CLIMATE LEADERSHIP COUNCIL

Unlocking Net Zero Emissions: Accelerating Innovation & Deployment through Carbon Pricing

White Paper

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About the Author

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Executive Summary

Recent estimates suggest that 35 to 45% of the global emission reductions needed to get to net zero will be achieved through technologies that *are not currently available*. They have not been invented yet or are not ready for wide scale commercial use. This presents a massive challenge, but one that can be solved.

To avoid the worst impacts of climate change, we need more rapid innovation and deployment of affordable low-emitting, zero-emitting, and emission sequestering technologies across all economic sectors – and policies in place to encourage these outcomes.

Replacement technologies must be cleaner (lower-emitting), cheaper, and better (preferred by consumers) than what exists in the marketplace today. For the promising technologies we already have, widespread adoption must speed up. All of this requires mass innovation.

Make no mistake: “innovation” is more than just the invention of products and technologies. The kind of innovation we need will happen at every stage of the invention-mass deployment continuum, from the idea stage to demonstration projects, wide availability, and use.

And in many ways, it refers to new policy development too.

Mass innovation does not happen without the likely prospect of a reward for investors, manufacturers, and generators of new ideas. To date, attempts to create an effective incentive “pull” have created silos by rewarding, penalizing, or mandating specific technologies rather than pursuing whatever works to get to the desired outcome (lower emissions).

Only an economy-wide market incentive, like that provided by a carbon price, offers this flexibility, predictability, and potential.

With a carbon price:

- We create incentives across all economic sectors and at every stage of the invention-deployment continuum.
- We reward any and all solutions that cut emissions, including new technologies and process improvements.
- The persistent, predictable, and pervasive price signal serves as the connective tissue pulling innovative technologies from one stage to the next.
- The price creates a constant pull to bring technologies into the marketplace that are ultimately cleaner, cheaper, and better than their higher-emitting incumbent technology.

A carbon price enhances existing climate solutions, but it can also be a long-term replacement for policies like subsidies that are designed to sunset after a set number of years. It can permanently carry forward the incentives for these technologies while shifting the costs from federal taxpayers to the private marketplace.

A vibrant U.S. innovation environment, focused on emissions reduction and driven by a carbon price, will expedite the achievement of U.S. climate goals. More importantly, addressing the vast U.S. consumer market will permit economies of scale that allow solutions to become more affordable for global deployment.

Introduction: The Innovation and Deployment Gap

This paper reviews the role of U.S. innovation in meeting climate goals and identifies ways in which the innovation effort can be accelerated. It is broadly recognized that cutting emissions to net zero by midcentury will require deploying a vast amount of clean technology across the global economy. Some argue[i] (implicitly or explicitly) that all that needs to happen is for a range of available, existing decarbonization technologies to be made available to an existing consumer base. But the challenge is not just to make clean tech available, but to make it attractive enough for people worldwide to eagerly adopt it. “Build it and they will come” isn’t going to work. Clean tech products need to be globally available, usable, and affordable – and as a result, seen by consumers as preferrable to what they’re using now.

This is no small task. Some technologies are simply not available; there is no workable electric airliner, for example.

Even for available technologies, there are barriers that slow implementation. A chief obstacle is affordability: a new battery electric vehicle is out of reach for many U.S. households. Then there’s the lack of infrastructure: solar power in Africa is a great idea, but right now there is no way to transmit it from the places where it is most abundant to the large and growing population centers in Sub-Saharan Africa. Even in developed countries like the U.S. or Germany, building such infrastructure can be a lengthy and expensive task. In product markets, building familiarity can also be challenging. For example, heat pumps may reduce household heating and cooling energy costs, but many HVAC installers and technicians are unfamiliar with this emerging technology. These limitations of the clean technologies available today both reduce their attractiveness to consumers and the speed at which they can be deployed.

The global transition to a net zero future will require deployment, but also massive innovation to identify, improve, and commercialize emerging—and unknown—solutions. This is the proper way to consider our pathway to deep decarbonization: not technology deployment or innovation siloed off from one another, but the full innovation spectrum from invention all the way through broad commercialization. The recently passed Inflation Reduction Act (IRA) is widely described as the largest climate investment in U.S. history. It targets nearly $400 billion at clean energy deployment, carbon removal, industrial decarbonization, and other critical pathways. But it won’t get us to our climate targets.[ii]

Missing from the energy transition landscape is a clear, durable signal to accelerate the shift to and cultivation of lower-carbon and zero-carbon alternatives. An economy-wide carbon price like the Baker Shultz Carbon Dividends Plan can unlock $1.4 trillion[iii] in new capital deployment by 2035. This is a meaningful innovation signal that dwarfs even the largest investment of taxpayer funds in U.S. history.

This paper explores the challenge ahead and the global importance of the U.S. market. It also identifies how an economy-wide carbon price, added to the existing policy mix, will incentivize further innovation, accelerate deployment in the U.S., and lay the groundwork for exporting appropriate and affordable solutions to international partners, including emerging markets and developing economies.

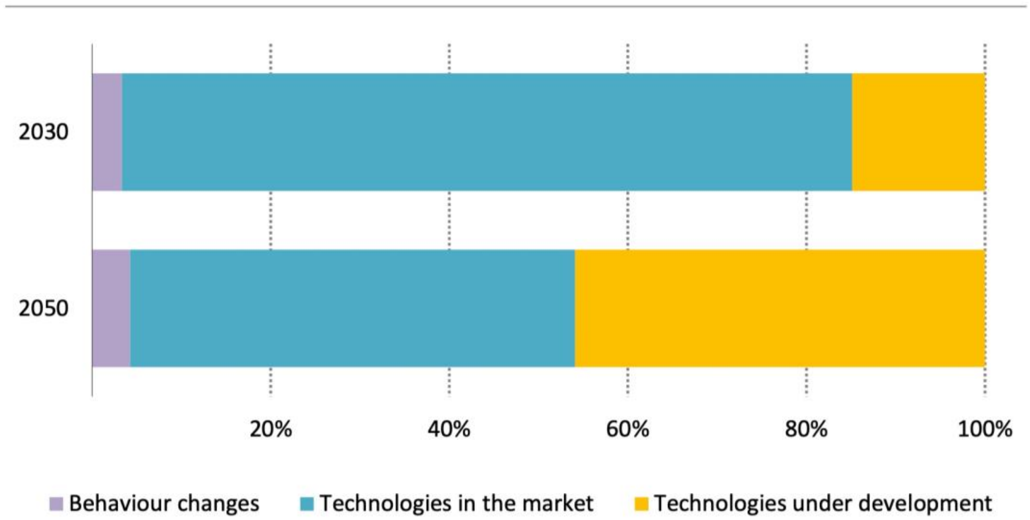
Innovation Is Critical for Addressing Climate Change

To reach a net zero economy requires substantial improvements in available climate solutions and new approaches to difficult-to-decarbonize challenges.

Much of what we need is not yet commercially available. The global management consultancy McKinsey recently estimated that today's existing technologies, applied widely, can provide about 60% of the reductions needed to meet the goal of lowering global emissions to net zero by 2050. A further 25-30% reduction requires technologies that have been demonstrated today but are not ready for the market. Then, the last 10-15% will need to come from those that are still in the early stages of research and development.[iv] This is probably a best-case view. It appears the study presumed no other barriers to deployment, even in developing countries.

The International Energy Agency, in their 2021 roadmap to Net Zero 2050, reached similar conclusions. To achieve global net zero emissions by 2050, more than 15% of emissions savings through 2030 needed to come from technologies that are not yet commercially available. By 2050, yet-to-be-innovated technologies will be necessary to secure a full 40% of the necessary emissions savings.[v]

Chart 1. IEA Projections of CO2 Emissions Savings in the Net Zero Pathway, Relative to 2020
Source: IEA: A Roadmap for the Global Energy Sector, 2021



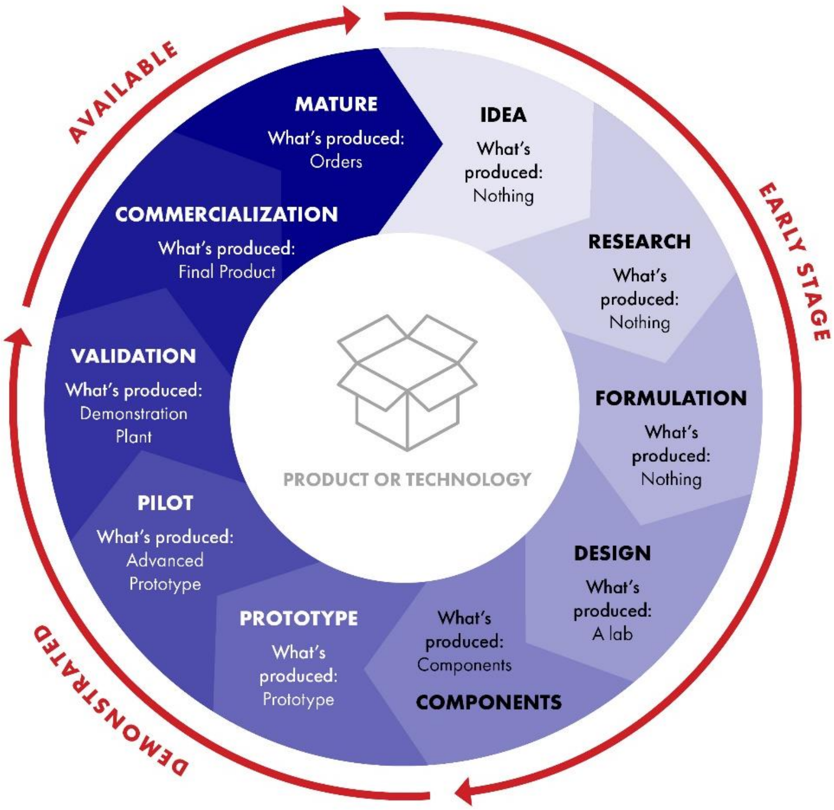
While existing and demonstrated technologies have challenges, for at least 10% of current sources of emissions, there is no obvious credible, available, affordable zero-carbon alternative. This includes globally critically production processes for commodities like steel and chemicals, services like transportation, and even many national security and defense operations. Innovation in these areas is particularly critical.

Invention is just the start of the broad innovation spectrum. And while innovation is typically associated with delivering new technologies, many important parts of the process are not technological. Innovation captures any step to devise or change a product or service for the better, including by introducing new products, ideas, or methods. The invention of the telephone did not directly give us the smart phone. It was obviously a necessary factor, but a whole slew of other innovations—in associated technologies, infrastructure, and manufacturing processes—were necessary before the ubiquitous product billions of consumers worldwide enjoy today could be made available.

As the smart phone example suggests, innovation can take place in multiple areas (or combinations of them): new, combined, or adapted products; new or adapted services; wholesale or incremental process improvements; and new or enhanced business models (new cost structures, revenue streams, partnerships etc.).[vi] These areas are expansive. Even opening a second manufacturing facility requires innovation to standardize and simplify methods of production. They are also continuous processes that persist through the life of a product or service. Many technical or performance improvements and cost reductions build incrementally on past work. The full innovation process takes an invention and *continuously improves it* into something that is usable by the consumer, attractive in terms of cost, and readily available—at least until the next technology comes along to disrupt the market.

We can envisage three stages of innovation with ten sub-stages from initial concept to commercialization, captured in Chart 2, below. As the chart shows, improvement must happen at each stage along the deployment chain for an invention to progress from a basic idea until it ultimately finds its place in the market. This is a process of continuous innovation that, as we all know from the smart phone example, continues as the market expands.

Chart 2. The Invention-Deployment Continuum



To be widely adopted, a product or technology needs to be perceived as "usable," that is suitable for the consumer in performance and better than the current technology or approach in some important dimensions, including perhaps environmental performance. It also must be readily available at a time and place the consumer wants it. The product or technology also needs to be competitive with available alternatives in terms of final cost. For global adoption, that means achieving lower unit costs through standardization, scale, and production experience. All these considerations are critically important if the product or technology is to be successful in emerging and poorer developing countries, even with substantial help from OECD or other external financial sources.[vii]

Even existing decarbonization technologies can be improved with continued innovation. Chart 3 identifies where innovation can address key challenges to the full-scale global deployment of decarbonization technologies. Each technology has advantages but faces a particular set of barriers to mass deployment centered on usability, affordability, and availability.

Chart 3. Key Decarbonization Technologies and Opportunities for Further Innovation

Wind & Solar[viii]	Electric Vehicles[ix]	Batteries[x]	Nuclear[xi]	Direct Air Capture and Carbon Capture and Sequestration[xii]
- Better reliability and grid integration - Price declines at residential and commercial scale - More secure supply chains - Required infrastructure	- Longer range - More affordable models - Improved infrastructure and charging stations	- Expand availability for all applications - Reduce input prices, especially for minerals - Supply chain constraints and vulnerabilities	- Familiarity building and bringing on-line new facilities - Plant and regulatory costs - Address public safety concerns	- Identify additional sites - Better integrate with existing infrastructure - Lower capital and regulatory costs

Reinvigorating U.S. Innovation

As we have seen, the innovation challenge exists at all stages in the continuum. Governments can play a key role in promoting or discouraging innovation. This is because at its simplest level, innovation decisions are driven by the perception of the balance between search costs and potential rewards. Is the potential benefit of successful innovation lucrative enough and certain enough to justify the risk and cost of searching for it? The calculation will include the opportunity costs of other things that could be done with the people or money involved. Both sides of this equation have important dimensions that governments can influence, for good or ill.

Stages of the Invention-Deployment Continuum

Early Stages

The early stages of the invention-deployment continuum are in many ways the easiest for governments to impact. Governments can do their own research work and make the findings available to the market; but government dollars will always be limited and deciding the right areas for such work will almost always lack the vital insight of market (consumer) feedback. An additional way to tip the scales toward investment in innovation is by reducing the real cost of the search for private companies. A prime tool is direct subsidies for the research or other work.[xiii] These are widely accepted to be most effective when the subsidies are general and technology neutral,[xiv] such as in the case of the U.S. R&D tax credit, first introduced in 1954. Unfortunately, the value of this credit was significantly undermined in 2022 when immediate expensing was replaced by amortization of R&D over five (domestic R&D) or fifteen (overseas) years, a significant reduction in an era of higher inflation.[xv] But even with generous R&D subsidies, an innovator needs to be confident that the ultimate commercial benefits of their search for an innovation will be worth the costs. The skilled staff concerned are limited, and their time has significant opportunity costs.

Benefits also need to be tangible and reliable (or at least relatively predictable) to be most effective. Governments can achieve this by guaranteeing the company's ultimate market through eliminating or reducing competition. This can have negative consequences for consumers. For example, for most of the 20th century, telephone systems worldwide were closed to competition. De-monopolization resulted in a wave of technological and service innovations and benefits we all enjoy today. Conversely, governments can ensure robust competition and transparency, which will allow innovators to gain market share. Consider that liberalized power markets in Texas have been a principal driver of electricity decarbonization and renewable uptake.

Demonstration Phase

A new idea in the energy field usually requires a field demonstration phase. This is akin to the prototype stage in a product market, though it is usually a lot more complex and expensive. Because the energy field is so heavily regulated, demonstrating a new technology requires a high degree of certainty on cost recoverability—and regulatory space to operate the plant (and learn from it) before the final regulation that will ultimately govern its use is designed. Both represent important roles for government. The provisions for new experimental nuclear reactors in the IRA are a good example of necessary financial support in action. The Nuclear Regulatory Commission's approach, which meant NuScale spent over $500 million just to prepare a design certification application for its new small modular reactor family, sadly shows a less happy story[xvi].

In the Marketplace

Beyond the demonstration phase, governments can push technology into the market through their efforts and incentivize, or even commission, private actors to do the same. In the most extreme case, the government can directly build and sell new products or buy them itself. The main government tools to facilitate deployment of low-carbon technologies are:

- **Direct procurement.** The government is a major consumer in the domestic economy. Its procurement decisions can secure markets for new technologies, like fleet electric vehicles or liquid fuel alternatives.

- **Prescriptive product standards.** Governments can use regulation to establish facility or equipment performance standards that require specific technologies or attributes, like the stipulation for "best available technology" in the U.S. Clean Water Act.

- **Subsidies.** Governments can provide specific subsidies for clean energy technologies to encourage demand or drive-up domestic investment.

- **Broad "clean energy" or "clean fuel" standards.** Governments can establish power or fuel standards that require a certain amount of energy to come from renewable or zero carbon sources or require that fuel supplies become progressively lower carbon.

Such policy interventions must consider that government approaches will have natural limits. Government cannot substitute for the wealth of knowledge and preferences provided by consumer feedback in the marketplace. As such, government policies tend to identify and support a narrower set of technologies, needed innovations, and consumer preferences, than the market left to its own devices.

Effectiveness

The U.S. government and many state governments are using all these tools. The collective experience has demonstrated both their potential and limitations. Since 2005, U.S. net greenhouse gas emissions have fallen by 12%, an average year-over-year reduction rate of 0.9%, much of it by replacing coal with natural gas. At that pace, U.S. net emissions in 2050 will still be about 75% of today's levels.[xvii] To achieve net-zero emissions requires a rate of reduction that is many times the historic rate.

The U.S. needs to reinvigorate the American innovation machine to identify new and more rapidly deploy existing technologies. This means recognizing the benefits of existing policies but also acknowledging and addressing the limitations. The IRA is clearly directionally helpful, but even at full implementation, it is expected to cut domestic emissions just 10% more than business as usual.[xviii] That will put the U.S. short of its target to cut emissions in half by 2030 and well-short of a net zero future.

Increasing Market Certainty and Clarity

Innovators need to know that their investments are likely to be rewarded by the marketplace. That requires a market to function by normal rules, with market signals that reflect business and consumer preferences. One of the least recognized challenges to innovation and deployment is the gradual erosion of market signals as the primary driver of business and consumer decision-making. This is occurring at both the product level and the firm level.

For many decarbonization products, the preponderance of government policies creates distortions by moving the market away from market-based signals and toward policy signals. For example, the electricity market has been impacted by a variety of policies intended to rapidly deploy wind and solar, which are the cheapest new sources of power in the United States provided they can be accommodated within the grid infrastructure.[xix] Those policies interact poorly with the electricity marketplace, and have exacerbated reliability challenges by distorting market signals, weakening utilities' ability to plan for the future, and complicating the operations of firm power sources needed to support reliable electric service.[xx]

Other policies can create price signals independent of market forces. For example, the California Low Carbon Fuel Standard (LCFS) intends to reduce the carbon-intensity of transportation fuels consumed in California. It includes a cap-and-trade function that encourages or penalizes the purchase of certain types of liquid fuels and an alternative compliance pathway that subsidizes the construction of electric vehicle charging infrastructure.[xxi] This alternative compliance pathway has evolved over time into a large program to subsidize the ownership costs of electric vehicles; by 2030, the LCFS will divert more dollars to electric vehicles than to programs intended to curb emissions in the liquid transportation fuel market.[xxii] This program has offered billions in support to the electric vehicle industry. California accounts for nearly 40% of all electric vehicle registrations nationwide.[xxiii]

These policy-driven incentives can create challenges for invention and deployment. First, policy-driven incentives are often shaped by lobbying by special interests. This can produce incentives for larger or incumbent firms but leave out smaller firms, often the engine of innovation. These smaller firms may be reliant on clear market signals that are upended by policy-driven signals. Second, policies can create uncertainty for businesses making investment decisions; uncertainty over the scale or longevity of a policy signal can hold back investments that would be made if the market were more certain.

This lack of predictable and tangible incentives based on market signals materially changes how companies invest. For example, the nonprofit Carbon Disclosure Project has laid out a roadmap for energy technology investments and the criteria that firms should consider as they build their business case. Few are financially quantifiable, and all require forecasting—not only of product markets, with which companies are familiar and comfortable, but also current and future government policy approaches.[xxiv] For firms working to balance potential rewards against search costs, these uncertainties can shrink and slow investments in needed invention and deployment.

Chart 4. Policy Choices Shape the Business Case for Decarbonization Investments
Source: CDP: Emerging Climate Technology Initiative, 2021

Despite the limitations of policy approaches, the U.S. has substantially reduced emissions in recent decades—but not enough. To accelerate clean energy innovation, private companies need a clear line of sight to the rewards that their efforts will open up. Innovations that lower emissions must become inherently more profitable, regardless of where in the economy they reduce emissions, by what methods, or at what scale; incentivizing all emissions reductions will ease the U.S. glidepath to a net zero future.

The Solution: A U.S. Carbon Price

The single most powerful tool to reinforce existing policies and accelerate clean tech innovation and deployment is a U.S. price on carbon. A carbon price would establish concrete and predictable benefits for companies' research and investment spending to make clean tech more available, useful, and affordable. Any investment that can deliver zero-emission alternatives would see an added commercial advantage. This is equally true of existing, familiar low-carbon energy and technology alternatives as it is of the solutions that will deliver reliable, affordable energy and energy services into the future.

This is how a carbon price functions: it improves the potential benefits of clean energy innovation by creating incentives across current and future supply chains for low- or zero-carbon products. It rewards advancements at every step along the invention-deployment continuum, unleashing the full capacity of the U.S. market toward decarbonization.

As mentioned above, prior Council research has demonstrated that an economy-wide carbon price can accelerate decarbonization in the electricity sector and unlock $1.4 trillion in new capital deployment by 2035.[xxv] Notably, that capital would be directed both at technological leaps, like carbon capture and storage and huge build-outs of renewables, and at meaningful innovations that are not primarily related to technology breakthroughs, like industrial efficiency improvements and shifts in manufacturing processes.[xxvi] This is the nature of needed innovation: market-shifting inventions, but also more experience with and deployment of familiar technologies and processes that deliver incremental emissions reductions.

A carbon price can unlock such broad invention and deployment benefits because it has several distinct advantages over expansion of the existing policy tools:

Reach and Comprehensiveness. An economy-wide carbon price puts a clear monetary value on reducing carbon emissions and so immediately tilts the marketplace toward zero- or low-carbon choices. Any solution that helps cut emissions is equally rewarded without policymakers identifying new subsidies or regulations to ensure deployment. Instead, market innovators can select any available decarbonization pathways that helps them reduce emissions, avoid the carbon price, and benefit financially. Unlike subsidies or regulations that target certain stages along the invention-deployment continuum, a carbon price offers a persistent and pervasive signal that continuously pulls all clean technologies, processes, or methods through to the next stage of development.

Speed. Once a price is set, it will start shifting decisions in the marketplace. This will be true even before the price goes into effect. The private sector will begin making investment and capital deployment choices with an understanding about the future impact of the carbon price. This can dramatically compress implementation timelines and accelerate capital turnover. And if the price is set over a reasonable time horizon and designed to be responsive to changes in emissions, it will not need to be periodically updated or retooled like other innovation or deployment policy strategies.

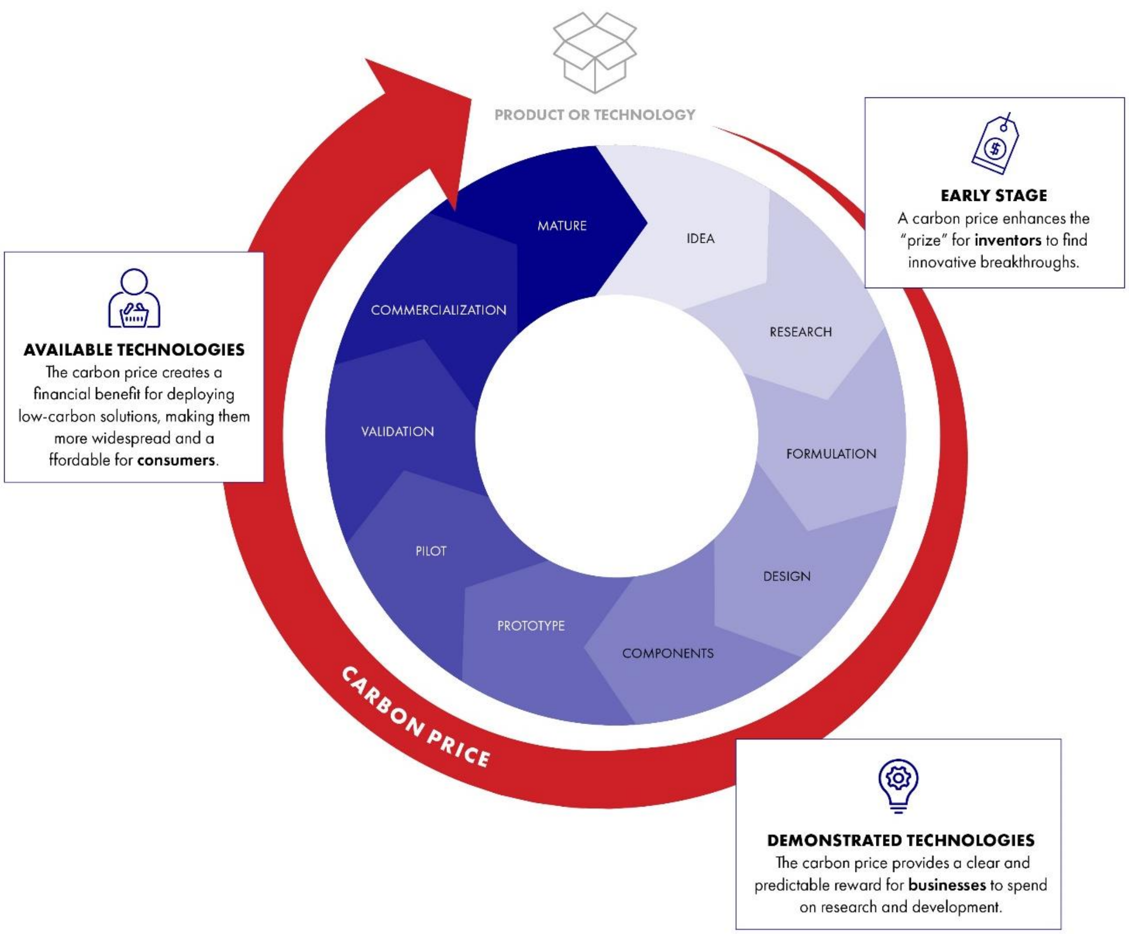
Predictability. The future carbon price path is known and can be built into investment and purchasing decisions. In this way, a carbon price offers predictability over a regulatory approach or even subsidies subject to congressional sunset dates or regulatory rulemakings. The clear, long-term expectation for economic rewards clarifies what innovation and deployment investments may be profitable. The predictability of a carbon price may also allow Congress to reshape existing subsidies toward more intractable decarbonization challenges, address climate change in other ways, or reduce the deficit.

Progressivity. Decarbonization will require meaningful shifts in the ways we make and use energy and products across the economy, including at the household level. A carbon price can support dividend payments to households that can help insulate consumers from rising energy costs during the transition to clean energy and recognize the powerful role that households will play in identifying and deploying preferrable decarbonization solutions. Dividends can ensure that most American households are financially better off under a carbon price than without one.[xxvii]

International Leverage. A carbon price ensures that all companies doing business in the U.S. market are held accountable for their contributions to global carbon emissions—even those businesses that import goods from abroad. More than 70% of U.S. imports come from countries that are more carbon intensive than the U.S. economy,[xxviii] which means a carbon price will force international firms to decarbonize or lose U.S. market share. Combining a domestic carbon price with a border carbon adjustment will level the domestic playing field and give the U.S. more leverage over international partners to reduce their emissions.

For all these reasons, a carbon price is a powerful and comprehensive approach that is missing from the existing innovation policy toolkit. It offers clear benefits over other policy approaches that target distinct technologies or specific stages of development. Returning to the invention-deployment continuum, a carbon price would reverberate through each stage and draw innovation through from concept to maturity.

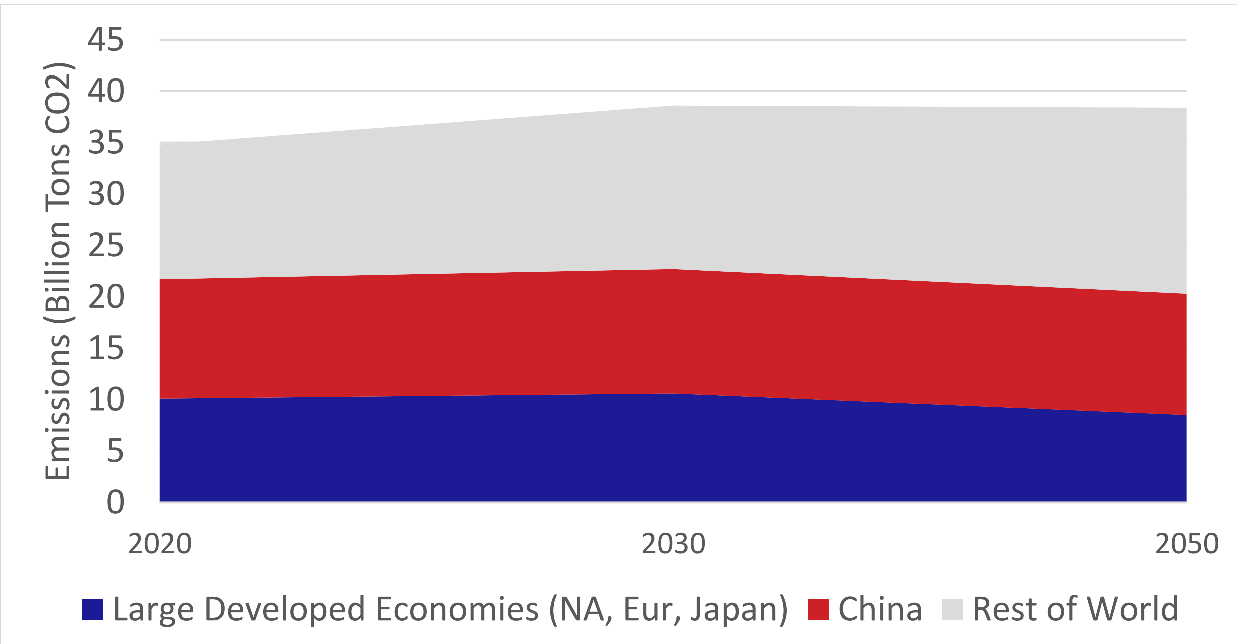
Chart 5. A Carbon Price Pulls Technologies Along the Invention-Deployment Continuum



U.S. Innovation is Vital to Global Decarbonization

In relatively rich, developed, and climate ambitious economies like the U.S., Europe, and Japan, emissions are flat or falling. The rest of the world, excluding China's emissions, emit 38% of the global total and will continue to grow, absent significant changes in the energy sources and products that are available, affordable, and reliable from their perspective. IEA's 2022 Stated Policies Scenario, which assumes countries do everything they have proposed in their Nationally Determined Contributions (NDCs) under the Paris Agreement, shows that by 2050 "Rest of World" emissions rise by 20% to be 44% of the higher global total. It is clear that the global emissions problem cannot be solved without significant change in poorer countries' energy options.

Chart 6. CO2 Emissions Under IEA Stated Policies
Data Source: IEA World Energy Outlook 2022 (Table A28)



Wealthy countries are already benefiting from continued innovation in clean technologies, and their experiences will make more technologies affordable and usable in emerging markets. The U.S. can play a central role.

Poorer countries need energy to grow their economies to address human development goals and reduce poverty. They are handicapped by the frequent lack of infrastructure, poorly developed markets, and inability to afford the subsidies and energy costs which have underpinned the transition to date in the OECD. While developing country governments have a major role to play in creating the business environment for successful investment in their energy markets, ultimately usable clean technologies to support net zero will have to be made available to poorer country consumers at prices they can afford. In other words, a vast amount of innovation is necessary before poorer countries can fully follow those in the OECD down the energy transition path.

The U.S. is ideally positioned to promote and benefit from such innovation. The U.S. economy is historically an engine of innovation. The U.S. benefits from skilled workers, strong intellectual property protections, ready access to capital, market-led creative destruction, and relatively low regulatory barriers to deployment. These factors have helped to establish the U.S. market as an incubator for innovations. Air conditioners, color TVs, personal computers, and numerous other consumer products began life in the U.S. before being exported worldwide. The U.S. market is also vast, accounting for nearly a quarter of the world's nominal GDP in 2021, or about 36% more than China's share.[xxix] It also has relatively high levels of consumer income: GDP per capita in the U.S. is 27 times the average level for lower- and middle-income countries.[xxx]

The U.S. has a record of rapid innovation in certain sectors, especially where regulation is limited or absent—internet technology or software, for example. Equally successful is innovation in areas where rewards are particularly high, such as in the medical or pharmaceutical fields. However, these industries are significantly different from the sectors that are most likely to drive decarbonization. IT and medical product cycles are relatively short (five years in IT, less than 20 years in medicine). The amount of committed capital that is tied up by such rapid innovation is therefore limited.

By contrast, in the energy field, change has been slow—typically a matter of generations rather than years.[xxxi] The sector has long production life cycles: 30-40 years for production and generation assets. Meanwhile, capital costs are very high. One deep water appraisal oil well can require $250 million in investment,[xxxii] while a single nuclear power plant can cost nearly $30 billion to build.[xxxiii]

There are exceptions to this story. U.S. fossil fuel production saw rapid price declines and productivity gains thanks to hydraulic fracturing and horizontal drilling. In 2021, utility-scale wind and solar became in most cases the cheapest new sources of power in the U.S., edging out natural gas. Yet even these evolutions were based on techniques dating back decades, and the requisite innovation permitting wide adoption and market changes took decades.

To reach net zero, the world will need to dramatically accelerate change in this difficult area. We need advances, not only in energy production and transmission, but also in the ways in which consumers and manufacturers use energy and energy-intensive products. Global progress requires U.S. innovation leadership. By leveraging the vast U.S. market, companies can build capacity. Through innovation, learning, and experience, they can attain economies of scale that can allow them to reduce costs sufficiently and provide these new clean technologies affordably to promising and potentially lucrative overseas markets.

Conclusion

Unleashing the full innovative capacity of U.S. businesses requires a policy that supports innovation throughout the economy and nudges billions of everyday decisions about energy toward lower carbon and more efficient choices. The right policy mix, including a carbon price, can drive innovation and deployment at the same time.

The current suite of U.S. government actions and policies have promoted the deployment of some clean energy technologies and encouraged innovation in some key areas vital for decarbonization. To date, the pace and range of innovation and deployment supported by existing policy is insufficient. The IRA will help close the gap, but it does not put the U.S. on track to satisfy its international climate commitments. We need to accelerate innovation and deployment dramatically to reach ambitious climate goals by midcentury.

Existing tools alone cannot yet meet such a challenge given the real-world constraints on their scale and effectiveness. Adding a carbon price to the policy mix would increase the certainty of rewards needed for innovation and thus comprehensively incentivize deployment of many existing and new technologies and speed up that process. The carbon price adds a powerful instrument to the suite of government approaches to innovation and deployment and builds a platform for market-driven innovation to create significant, tangible rewards for U.S. inventors. In turn, U.S.-innovated decarbonization approaches will be market-tested and more viable in the rapidly growing developing and emerging markets that even today represent two-thirds of global emissions.

Notes

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