early-stage R&D targets knowledge and motivation gaps.

Phase 2: Proof of Concept | Maersk

Maersk aims to deliver net zero supply chains by 2040 covering all direct and indirect emissions. In November 2022 it signed a letter of intent to purchase future supplies of green methanol from a US-based supplier, adding to a series of such agreements aimed at accelerating production of lower-emission fuels for ocean shipping.[59]
This commitment can de-risk the upfront investment required to establish new sources of supply and the attendant supply chains, allowing the nascent industry to take advantage of learning effects and economies of scale.

Phase 3: Early Adopters | Fortescue Future Industries

Fortescue Future Industries, a subsidiary of Fortescue Metals Group, is at the forefront of supplying green hydrogen to niche markets. The company has multiple agreements in place to supply green hydrogen to Europe. A recent partnership with E.ON aims to deliver 5 million tons of green hydrogen annually to Germany, the Netherlands, and other cities in the region by 2030.[60]
Signing into offtake agreements can alleviate market trepidation as emerging technologies move into larger scale commercialization.

Phase 4: System Integration | Phillips Lighting

Signify (Phillips Lighting) is one of the world's largest manufacturers of LED lighting. Marking a relatively steep S-curve, LEDs accounted for around 5% of the global lighting market in 2013, but currently make up about half of sales and are projected to reach 99% by 2030.[61] As LEDs reach global scale and high market penetration, Signify is collaborating closely with industry partners and regulators on its connected lighting systems strategy that will embed LEDs and intelligent controls in standards for virtually all lighting applications.[62]
Through radical collaboration, companies can integrate innovations into the larger system.

Phase 5: Market Expansion | Lightsource bp

Lightsource bp is one of the world's largest solar developers, with a goal of 25GW of solar installed by 2025.[63] As solar project development has scaled globally, with increasing penetration in mature markets in developed economies, developers such as Lightsource bp have increasingly focused on growing their operations in emerging market countries in the global South.[64]
This widening market focus is characteristic of emergence strategy in phases 4 and 5 of the S-curve.

Source: RMI and Deloitte analysis

An *emergence strategy* takes a systems view, with a focus on how a company can accelerate change through engagement of other key system actors, especially those up and down the value chain. A corporate emergence strategy often involves these key considerations:

01. **Frame corporate strategy based on transformational change versus incremental change.** To address the monumental challenges of moving to a climate-aligned economy, leaders need a new vision of future systems and the value they seek to create. Companies with emergence strategies typically take an expansive and forward-looking perspective toward climate action. It can be a big change. Conventional strategy approaches sometimes relegate climate action to the sidelines by delegating responsibility to a team focused on squeezing emissions reductions out of a company's operations and supply chain with as little disruption to the core business as possible. Emergence strategists invert this approach, exploring new ways to pivot the business so that it can create products and services that are inherently low emissions while accelerating market transitions to create differentiated value for these products and services.

02. **Recognize when and where systems transformation may be occurring or could emerge.** Leaders should acquire a deeper understanding of what is happening in the economy beyond their immediate supply chains. Transitions that emerge within a company's industry can often be visible and relatively easy to identify. Those that emerge in a company's value chain or from changes in adjacent industries may be much more difficult to identify but can cascade quickly. An emergence strategy examine these transitions and expands the scope to the entire ecosystem of value chains, with a particular focus on those value chains' intersection—in other words, mapping where transitions overlap.

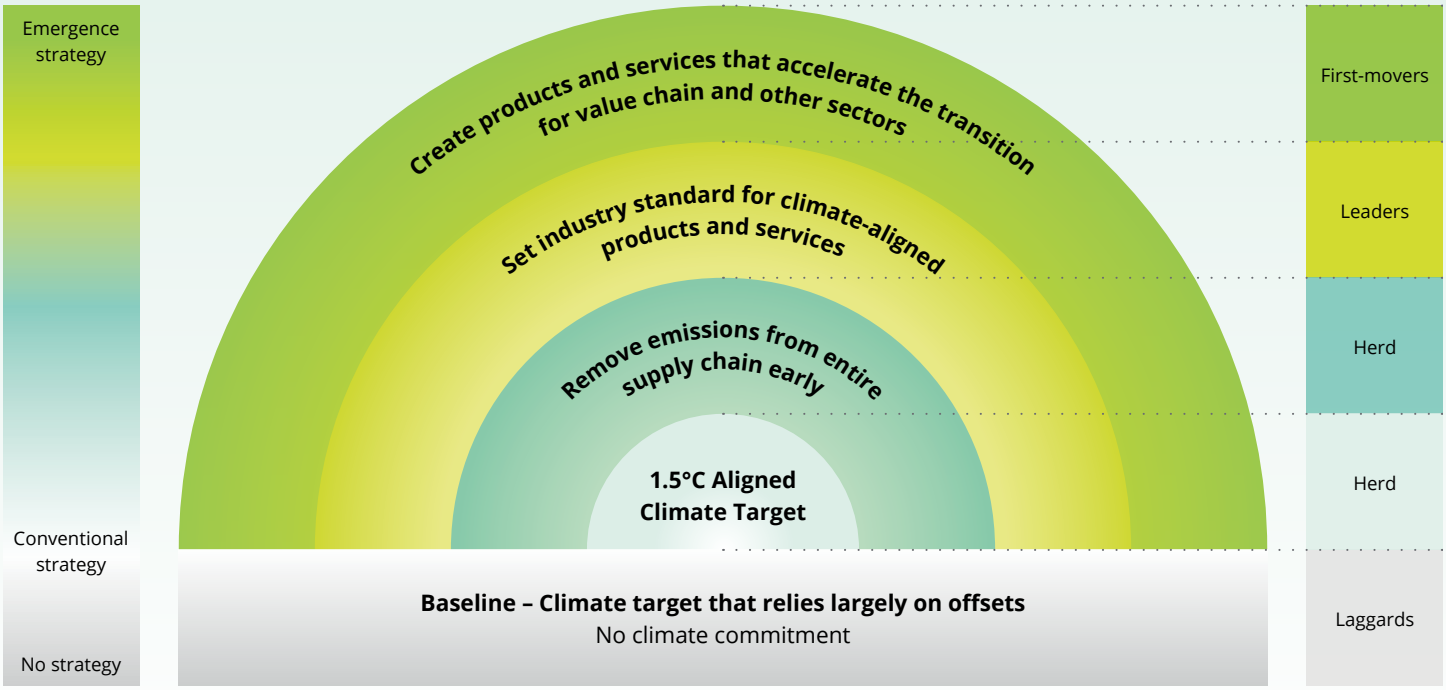
03. **Diagnose phases of systems transformation and tune strategy accordingly.** Leaders need to develop an understanding of the innovations that underpin the transition to the new economy. By placing an innovation on the phases of the S-curve, leaders can tune activities and planning to the unique phase dynamics and prepare for and contribute to rapid change (Table A1 in the appendix). In practice, companies are likely to be engaged along multiple phases and perhaps in multiple S-curves spanning a range of innovations. From this understanding, leaders can evaluate what actions can have disproportionate effects and returns.

04. **Engage a wide range of stakeholders to shape system-level outcomes.** To amplify the ability to drive transformational industry-wide change, leaders should look to work with other key actors, from competitors and customers to investors and civil society groups. These strategies often entail activating new coalitions and together overcoming challenges to adoption and strengthening reinforcing feedback loops. What holds these coalitions of actors together is usually a *shared vision of a future system and its benefits*.

05. **Adopt a beginner's mindset.** Leaders should be open to continuously learn and adapt to changing environments. In times of disruption and uncertainty, staying open, flexible, and agile is of utmost importance, as is looking at the world and its issues with fresh curiosity and wonder as these transitions unfold.

Companies may already be designing their strategies based on a subset of these pillars. They may exhibit all five pillars for a specific product or service they provide. However, companies that emerge as market leaders in the new economy will likely be those standing on all five pillars across their entire current portfolio and future investments.

FIGURE 8.
Levels of corporate climate strategy, from no strategy to emergence strategy[65]



Source: RMI analysis

Conclusion

The world is on the cusp of a fundamental reconfiguration of our economy. Climate change, and the global response to it, are altering the business landscape everywhere. Several critical technologies—including wind, solar, lithium-ion batteries, and LED lighting—have already reached tipping points, with many more on the horizon, ranging from green hydrogen and low-carbon cement to widespread adoption of net zero buildings.[66] However, to advance new technologies and ideas at the speed and scale required to avert the worst impacts of climate change, we need faster and larger systems transformation than anything that has played out in the past. The world does not have the luxury of waiting for leaders to take a go-slow approach.

Corporate leaders should work to understand systems thinking and systems transformation if they want to be active players—rather than bystanders or, worse, victims—in the transition to the new climate-aligned economy. By reorienting their approaches from ones dominated by business-as-usual goal setting and compliance to emergence strategies, businesses have an opportunity to capitalize on early-mover advantages, shape the direction of emerging systems, and prosper in the new competitive environment. In doing so, they can play their part in addressing the greatest challenge of the 21st century.

In this report we have laid out the logic and language of system transformation, its five phases, and guidance to help corporates develop their *emergence* strategies. Everyone has a role to play, and by taking meaningful action today—investing at the speed and scale that is necessary—business leaders can thrive in the economy of the future. We stand ready to help businesses at this critical moment as they work to make this happen.

Appendix

TABLE A1.
Stakeholder roles in accelerating system transformation across the S-curve

Phase	1. Solution Search	2. Proof of Concept	3. Early Adopters	4. System Integration	5. Market Expansion
Who's involved?	Visionaries	Innovators	Early Adopters	Early & Late Majority	Laggards
Tipping points to next phase	• **Problem or opportunity is matched to one or more innovations**	• **Feasibility is demonstrated** in practice • **Niche market is established**	• **Clear business case for mass market** • **Plans for value chain build-out** (e.g., infrastructure)	• **Enabling environment (e.g., infrastructure, regulation) is established**	• **The innovation has become the norm**
Common barriers	• **Limited understanding** of the problem • **Lack of leadership** or coordination to address the problem • Limited options in innovation landscape, often due to **lacking resources for early research**	• The "**valley of death**" – limited resources to bridge public-funded early research to commercialization research • **Lack of regulatory support and flexibility** for experimentation • **Low technological or commercial viability** • **Highly decentralized group of stakeholders**	• **Business case does not materialize** • **Lack of demand**, high costs, risk aversion, knowledge gaps • **High costs** for market build-out • **Resistance from incumbents** • **Avoiding responsibilities** between actors (**pointing fingers**)	• Challenges adapting the innovation to a mainstream audience • **Limited resources for establishing enabling environment** (e.g., infrastructure, regulation, human capital) • **Lack of standardization, higher risk of misinformation** • **Continued resistance from incumbents**	• Challenges adapting the innovation to new markets • Limited resources for capacity building in new markets
Government roles	• Provide **public R&D funding** • Define **research agendas** • Set (binding) **targets and commitments**	• Provide **grant funding** for demos and pilots • **Create vision and roadmaps** that break down the transition in manageable pieces • Create **regulatory frameworks** that allow flexibility and support around strict standards, market access, and infrastructure	• Implement **demand pull policies** (e.g. subsidies, public procurement) • Ensure **taxes and regulation** support growth of the new (and decline of the old) • **Mitigate risk** for financial and private sectors (e.g. **blended finance**) • Fund **infrastructure projects** • **Public awareness campaigns**	• Alter the economic playing field through taxes and regulation • Fund large-scale **infrastructure projects** • Develop **regulatory standards** targeting planned **phase-out of "the old"** • Implement **just transition policies** • Run **public awareness campaigns**	• Implement **just transition policies**; mitigate transition losses and resistance • **Update and create new regulations**, standards, and institutions as needed • Enforce phase-out of "the old"
Private sector roles	• Set voluntary **targets and commitments** • Conduct **corporate R&D**	• Conduct **demos and pilots**, stimulate experimentation • **Develop new business models** • **Develop vision** including root cause analysis and value chain perspectives • **Collaborate** with value chain partners • **Showcase what is possible** through marketing	• Establish niche markets supported by **offtake agreements and buyers coalitions** • **Collaborate** with value chain partners • Pursue **cost reduction and quality improvement** in niche markets • **Refine business model** and go-to-market strategy • Shape consumer preferences through behavioral nudges and **marketing** and counter incumbent narratives • **Lobby** for better regulations and subsidies.	• Expand to **mass market** • Conduct **value chain projects** • Invest in physical assets and **workforce development** • **Lobby** for better regulations, counter incumbent narratives • Shape consumer preferences through behavioral nudges and **marketing**	• Develop **new markets** • Engage in **transition risk management** practices

Phase	1. Solution Search	2. Proof of Concept	3. Early Adopters	4. System Integration	5. Market Expansion
Civil society roles (e.g. NGOs, media, advocacy groups)	• **Raise public awareness** to create urgency through advocacy and movement building • **Applied research** to highlight importance of the problem and direction for solutions • **Provide platforms** for commitment setting and collaboration	• **Applied research** to highlight importance of the problem and stress-test and validate pilot studies. • **Raise public awareness** (on innovation benefits, urgency) • Facilitate and participate in **coalition building**	• **Information campaigns** to support demand generation • Support niche market creation with premiums (e.g. **certification**) • Place **public pressure** on key government and private sector actors (rewarding frontrunners and calling out laggards) • Facilitate and participate in **coalition building**	• **Information campaigns** to support demand generation • Place **public pressure** on key government and private sector actors (in this phase, emphasize calling out laggards, e.g. through **tracking & monitoring**) • Push for **just transition policies** • Facilitate and participate in **coalition building**	• **Knowledge and technology transfer** to new markets • Facilitate and participate in **coalition building**
Financial sector roles	• **Set voluntary targets and commitments** • Launch & participate in **transition-aligned finance** agreements, committing to transparency & disclosure, portfolio alignment • **Engage and consult** with asset owners & shareholders	• Provide **venture capital and private equity funding** to early start-ups or promising companies • Conduct **risk assessments** on stranded assets • Participate in **transition-aligned finance** agreements • **Engage and consult** with asset owners & shareholders	• Provide **venture capital and private equity funding** to emerging companies • **Plan for potential stranded assets** • Participate in **transition-aligned finance** agreements • Implement **financial incentives** (e.g., sustainability-linked loans) • **Engage and consult** with asset owners & shareholders	• Provide **transition finance** • Participate in **transition-aligned finance** agreements • Implement **financial incentives** (e.g., sustainability-linked loans) • **Plan for future stranded assets** • **Engage and consult** with asset owners & shareholders	• Provide **transition finance**
Examples of possible multi-stakeholder / cross-sector coalitions	• Align messaging & **amplify public awareness / marketing** campaigns (private sector + NGOs, advocacy groups) • **Build and share knowledge** (private sector + research orgs)	• Create **frontrunner groups** with a shared problem statement and vision for the future *(multi-stakeholder)* • **Design and test new market structures** *(value chain partners)* • Align messaging & **amplify public awareness** / marketing campaigns *(private sector + NGOs, advocacy groups)* • **Build and share knowledge** *(private sector + research orgs)*	• **Frontrunners build out niche market infrastructure** *(value chain partners, public + private)* • **Buyers alliances create demand** *(buyers + NGOs)* • **Build and share knowledge** *(private sector + NGOs / research orgs)* • **Share financial risk** e.g. blended finance *(public + private sector)* • **Align messaging & amplify public awareness** / marketing campaigns *(multi-stakeholder)* • **Align lobbying** strategies *(private sector + NGOs)*	• **Coordinate phased rollout of new infrastructure**, regulations *(multi-stakeholder)* • If scaling new solutions fails, broaden frontrunner coalitions to ensure **majority participation** • **Align messaging & amplify public awareness / marketing** campaigns *(multi-stakeholder)* • **Align lobbying strategies** *(private sector + NGOs)*	• Jointly develop technology and knowledge transfer programs *(private sector + NGOs, IGOs)*

Source: RMI, "Harnessing the power of S-curves," October 28, 2022; based on:

- RMI 1.5°C Wayfinder, "Ambition Loop Dashboard," accessed January 2023
- Everett M. Rogers, *Diffusion of Innovations: 3rd Edition* (New York Press 2003)
- Frank W. Geels, "Multi-Level Perspective on System Innovation: Relevance for Industrial Transformation," In Understanding Industrial Transformation, 2006
- Marko P. Hekkert, R. A.A. Suurs, S. O. Negro, S. Kuhlmann, and R. E.H.M. Smits, "Functions of Innovation Systems: A New Approach for Analysing Technological Change," Technological Forecasting and Social Change 74, no. 4 (2007)
- Stephen K. Markham, Stephen J. Ward, Lynda Aiman-Smith, and Angus I. Kingon, "The Valley of Death as Context for Role Theory in Product Innovation," Journal of Product Innovation Management 27, no. 3 (2010)
- Mariana Mazzucato, "Mission-Oriented Innovation Policies: Challenges and Opportunities," Industrial and Corporate Change 27, no. 5 (2018)
- J. Roland Ortt and Linda M. Kamp, "A Technological Innovation System Framework to Formulate Niche Introduction Strategies for Companies Prior to Large-Scale Diffusion," Technological Forecasting and Social Change 180 (July 1, 2022): 121671
- Lucas Simons and André Nijhof, *Changing the Game: Sustainable Market Transformation Strategies to Understand and Tackle the Big and Complex Sustainability Challenges of Our Generation* (Routledge 2021)

Endnotes

1. Pradeep Philip, Claire Ibrahim, and Cedric Hodges, *The turning point: A global summary*, Deloitte Economics Institute, May 2022.
2. Kingsmill Bond and Sam Butler-Sloss, *The Energy Transition Narrative*, RMI, November 2022
3. Sarah Golden, "The clean energy transition is happening faster than forecasters thought," GreenBiz, December 2022.
4. Deloitte, *The turning point: A global summary*, May 2022.
5. Rupert Way, Matthew C. Ives, Penny Mealy, and J. Doyne Farmer, "Empirically grounded technology forecasts and the energy transition," Joule Vol. 6, Issue 9, September 2022.
6. Lachlan Carey and Jun Ukita Shepard, "Congress' Triple Whammy: Innovation, Investment, and Industrial Policy," RMI, August 2022.
7. Baysa Naran, Jake Connolly, Paul Rosane, Dhashan Wignarajah, Githungo Wakaba, and Barbara Buchner, *Global Landscape of Climate Finance: A Decade of Data*, Climate Policy Initiative, October 2022.
8. Deloitte, *The turning point: A global summary*, May 2022.
9. Chi Xu, Timothy A. Kohler, Timothy M. Lenton, and Marten Scheffer "Future of the human climate niche," PNAS Vol. 117, Issue 21, May 4, 2020.
10. Deloitte, *The turning point: A global summary*, May 2022.
11. Jeremy Reiner, "Total share: 30 years of personal computer market share figures," arsTechnica, December 2005.
12. Deloitte, *2023 CxO Sustainability Report*, January 16, 2023.
13. Ibid.
14. UN Environment Programme, *Emissions Gap Report 2022*, October 27, 2022.
15. CDP, *Missing the Mark: 2022 analysis of global CDP temperature ratings*, September 2022
16. New Climate Institute, *Corporate Climate Responsibility Monitor 2022*, February 2022.
17. Climate Action 100+, "Climate Action 100+ Net zero company benchmark shows continued progress on net zero commitments is not matched by development and implementation of credible decarbonization strategies," October 13, 2022.
18. The Greenhouse Gas Protocol defines Scope 3 emissions as "Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity." See Greenhouse Gas Protocol, "Frequently asked questions," accessed April 12, 2021.
19. Deloitte, *2023 CxO Sustainability Report*, January 16, 2023.
20. See, for example: Michele Della Vigna, "Carbonomics: 10 key themes from the inaugural conference," Goldman Sachs, November 12, 2020.
21. International Energy Agency, *World Energy Outlook 2020*, October 13, 2020.
22. Colin McKerracher et al., *Electric Vehicle Outlook 2020*, BloombergNEF, May 19, 2020.
23. For just one example, see Dan Gearino, "Car Companies Are Now Bundling EVs With Home Solar Panels. Are Customers Going to Buy?" Inside Climate News, December 1, 2022.
24. Fernando F. Suarez and Gianvito Lanzolla, "The Half-Truth of First-Mover Advantage", Harvard Business Review, April 2005.
25. Donella H. Meadows, *Thinking in Systems: A Primer*, edited by Diana Wright (Chelsea Green, 2008); Anna J. Wieczorek and Marko P. Hekkert, "Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars," Science and Public Policy Vol. 39, Issue 1, February 2, 2012.
26. Scott Corwin and Derek Pankratz, "Leading in a low-carbon future: A "system of systems" approach to addressing climate change," Deloitte Insights, May 24, 2021; Corwin and Pankratz, "To Thrive in a Low-Carbon Future, Think Systems," Deloitte WSJ, October 13, 2021.
27. Michael Raynor, "Innovation: A chimera no more," Deloitte Insights, July 24, 2013; Joni Rautavuori, "Sustainability isn't holding back innovation, it's accelerating it," World Economic Forum, September 12, 2022.
28. Laurens Speelman and Yuki Numata, "Harnessing the Power of S-Curves," RMI, October 2022.
29. Alan McDonald and Leo Schrattenholzer, "Learning curves and technology assessment," International Journal of Technology Management, Vol. 23, Issue 7, 2002.
30. Edward S. Rubin, Inês M.L. Azevedo, Paulina Jaramillo, and Sonia Yeh, "A review of learning rates for electricity supply technologies," Energy Policy, Vol. 86, November 2015.
31. On a levelized cost of energy (LCOE) basis. Mark Bolinger, Ryan Wiser, and Eric O'Shaughnessy, "Levelized cost-based learning analysis of utility-scale wind and solar in the United States," iScience, May 8, 2022.
32. Wind Energy Technologies Office, "The Future of Offshore Wind Is Big—Literally," US Office of Energy Efficiency and Renewable Energy, October 13, 2021.
33. Antonia Violante, "Putting Peer Pressure to Work: A Q&A with Robert Frank," Behavioral Scientist, March 2, 2020.
34. RMI, "Harnessing the Power of S-Curves," October 2022.
35. David I.A. McKay, Arie Staal, Jesse F. Abrams, Ricarda Winkelmann, Boris Sakschewski, Sina Loriani, Ingo Fetzer, Sarah E. Cornell, Johan Rockström, and Timothy M. Lenton, "Exceeding 1.5°C global warming could trigger multiple climate tipping points," Science, Volume 377, Issue 6611, September 2022; Richard E. Fewster, Paul J. Morris, Ruza F. Ivanovic, Graeme T. Swindles, Anna M. Peregon, and Christopher J. Smith, "Imminent loss of climate space for permafrost peatland in Europe and Western Siberia," Nature Climate Change, Vol. 12, March 2022; Carbon Brief, "Explainer: Nine 'tipping points' that could be triggered by climate change," February 10, 2020.
36. RMI, "Congress' Triple Whammy: Innovation, Investment, and Industrial Policy," August 2022.
37. Orrick, "Section 45X of the Inflation Reduction Act: New Tax Credits Available to Battery Manufacturers," n.d., Accessed November 17, 2022.
38. Hannah Ritchie and Max Roser, "Technology Adoption," Our World in Data, 2017.
39. Carlota Perez, "Technological revolutions and techno-economic paradigms," Cambridge Journal of Economics Vol. 34, Issue 1, September 15, 2009.
40. RMI and Deloitte analysis.
41. International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector*, May 2021.

42. RMI, "Harnessing the Power of S-curves," October 28, 2022.
43. U.S. Department of Energy Office of Science, "University Research & National Labs," December 9, 2020.
44. US Department of Energy, "The History of the Electric Car," September 15, 2014.
45. Michael Baumann, "A short history of the electric vehicle battery," Electric & Hybrid Vehicle Technology, February 24, 2022.
46. Gary Witzenburg, "GM's EV1 Electric Car Invented Many Technologies that are Commonplace on Today's EVs," Car and Driver, July 7, 2021.
47. Jay Ramey, "The first Tesla Roadster: A look back at the early adopter's electric car," Autoweek, November 27, 2017; Nissan, "A decade of innovation – the LEAF's incredible journey," December 4, 2020.
48. David L. Chandler, "Study reveals plunge in lithium-ion battery costs," MIT News, March 23, 2021.
49. Charlie Bloch, James Newcomb, and Madeline Tyson, "Breakthrough Batteries," RMI, 2019.
50. Leonardo Paoli, Amrita Dasgupta, and Sarah McBain, "Electric Vehicles – Analysis," International Energy Agency, September 2022.
51. Zachary Shahan, "Fully Electric Vehicles Reached ~6% of Auto Sales in USA in 3rd Quarter," CleanTechnica, October 13, 2022.
52. U.S. White House, "FACT SHEET: Biden-Harris Administration Proposes New Standards for National Electric Vehicle Charging Network," June 9, 2022.
53. David L. Chandler, "Study reveals plunge in lithium-ion battery costs," MIT News, March 23, 2021.
54. Csaba Csere, "Can Your EV Power Your House?" Car and Driver, May 11, 2022.
55. Vehicle Technologies Office, "FOTW #1200, August 23, 2021: Sales of New Electric Vehicles in the U.S. Were Up for 2020 While Conventional New Light-Duty Vehicle Sales Were Down," Office of Energy Efficiency & Renewable Energy, August 23,2021; RMI and Deloitte analysis.
56. RMI, "Harnessing the Power of S-curves," October 28, 2022.
57. RMI and Deloitte analysis.
58. Holcim, "Holcim Accelerator". n.d., Accessed January 2023.
59. Maersk. "A.P. Moller - Maersk and SunGas Renewables Sign Strategic Green Methanol Partnership," December 15, 2022.
60. James Ruchira and Singh Burgess, "Fortescue, TES partner for 300,000mt green hydrogen supply to Europe," S&P Global Commodity Insights, October 5, 2022; Nicholas Stern and Joseph E. Stiglitz, "Getting the Social Cost of Carbon Right," Project Syndicate, February 15, 2021.
61. Kevin Lane, Chiara Delmastro, and Fabian Voswinkel, "Lighting – Analysis," International Energy Agency, September 2022.
62. Signify. "20 Years of LED Innovation," n.d., Accessed January 2023.
63. Lightsource Bp. "Lightsource bp further accelerating growth, now targeting 25GW solar developments by 2025," September 20, 2021.
64. Lightsource Bp, "Lightsource bp and América Energia partner to offer clean energy to small businesses at a competitive cost," July 25, 2022.
65. RMI analysis.
66. Ji Chen and Koben Calhoun, "Op-Ed: Clean Energy Tipping Points," RMI, May 27, 2020.

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