MILKEN INSTITUTE

FINANCIAL INNOVATIONS LAB®

Models for Financing an Environmentally Sustainable Business Transition

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The Milken Institute is a nonprofit, nonpartisan think tank. We catalyze practical, scalable solutions to global challenges by connecting human, financial, and educational resources to those who need them. We leverage the expertise and insight gained through research and the convening of top experts, innovators, and influencers from different backgrounds and competing viewpoints to construct programs and policy initiatives. Our goal is to help people build meaningful lives in which they can experience health and well-being, pursue effective education and gainful employment, and access the resources required to create ever-expanding opportunities for themselves and their broader communities.

About Financial Innovations Labs®

Financial Innovations Labs® bring together researchers, policymakers, and business, financial, and professional practitioners to create market-based solutions to business and public policy challenges. Using real and simulated case studies, participants consider and design alternative capital structures and then apply appropriate financial technologies to them.

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Maressa Brennan prepared this report.

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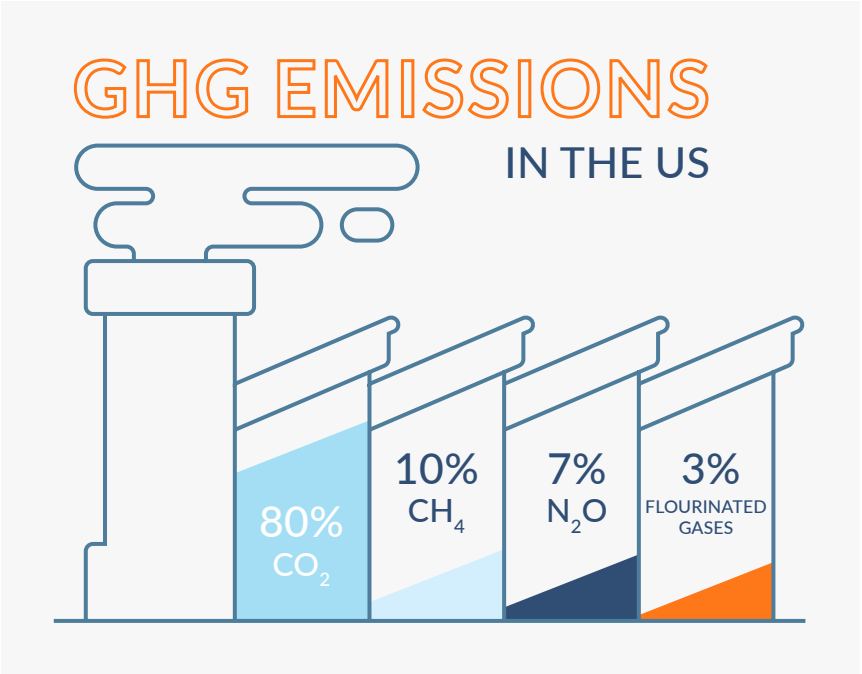
INTRODUCTION

There is undeniable evidence that changes to the climate impact the day-to-day lives of individuals, communities, and corporations alike. The latest report from the UN Intergovernmental Panel on Climate Change (IPCC), released in August 2021, confirms that increased emissions of greenhouse gases (GHG), so-called because they absorb and trap heat in the Earth's atmosphere, have irreversible consequences. Climate change has arrived and more quickly than was predicted in previous assessments.[1] Its repercussions, in the form of extreme heat waves, wildfires, superstorms, and flash floods, are already scarring, charring, flattening, and inundating large swaths of land, devastating cities and towns, and uprooting lives and livelihoods. With an intense focus on an environmentally sustainable future by organizations, both big and small, adapting the existing systems and developing new, cleaner technologies will be critical.



Dire long-term consequences hold as well for corporations. "It is unequivocal," states the IPCC report, "that the increase of [carbon dioxide] CO_2, methane (CH_4) and nitrous oxide (N_2O) in the atmosphere over the industrial era is the result of human activities, and that human influence is the principal driver of many changes observed across the atmosphere, ocean, cryosphere, and biosphere."[2] Without the collective efforts of all sectors, there will be no sustainable future—and firms' longevity will be defined by how well they adapt and reinvent their business models toward cleaner energies and technologies. The industries that impact our daily lives—oil and gas, transportation and shipping, electrical generation, agriculture, heavy manufacturing, food production, water, and waste management—will be some of the most impacted. None of these sectors have much time to align their transitions to cleaner processes and practices with the goals and obligations of the 2015 Paris Agreement, especially as they assess the "cradle to grave" emissions footprint in their supply chains.

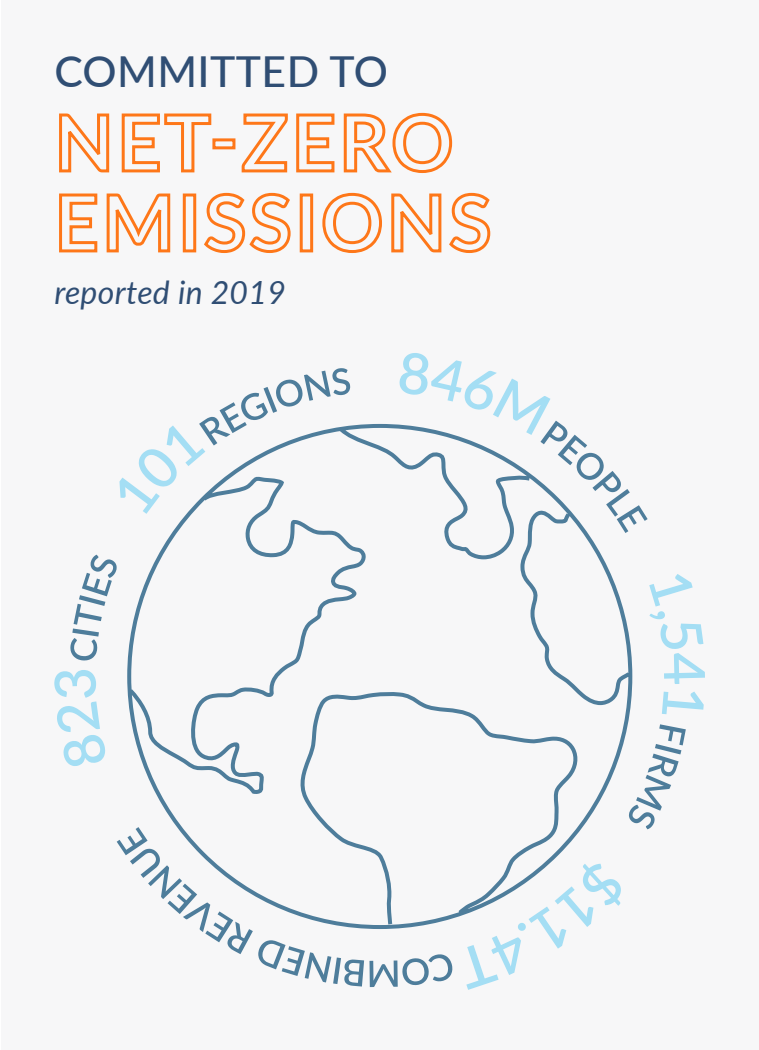
The goal of the Paris Agreement has been "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[3] As background, climate scientists typically use the period 1850–1900 as the "pre-industrial" global average reference point because this was the earliest period for which observations were widespread and reliable. Researchers can calculate warming trends across other periods relative to that measure.

Well-mixed GHGs are essential for safeguarding the Earth's layered atmosphere and keeping the planet habitable. But high GHG concentrations that

cannot be removed by natural processes or reabsorbed back into the oceans or soil—both are known carbon sinks—remain in the atmosphere, trapping heat. At 80 percent of the total US GHG emissions, carbon dioxide (CO_2) is the main global warming culprit, followed by methane (CH_4) at 10 percent, nitrous oxide (N_20) at 7 percent, and fluorinated gases at 3 percent.[4] The "net-zero" goal is achieved when emissions decline or are removed from the atmosphere at the same rate they are added. The world needs to address all excessive GHG emissions to achieve environmental sustainability.

The 26th annual UN Climate Change Conference of the Parties, or COP26 (Paris 2015 was COP21), scheduled for November 2021, bills itself as the world's "best last chance to get runaway climate change under control."[5] Delegates from 191 countries will meet to finalize the Paris Agreement implementation rules and negotiate other issues, including mobilizing climate finance commitments, reducing consumption of fossil fuels, building resilient infrastructure, and increasing investment in renewables.[6] There will be debates about climate justice and who bears the highest costs, but the global will to change is unmistakable. The NewClimate Institute, based in Cologne, reported in late 2019 that in less than a year, the number of agencies and organizations worldwide committed to net-zero emissions had almost doubled to include 823 cities and 101 regions representing 846 million people. In addition, 1,541 firms, with combined revenue of $11.4 trillion, have pledged to reduce their net emissions to zero.[7] They will be helped by new investment strategies using risk-reducing financial technologies and cost-effective capital structures.

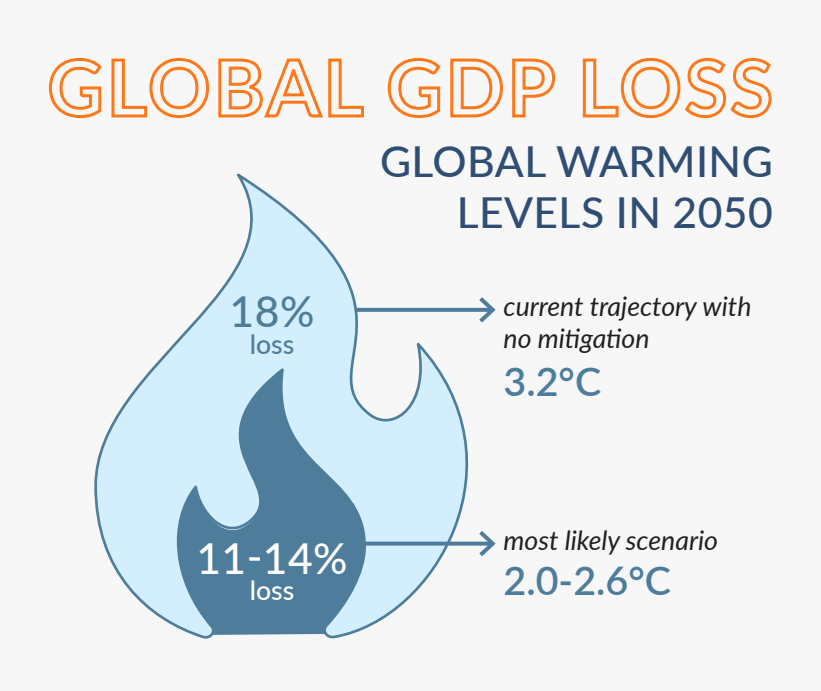
As environmental, social, and governance (ESG) investing grows, asset managers and investors increasingly want to identify innovative opportunities to help corporations meet sustainable transition targets. Because national policies will play a significant role in defining investment markets, the Milken Institute organized a Financial Innovations Lab in June 2021 to explore financing opportunities for facilitating investment in sustainability transition elements in North America, mainly the United States. The Lab brought together investors, asset managers, clean tech startups, consultants, and corporations to develop recommendations to expand the range and availability of investment opportunities and market-test new financing structures.



ISSUES AND PERSPECTIVES

The Cost of Climate Change

The effects of climate change can be found everywhere. While some effects seem potentially reversible—over some regions, the ozone shows signs of repairing itself[8]—others lie far beyond comprehensible human time scales. Ocean warming, acidification, and sea level rise can take thousands of years to reverse; growing back ice sheets can take tens of thousands of years. But increasingly, the world does seem to comprehend the gravity of the risk. Green New Deal initiatives have taken root at national levels globally. State legislatures are passing bills to require and incentivize renewable energy and GHG reductions. For the first time in its 15-year history, respondents to the World Economic Forum's "Global Risk Perception Survey" placed climate-related crises—extreme weather, climate action failure, natural disasters, biodiversity loss, and human-made environmental disasters—in the top five slots of risks "likely" to occur. They also ranked climate action failure, biodiversity loss, and extreme weather among the top five risks (joining weapons of mass destruction and water crises) whose impacts would be most significant.[9]



Consumers and corporates are also coming to terms with the massive economic and financial costs that will accompany climate change mitigation even if immediate, cumulative, deep steps are taken. Analyzing predictions that global warming, even with mitigation efforts, will reach 2.0–2.6°C (rather than the Paris target of well under 2.0°C) by 2050, the Swiss Re Institute has modeled global warming scenarios—at 2°C, 2.6°C, and even 3.2°C—showing how each would likely affect global GDP relative to a world without climate change. For the most likely global warming scenario of 2.0-2.6°C, even with mitigation, the loss in global GDP relative to a world where climate change does not exist could run 11 to 14 percent. GDP losses spike to 18 percent if the current trajectory continues with no mitigation and global warming reaches 3.2°C. Even with mitigation and the Paris target of global warming below 2.0°C in 2050, global GDP is estimated to be 4 percent lower than it would have been in a world with no global warming.[10]

The current IPCC report and its two companion reports all build off five "core" scenarios representing different climate change mitigation levels and the likelihood of their projected impacts on global warming trajectories through 2100. The mitigation/likely scenarios are examples of what is known in the literature as Shared Socioeconomic Pathways (SSPs), which reflect societal choice and socioeconomic factors. The scenarios build on previously developed Representative Concentration Pathways (RCPs), which focused more scientifically on GHG levels. The future projections are essential for corporations because they allow them to identify risks their activities pose and quantify the cost of continuing with business as usual. While a transition will undoubtedly be expensive, doing nothing will cause an even more significant hit to balance sheets.

THE IMPACT ON SOCIETY

Quantifying the costs of climate change across society depends on which aspect of the challenge is analyzed. The social costs of CO_2, for example, are defined as the "measure, in dollars, of the long-term damage done by a metric ton of carbon dioxide (CO_2) emissions in a given year," and include "changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning."[11] Measuring social costs is subject to uncertainty, in part because they do not incorporate all economic or ecological impacts, some of which are not fully understood. Future emissions impacts are expected to exacerbate systems and economies already struggling to adapt.[12] Models that depict climate change damage as a proportion of GDP, using a 3 percent discount rate, show social costs ranging from $51 in 2020 to $85 in 2050.[13] Higher discount rates are said to result in lower social costs.[14]

Damages caused by extreme weather are among the most direct costs. Since 1980 the United States has weathered 285 climate disasters whose individual damages exceeded $1 billion. The average annual cost from 2016 through 2020 topped $121.3 billion. All US records were broken in 2020, during which 22 extreme climate-related events resulted in damages costing $95 billion. Since the National Oceanic and Atmospheric Association's National Centers for Environmental Information began tracking such events in 1980, the cumulative cost is nearly $1.9 trillion.[15] Yet even as covered losses mount, so have uninsured losses. The Swiss Re Institute notes that from 2017 to 2018, global insured losses totaled $219 billion, while uninsured losses—a "global all-catastrophe protection gap"—came to $280 billion.[16] As natural disasters increase in frequency and destruction, that gap is likely to expand further. Unfortunately, communities that are already experiencing health-threatening weather are only expected to get worse.

THE IMPACT ON CORPORATIONS

The global standard for calculating GHG emissions comes from the World Business Council for Sustainable Development and the World Resources Institute. Their Greenhouse Gas Protocol breaks down an organization's GHG emissions into three categories, called "scopes," for international accounting purposes. Scope 1 emissions derive from fuels a business generates directly, in its own facilities or its fleet of vehicles; Scope 2 emissions are indirect, generated by the company's operational use: electricity, steam, heating, and cooling; and Scope 3 emissions, also indirect, come from the activities that the firm does not own but which are still part of its value chain (e.g., business travel, waste disposal, purchased supplies, upstream and downstream transportation and distribution).[17] "The Scope 3 emissions for one organization are the Scope 1 and 2 emissions of another organization," notes the Environmental Protection Agency (EPA), which harmonizes its guidance with the international protocols.[18] The EPA adds that Scope 3 emissions may be a firm's largest GHG emission source and thus an area to look for mitigation measures.

The EPA requires annual GHG self-reporting "from large GHG emission sources, fuel and industrial gas suppliers, and CO_2 injection sites." Small businesses are generally exempt. California has required qualifying firms that operate in the state to report their GHG emissions since 2006. As of March 2012, 19 states and Puerto Rico have instituted statutory GHG reporting and/or statutory reduction requirements, or registered in two cap-and-trade programs addressing the power and transportation sectors.[19] Firms can access the data

to see how they are faring relative to industry peers and gain insight into energy-saving processes and policies.

Some of the most well-known brands and companies are also, unfortunately, some of the largest GHG emitters. One hundred fossil-fuel producing (coal, gas, oil, oil sands) companies account for 71 percent of industrial emissions worldwide.[20] The top 15 US food and beverage companies generate 630 million metric tons of GHGs annually. That total is comparable to the output of all of Australia.[21] Fortunately, many firms—including 23 percent of Fortune 500 companies—have made pledges to reduce their GHG emissions to net-zero.[22] And of the 187 firms responding to the American Business Act on Climate Pledge, 138 have reportedly met or are expected to meet the 2020 goals they set in 2015 to reduce energy consumption, water usage, waste, or emissions.[23]

Since 2000, the nonprofit organization CDP (formerly Carbon Disclosure Project) has been helping these firms and others worldwide with their GHG disclosures. In its 2020 *Global Supply Chain Report*, which analyzes survey responses and disclosures of more than 8,000 suppliers of 154 major buyers, CDP concludes that "$1.26 trillion of revenue is likely to be at risk over the next five years due to higher costs associated with shifting markets, regulations, and routes related to climate change, deforestation, and water insecurity." The report also notes that in 2020, improved reporting over the entire supply chain life cycle (Scope 3) is now reflected in a significant increase of suppliers' upstream emissions—more than 11 times the total of their operational emissions, and up from 2019, when the upstream emissions were 5.5 times their operational emissions.[24] That reporting is a good thing; the nonprofit notes that 94 percent of the surveyed suppliers whose climate goals are aligned with IPCC and other science-based targets also report their Scope 3 emissions numbers.

Often companies lack access to the technologies they need to improve their processes; reasons vary from cost (legacy options are less expensive to maintain) to practical reasons (the technology is not yet available at a commercial scale). They may not have the in-house expertise to analyze the science to decipher the costs and benefits of new technologies or products. There are challenges of investing at a scale that will pay off, both for companies at the forefront of technology development and those hopeful to use the new technologies. Corporations are looking for proven commercial-scale innovative technologies. But these also require upfront capital and time for research, testing, marketing, and launch.

Corporations have traditionally tried to offset their carbon emissions by planting trees, setting aside parks and open space, supporting green infrastructure, or engaging in cap-and-trade. Under the Kyoto Protocol, more than 200 kinds of projects qualify as carbon offsets. However, there is a consensus that carbon offsets are insufficient to achieve net-zero goals and keep global warming to a manageable level. This is forcing corporations to rethink their approach to meeting climate targets.

Carbon pricing is a mechanism by which governments can encourage their economies to transition to lower emissions or help cover the costs of short-term effects. For example, Canada introduced a carbon tax on diesel fuel in 2019, several US states participate in cap-and-trade programs, and various EU countries already have a carbon tax. In May 2021, the EU started the process of implementing a carbon border adjustment mechanism that reduces a company's ability to avoid regulation by moving operations to a region without a tax. Under a border adjustment policy, certain goods imported into Europe will be subject to carbon taxes.[25] With consumer preferences and regulations changing, corporations have a financial and environmental incentive to transition their supply chains and processes to be more sustainable.

Scaling Climate Technologies

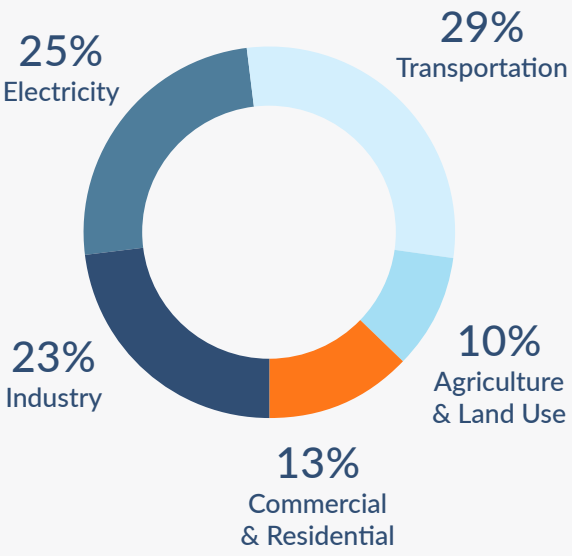
Lab participants addressed technology needs and time horizons across major sectors and identified financing options in each that could help innovations attain a commercially viable scale. Industries and technologies have varying short- and long-term costs. Short-term costs, for example, are the cost of switching from coal-powered electricity to solar-generated electricity. Both technologies are available today; the short-term cost is the price difference between the two. On the other hand, long-term costs, like investing in the research and development of technologies, consider how capital

invested today will advance interventions that will help to lower the cost of reducing emissions in the future.

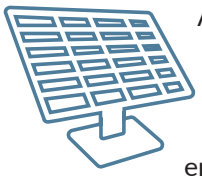
AREAS OF OPPORTUNITY

Any significant transition presents areas of opportunity. Given the scale of the required climate transition, the potential opportunities are substantial. Improved efficiencies, whether in supply chains, processes, or energy usage, can help a company lower its costs and enhance its resilience by no longer relying on a limited commodity or shifting to more locally available resources. Most substantially, change spurs innovation that can produce new and improved technologies that spur yet more innovation.

FIGURE 1: TOTAL US GREENHOUSE GAS EMISSIONS BY ECONOMIC SECTOR (2019)

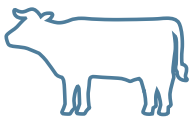


Source: Adapted from EPA, Inventory of US Greenhouse Gas Emissions and Sinks, 1990-2019 (2021)



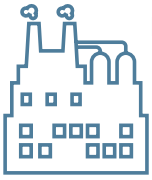
As noted, every industry needs cleaner technologies. For some, the need is immediate—the energy sector is responsible for 76 percent of GHG emissions each year.[26] This significant percentage includes energy use across various industries. Electricity generation alone makes up 25 percent of GHG emissions.[27] With the shift from coal to natural gas and an uptick in renewables, electricity emissions decreased for a period (2013–2016). However, in more recent years, data shows electricity generation emissions rising again.[28] Opportunities for decarbonization include efficiency updates to existing grid systems, which could help reduce wasted energy such as natural gas pipeline leaks or energy lost in the distribution process. Upgraded storage capacity for renewable energy to save the power generated by wind and solar to be used when the wind isn't blowing or the sun isn't shining is an area currently receiving much attention. Additionally, emission abatement technologies and further R&D in nuclear and alternative fuels can help to reduce the reliance on outdated systems.

As a standalone industry, transportation is the highest polluter, as represented in Figure 1 (above). The EPA reports, "between 1990 and 2019, GHG emissions in the transportation sector increased more in absolute terms than any other sector."[29] Low-hanging fruit to address transportation emissions includes investing in alternative mobility options, such as bike and pedestrian paths. Electric vehicles are gaining popularity, requiring additional system electrification for charging stations. Air travel is a significant issue area, so improving the pricing and availability of cleaner fuel options, such as sustainable aviation fuel (SAF) and other biofuels, is a market opening. In general, infrastructure upgrades, as in air-traffic control systems and traffic congestion to prevent vehicle idling, will have beneficial impacts.



As previously mentioned, the largest-contributing GHG to climate change is CO_2. It is the most emitted pollutant by metric ton because it is the highest emission from most industries. However, the emissions associated with various agricultural activities are more heavily concentrated in methane (CH_4) and nitrous oxide (N_20).

According to a 2018 report by the US Department of Agriculture, "US agriculture emitted an estimated 698 million metric tons of carbon-dioxide equivalent in 2018: 12.3% as carbon dioxide, 36.2% as methane, and 51.4% as nitrous oxide."[30] Agriculture and land use have a variety of adaption options to help lower emissions. Many involve expanding farming techniques that can lower the quantity of water and land needed for production. Improvements to irrigation techniques can reduce water waste. Revamping existing supply chains to focus on locally available and naturally growing food sources will lower transportation costs and may require fewer synthetic fertilizers. Additionally, further R&D of drought-resistant or faster-growing crops can help communities manage seasonal plights. Plant-based meats help reduce the emissions associated with livestock.



Heavy industry, such as steel and cement production, is one of the fastest-growing sectors. Industry also refers to waste processing and other forms of manufacturing, meaning no one solution will address all businesses. Across industry sub-sectors, the technologies needed for mitigation and recycling are complex and require significant capital commitments. While Scope 2 emissions (purchased electricity) are a substantial driver, there must be innovation around heat and conversion processes. Opportunity areas include transforming current recycling processes and developing lower GHG alternatives for the manufacturing process. Advancements in the hydrogen market stand to benefit many industrial processes that require high heat for production.

Commercial and residential real estate, infrastructure, and construction utilize many materials produced by heavy industry. As referenced above, steel and cement manufacturing create significant emissions, including the upstream and downstream processes, so consequentially, as building materials, they have high levels of "embodied" carbon. Reducing the emissions associated with input materials is an area for innovation and investment. Once a building is in operation, opportunities exist to lower emissions through heating and cooling efficiency updates.

THE SPECTRUM OF TECHNOLOGY NEEDS

Since the opportunity to reduce emissions is present across all sectors, the spectrum of technology needs is vast. Investment here can offer diversified opportunities with stable and predictable cash flows and can be broken into three categories, each of which requires a different type of investor.

Roughly 40 percent of climate technologies, as estimated by Lab participants, are commercially proven, mature, and readily financeable. For example, wind and solar contracts are relatively well standardized, and development projects have access to the financial markets through securities and other well-understood investment vehicles. These projects are typically backed by manufacturer warranties, long-term contracts, and government subsidies over significant investment horizons that match institutional investor needs. Being more mature technologies, they have achieved market scale, can raise and deploy capital effectively, and have an understood benefit to the market.[31] Many infrastructure-style investments are also well understood. Over the last decade, billions of dollars have flooded into financing natural gas pipelines. As markets integrate hydrogen as a cleaner energy source, pipeline investments will be key to scale. Upgrading transmission lines to improve the efficiency of electricity delivery is well suited for institutional capital, which is already in the space.

The 20 percent of technologies on the verge of being commercially viable are slightly higher on the risk spectrum. Still, the capital markets do not yet fully understand how to finance them, and there is no standardized market. For example, investors in grid-scale battery storage are participating in unique, location-specific project finance deals. Even though the technologies are sound, investor hesitancy persists, mainly around a lack of expertise to assess the deals. This category of technologies is likely to play a significant role in corporate decarbonization over the coming decades but lacks financing models that can help drive capital to this space.

Beyond the technologies on the cusp of commercialization are those still being proven in the science lab. Startups are designing clean cement, green steel, sustainable aviation fuel, and carbon capture

technologies, yet few are at a stage to market or scale significantly. The focus must be on lowering technology risk and building demand to reduce the market risk for these interventions, explained further below.

Current Funding and Financing Sources

The UN Environment Programme has estimated that developed nations could pay $140 billion to $300 billion per year to meet the 2030 climate adaptation goals and $280 billion to $500 billion by 2050.[32] For the decade 2020–2030, the annual global cost of investments in low-carbon and efficient energy is estimated at $300 billion to $460 billion by 2030.[33] Capital requirements of that scale will require both public- and private-sector capital commitments.

PUBLIC FUNDING

Government policy will continue to play a significant role in addressing climate change; long-term policies like the forward-thinking Paris Agreement send a strong signal to the capital markets about need, opportunity, niches, and investment gaps. US federal climate change mitigation policy and technology investment has often come in the form of incentives, such as investment tax credits, loans, feed-in tariffs, net metering, minimum standards, standardized contracts, and energy credits.

The federal government has used investment tax credits (ITCs) to incentivize expenditures in climate technologies. For instance, the solar ITC for home (IRS Section 25D) and commercial (IRS Section 48) customers, and for investors to develop solar technologies and large-scale solar farms, was implemented in 2006 and, according to the solar industry trade association, has helped the solar industry grow by 10,000 percent.[34] (Tax credits they are entitled to are also "sold" by firms and organizations that have no tax liability.) This ITC is expected to sunset in December 2021 (for new projects), but efforts are underway to gain a 10-year extension. A different kind of tax credit, a production tax credit, applies to renewable electricity production, such as from wind turbines, hydroelectric power, and biomass and geothermal sources. Like the solar ITC, it is set to expire at the end of 2021.

Another tax credit, known as the 45Q for its IRS section number, was extended for two years in December 2020. Enacted in 2008 and enhanced multiple times since then, 45Q provides a credit to encourage capture and sequestration of all carbon oxides. (Before 2018, credit was only extended to CO_2.) Credit size depends on whether the carbon captured is stored or used for permitted purposes, such as in some fuel extraction processes, and is credited per metric ton. Other enhancements were added, including increasing the tax credit value and the limit of captured tons.[35] Short of a federal carbon tax in the US, 45Q is the most direct policy to encourage investment in carbon capture and sequestration technologies.

One of the more indirect ways policy has directed capital is through emission standards. For example, renewable portfolio standards (RPS) and corporate average fuel economy (CAFE) standards have driven investment in cleaner vehicles and renewable energy sources. Renewable portfolio standards require any utility that connects to the grid to obtain a set percentage of the power it sells from renewable

sources. These standards have guaranteed an offtake market for power generated through renewable energy projects. According to the Berkeley Lab on Electricity Markets & Policy, "Roughly half of all growth in US renewable electricity (RE) generation and capacity since 2000 is associated with state RPS requirements. Nationally, the role of RPS policies has diminished over time, representing 34% of all US RE capacity additions in 2017. However, within particular regions—namely the Northeast, Mid-Atlantic, and West—RPS policies continue to play a central role in supporting RE growth."[36] Utilities often use renewable energy credits (RECs, also known as renewable energy certificates) to sell "renewable energy production without directly obtaining the energy from the direct sources."[37]

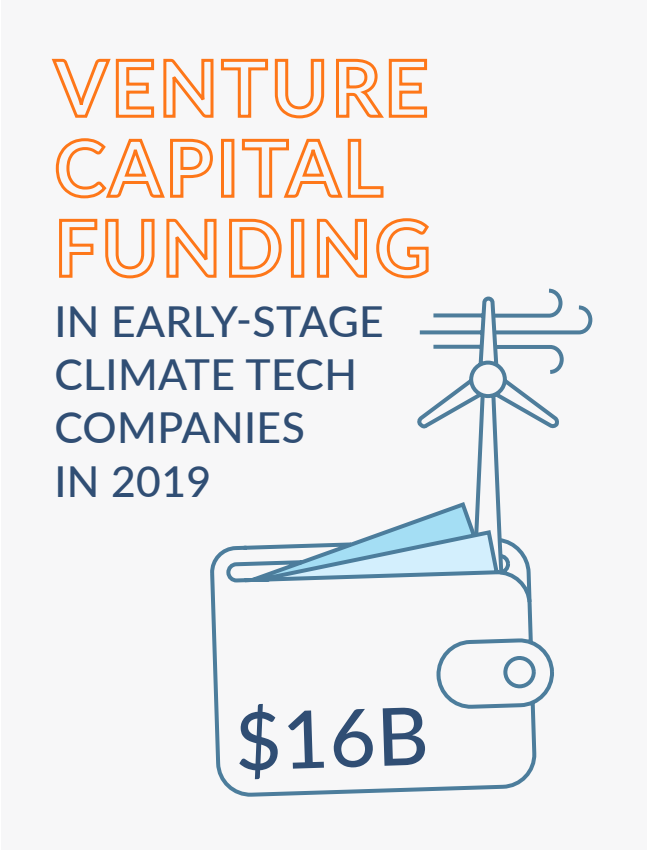
Two more incentives, net metering and feed-in tariffs, have helped expand the accessibility of renewable energy by lowering costs. Net metering applies to clients who use an alternative, renewable energy, such as solar, but are still connected to the local commercial grid. The "net" energy remaining is then stored in the grid for use at a later time. Net metering helps lower costs for individuals and has the added benefit of providing low- to no-cost solar energy to grids, which can help balance the cost of purchasing electricity from other sources. Net metering is widespread across the US and mandatory in many states. Meanwhile, feed-in tariffs are rates paid by the local utilities for energy they can pull from renewable systems, such as homeowners with solar panels selling unused energy back to the grid, or Tesla's Powerwalls, the home battery storage system that stores solar energy and can offload it to the grid.

PRIVATE FINANCING

While governments have been invested in clean energy adaptation and mitigation for decades, central banks and financial institutions have traditionally been too risk averse. However, they are now paying greater attention to the associated macro- and microeconomic risks. On the private investment side, investors have shown increasing interest in social, environmental, and impact investing. Across five major regions (Australia and New Zealand, Canada, Europe, Japan, and the US), assets under management in sustainable investments had ballooned to $30.7 trillion by 2018 and increased to $35.3 trillion in 2020.[38] The Task Force on Climate-related Financial Disclosures, established in 2015 by the International Financial Stability Board, aims to enhance the quality of data and reporting available to investors, underwriters, and other stakeholders on a consistent basis to assess and manage risk more accurately.

Venture capital funding plays an important role in the early development of climate tech companies and totaled more than $16 billion in 2019.[39] Its investment model aligns with the risk profile of many new technologies, and VC's presence is unlikely to diminish. However, a healthy pipeline of technologies signals that there are likely many attractive investment opportunities for more traditional sources of private capital in the next

few years. For example, as the demand for electric vehicles continues to rise, corporate players are likely to wade into the lithium battery market, which had previously been mostly VC-funded. As technologies look to scale and transition out of the VC space, they often look toward project financing as the next round of capital required. Project financing relies on the operating cash flow of an investment to earn a return. Deals tend to be bespoke and require manager expertise.



Barriers

TECHNOLOGY RISK

As investors consider putting capital to work to address climate change, one of the biggest challenges is understanding the science. Most investment teams lack the expertise to assess technical risk. Biotech, for example, has high technology risk; firms must go through numerous rounds of Food & Drug Administration (FDA) approval, and the full development process can often take 10–15 years before investors know if the product will be successful. In the climate space, clean cement and carbon capture innovations are still being proven in science labs.

While the companies developing these products need capital to continue their development, many investors do not have the expertise to distinguish a promising technology from an unworkable one. Proving the viability of the technology is the critical first step to attracting investment.

MARKET RISK

Once a company has proved the efficacy of its technology, it must develop a market for the product or service, and here it faces the hurdle of market risk. Clean hydrogen serves as an example: Scientists understand how to produce a hydrogen molecule using electrolysis. Through years of research, they have been able to lower clean hydrogen's technology risk, but further development has been thwarted because the infrastructure to distribute hydrogen does not yet exist on a large scale. Thus, the hydrogen vehicle market, for example, is still nascent. Without a robust market, investors are unable to project future cash flows. Investors are starting to build out the infrastructure required to use hydrogen as a clean energy source, seeing the potential long-term benefits. Still, it could be a few years before the market risk is reduced.

COMMERCIALIZATION RISK

Once a technology has matured, it attracts large corporations as clients. For example, commercial airlines are increasingly focused on purchasing sustainable aviation fuel (SAF), a biofuel, as an alternative to carbon-intensive jet fuel because it can be used in conventional airplane engines. Even though the technology risk is low, the commercialization risk is high. With its high capital costs, SAF is still much more expensive than traditional jet fuel, even though its pricing does not fluctuate with seasons or geopolitical concerns. Scaling SAF production to meet the volume commercial businesses want is a barrier to lowering costs. For many technologies, this is a final hurdle to widespread adoption. Investors in later-stage technologies are often investing in production and distribution infrastructure. Typically, a business needs considerable capital to build large-scale production facilities, and the investment bet is if they are successful, product revenue will skyrocket.

INNOVATIVE SOLUTIONS

While a handful of high-profile institutional investors have adopted fossil-fuel divestment strategies, many others are looking for investment opportunities that encourage the transition to a more sustainable future. In most cases, the industries that pollute the most will require the most advanced technologies. The Financial Innovations Lab engaged companies and investors across industries to understand where institutional investors can play a meaningful role in helping businesses lower their emission profile.

De-Risk Technologies through a Pooled Investment Vehicle

It's not only technologies that go through various stages of development—so do the companies behind them, and at different stages of capital risk, they look for different investors. Identifying the right financial tool to match capital to need, and risk to return, across all stages of a product or firm's life cycle, helps ensure the survival of both. Lab participants discussed the importance of creating pools of value that are attractive to various levels of risk appetite. Structuring a collection of underlying climate technology assets into a securitization-like vehicle or a blended capital investment fund can help businesses access the traditional capital markets more quickly and reach commercial-scale while expanding their pool of investors.

The benefit of any type of pooled vehicle is that it widens the available investment opportunities to meet different risk-return profiles. The underlying companies must be analyzed by a defined set of factors to match assets and investors effectively. Through discussions, Lab participants identified the screening factors necessary to evaluate and "bundle" different investment opportunities.

Some of the assessment factors include:

Technology maturity: Matching products that are at similar stages of technology maturity is critical. A clearinghouse agency could leverage the Department of Energy's (DOE) Technology Readiness Level scale. Has the product been tested in a pilot program? At what scale has it been implemented or produced?

Company fundamentals: Many investors prioritize getting to know the team and leadership at an organization to help them understand its future. How many employees are there? Has the private market put a valuation on the business? How much capital has the company raised?

Environmental impact: Technologies across sectors need to be assessed according to the quantity and quality of CO_2, or carbon equivalent, abatement.

Geography: How do local policies or subsidies boost or obstruct the development of climate change solutions? Are they likely to change with the political winds?

Supporting infrastructure: While some technologies upgrade existing systems, others will require new infrastructure for distribution. Understanding market conditions will help assess the speed of infrastructure buildout.

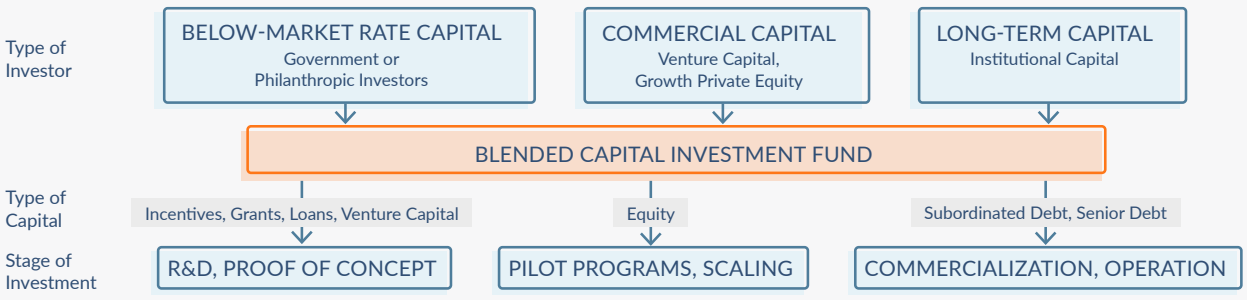
Depending on the type of investor, the pooled investment vehicle could be either a blended capital fund or a securitization-like loan product. The next sections explain the benefits of each.

BLENDED CAPITAL INVESTMENT FUND

Whether a company requires an equity investment, debt capital, or a blend of both has a great deal to do with where it sits in the development cycle. Businesses have different kinds of capital on their balance sheets, and the order of claims on repaid capital corresponds to the configuration of its "capital stack." At the bottom of the stack is senior debt, which is repaid first in the case of default (this holds equally true for a claim on returns or sale); the stack continues through common equity at the top. Different types of investors—from venture capitalists, accelerators, strategic investors, development banks, commercial banks, the capital markets, and bond markets—participate at various levels of the capital stack. Lab participants agreed some parts of the market are inefficient in matching available capital with investable opportunities. With thousands of new technology companies looking for financing, they often do not have access to the type of investment that most accurately aligns with their stage of development. More mature technologies have fewer barriers to attracting the type of capital they need. But that 20 percent of companies designing products on the verge of commercialization, as outlined earlier, often cannot attract the capital they need, whether that is cheaper debt or earlier equity investments. Lab participants discussed developing a blended capital investment vehicle that can match the investment opportunities institutional investors are looking for with the forms of financing businesses need. Today the largest industry stakeholders are likely to have separate internal teams that deploy capital into venture debt or growth equity opportunities. A single vehicle with different attachment points would help solve the current market inefficiency.

Blended finance structures were introduced in the early 2000s to help developing countries meet the UN Sustainable Development Goals. Typically, a government or multilateral entity will provide public funding incentives at the earliest stages of development to entice private investors to participate in the later stages of deals. Climate Fund Managers, owned by the Dutch Entrepreneurial Bank, FMO, and Sanlam InfraWorks, has launched the Climate Investor One Fund, a blended finance vehicle that invests in renewable energy projects. The fund's investors are a combination of public and private capital, and projects are financed from development through commercialization using different limited partners, and everything from development loans, equity, and senior debt along the way.[40] Leveraging a €40 million investment by the EU's External Investment Plan, the Climate Investor One Fund raised $850 million of additional private capital to develop renewable energy projects across a handful of emerging markets.[41] The early-stage donor capital finances the riskier development phase, with traditional equity investors participating once projects reach the construction phase.[42] The various types of capital and investors help move renewable energy projects through the stages of development efficiently.

FIGURE 2: BLENDED CAPITAL INVESTMENT FUND MODEL



Source: Milken Institute (2021)

Creating a blended investment product and identifying and commingling like-minded investors with different levels of risk tolerance will help deploy capital in a way that matches the financing needs of the most promising companies across their maturity timelines. As a business' product progresses through the development pipeline, the probability of success tends to increase, which lowers its risk profile. A lower risk profile increases the ability of the business to attract cheaper forms of capital relative to the more expensive early-stage equity often supplied by venture capital funds. A blended capital investment fund with limited partners interested in participating in different layers of the capital stack will improve the efficiency of the market. Identifying investors interested in taking subordinated debt positions, which fall between senior debt and equity on the capital stack, is particularly beneficial to scaling companies as an added resource. Subordinated debt has a higher interest rate than senior debt because investors take on higher risks. However, it is usually patient capital, cheaper than equity, and does not dilute ownership. Partners who participate in this tranche can help to de-risk and sweeten the upside for equity players. The critical step in setting up a synthetic structure of this type is analyzing and appropriately measuring the risk to match investors effectively.

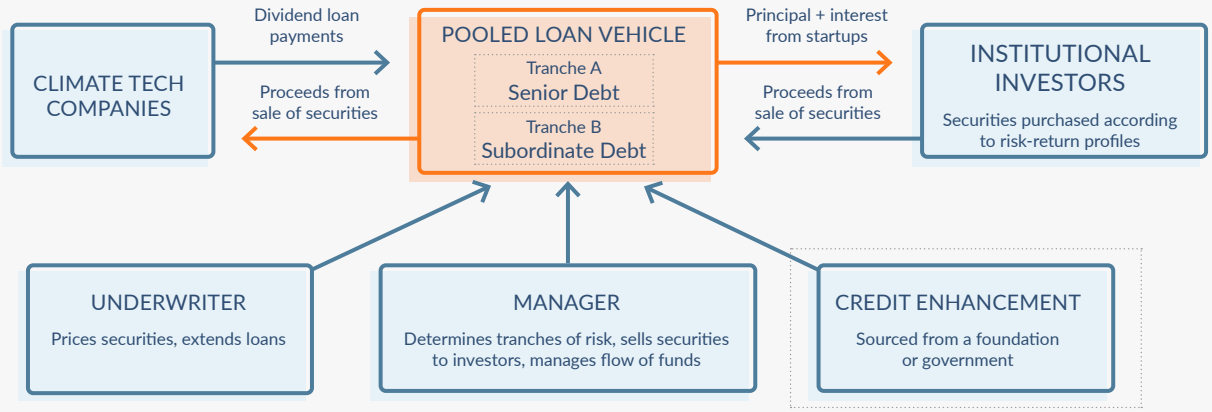
SECURITIZATION-LIKE PRODUCT

The DOE makes grants and loans to new technologies it identifies as promising. Specifically, the Advanced Research Projects Agency-Energy (ARPA-E) focuses on discovering technologies likely to have significant potential impacts but are too immature to attract private investment.[43] For technologies that mature beyond the scope of the DOE ARPA-E financing programs, a securitization-like product can serve as the next series of funding for them as they set to scale. Securitization is a way to bundle a group of underlying opportunities and repackage them as a single asset. For many scaling businesses, debt capital is unattainable or prohibitively expensive. On the investment side, currently, there are few pooled loan products targeting climate technology businesses. This model could allow for institutional capital to play a role in developing needed technologies. To construct a private market product, Lab participants agreed that the initial step must be to identify a central manager, or clearinghouse, that can qualify and vet the level of risk of each underlying asset. Technologies need to be categorized by the level of risk to be packaged and sold to investors.

The model suggested by Lab participants is somewhat of a hybrid structure that combines the benefits from a traditional securitization product and a revolving loan fund. Bundled loan products have helped scale many other types of markets. For example, in real estate, banks and investors have utilized mortgage-backed securities to lend to more homebuyers. Once a bank issues a critical mass of mortgages, they can combine the loans into a mortgage-backed security. This allows the bank to remove the liability from their balance sheet and pass the returns (from homeowners paying their mortgage, plus interest) through to investors who have bought a slice of the securitized product. This allows the bank to free up capital to make new loans and gives investors a product to help diversity risk. As it relates to a revolving loan fund, the EPA's Clean Water State Revolving Fund provides funding to states to allocate as they see fit. The government provided the initial $46.8 billion, and given the revolving nature of the loans, the program has been able to make $145 billion worth of investments in communities through 2020.[44]

As the final stage of the investment vehicle design, participants explored the possibility of a credit enhancement. A credit enhancement is capital that sits alongside other investment capital and serves as a protective layer; it allows the underlying companies to receive better terms to repay their debt. Government subsidies or major philanthropy typically help enhance returns for the private market. Lab participants suggested that a private-market securitization-like structure could incorporate an existing government offering or be provided by the significant foundation stakeholders working in the issue area. The scale of contribution from a state or federal government is likely to be higher, but coupling a few significant foundation grants to reach a $1 billion credit enhancement would be impactful.

FIGURE 3: SECURITIZATION-LIKE MODEL



Source: Milken Institute (2021)

Products in the scaling-up phase of development, where the risk is relatively quantifiable, are ideally positioned to benefit from a pooled investment financing tool. Few traditional investors are likely to have the due diligence capacity to assess the science behind technologies across asset classes and pick a single winner. A pooled approach allows the investment risk to be diversified across products. Companies designing products for long-duration storage, distributed energy generation, and grid infrastructure efficiency upgrades were mentioned as ideally positioned to accept pooled institutional capital. Assembling a set of underlying assets in these categories could help to lower the risk profile of an investment and be an attractive opportunity for those interested in participating in the climate technology transition.

NEXT STEPS

- Understand the market appetite for investment opportunities in debt versus equity to match the need at the company level effectively.
- For both a blended capital investment fund and a securitization-like loan product, a clear set of categorizing factors must be determined and finalized to place assets into investable instruments or tranches of different risk profiles.
- For a blended capital investment fund, understand where inefficiencies or a lack of investment options exists to develop instruments that meet investor and company needs.
- For a security-like loan product, identify or develop an entity prepared to serve as a manager or clearinghouse to qualify and sort underlying technology assets.
- Consider partners or government programs (at regional, state, and federal levels) that could provide credit enhancements to de-risk the opportunity further and attract investors with lower risk tolerance, such as pension funds.

Facilitate Co-Investment Partnerships

According to EY's Renewable Energy Country Attractiveness Index, 20 percent of institutional investors have invested in renewable energy indirectly through funds. However, only 1 percent of investors have invested capital directly into projects through co-investment partnerships.[45] A co-investment partnership is one way to address risk adversity in investors, be they private equity or large institutional, because the different partners bring a vast and diverse amount of experience to the table. This holds true as well if end-customers take on roles as co-investment partners. The more involved a company is with its end customer (acting as a partner), and the faster it can understand its product's use case and value, the quicker the development timeline unfolds. As indicated earlier, there is an alignment between many developing technologies and prospective corporate partners. However, there is a communication barrier to getting the technologies scaled in a suitable timeframe. Identifying partners across the value chain can help to reduce the market risk.

Using sustainable aviation fuel as an example, Lab participants evaluated the various roles in a well-planned co-investment deal:

- A partner that understands the dynamics and processes of the incumbent market and can assess the technical risk of the new technology. From their participation in jet fuel markets, commercial airlines know how to select production sites, understand storage requirements, bring in chemical engineers to assess fuel quality, and provide scientific due diligence. This expertise can be applied to analyze all SAF producers.
- An offtake customer who integrates the product into its supply chain. An offtake partner is also beneficial early in development to demonstrate the use case and suggest product improvements. A commercial airline partner doesn't have in-house investment teams to allocate capital but can help product design, like biofuel blends, early on and commit to significant purchase guarantees on the back end.
- Investors who provide capital at various points along the risk curve, from those willing to take early equity positions to long-term debt providers. Growth private equity players are interested in identifying opportunities for higher risk and higher returns. Alternatively, large pension funds need to deploy significant amounts of capital but in relatively low-risk deals. Both play an essential role in moving the technology through the development pipeline.
- Mentorship to vet and guide the leadership team. Many entrepreneurs are not commercially minded; guiding early technologies to become a marketable product is essential.

FIGURE 4: ROLE OF PARTNERS IN CO-INVESTMENT DEAL

Source: Milken Institute (2021)

Once there is sufficient expert due diligence to manage technology risk and expert partnering to manage market risk, institutional investors tend to be interested in participating as long-term partners. Lab participants agreed that an ideal underwriting covers a minimum five-year investment horizon. These days, many ESG strategies include climate change mitigation investments. Identifying and collaborating on direct investment deals will help streamline capital deployment to the most promising corners of the market.

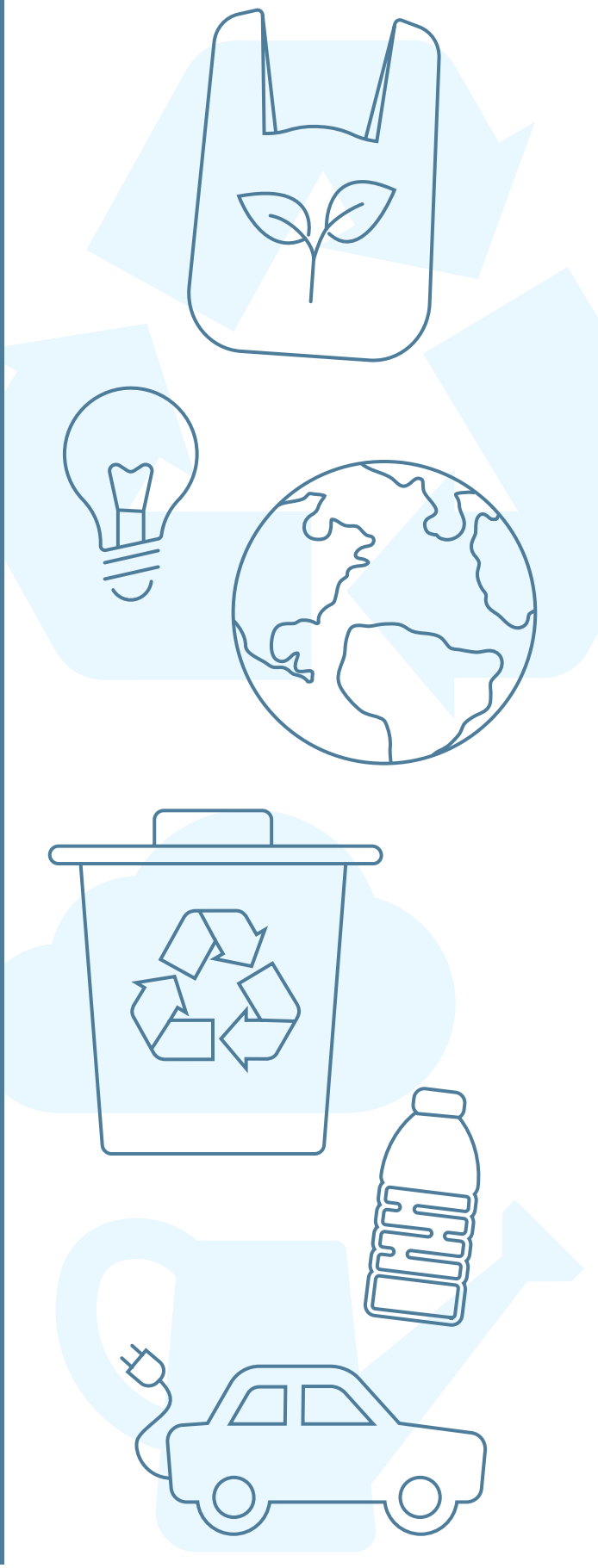
NEXT STEPS

- Understand the risk factors for a given technology.
- Survey the types of technologies that can benefit from a combination of partners.
- Define the types of partners needed in each stage of the development timeline.
    - What is the ideal time horizon for the participation of each organization?
    - How are incentives defined?
    - What expertise or benefit does each partner bring to the deal?
    - What risk factor does each partner mitigate?

Sidebar: Voluntary Carbon Credit Markets

In many instances, the future emissions reduced by a newer technology is the incremental value add to society and corporations. However, the emissions abated or avoided cannot come to fruition until the technology is proven and scaled. The Task Force on Scaling Voluntary Carbon Markets has brought together leaders across the private sector to mobilize capital to flow into net-zero tools by incentivizing early investment and developing a scaled and reliable market for the trading of carbon credits. There are current opportunities for businesses and individuals to purchase carbon offsets, which are credits from existing emission-reducing natural or technological sources. The mission of the private carbon credits market is to enable organizations to voluntarily purchase carbon credits, which can also compensate or neutralize emissions not yet eliminated. By buying carbon credit "futures," a corporation can finance the avoidance or reduction of emissions or remove greenhouse gases from the atmosphere and thus meaningfully contribute to the transition to global net zero.[46]

Lab participants likened the task force's mission to power purchase agreements (PPAs) in wind and solar power generation. A PPA is an offtake contract that commits a buyer to an upfront price per unit (for example, gigawatts) for electricity generated by a specific wind or solar farm project. A locked-in price provides upfront capital that helps the developers finance the construction and operation of the project. Voluntary carbon markets could play a similar role in funding the development of industrial materials or carbon capture and sequestration projects. "A liquid voluntary carbon market at scale could allow billions of dollars of capital to flow from those making commitments, such as carbon-neutral or net-zero, into the hands of those with the ability to reduce and remove carbon."[47] A more established system will build on the existing availability of carbon offset contracts and enhance the markets' ability to invest in carbon reductions not yet materialized. Instead of a traditional offtake agreement or PPA that commits a buyer to the product, a carbon credit "future" commits the buyer to just the credit for the future carbon abated. Necessary steps around developing a carbon credit "futures" market include defining the quality of carbon credits, standardizing prices and contracts for technology and abatement options, and defining a regulator and clearinghouse to facilitate the process.



Off-take (Purchase) Agreements

A co-investment partner who is also an offtaker (a buyer) serves to move the project along more quickly, provide end user feedback, and send an important signal to the market about its conviction of the product's worth. Lab participants highlighted the central factors to incorporate in purchase guarantees and the important signal they can send to the market.

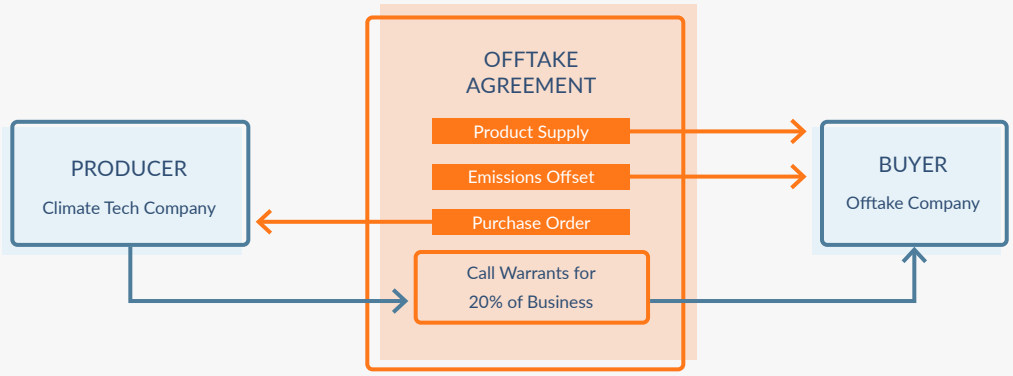
A large offtaker is likely to feel comfortable committing to buying a good only if there are very defined product specifications in the agreement. Outlining the quality, volume, and price expectations are a necessity. For up-and-coming technologies, including the data and transparency of carbon abated or carbon avoided can help communicate the technology's environmental attributes. It is the responsibility of the clean tech company to produce that data, either in-house or by hiring a third party. Hiring a reputable firm, such as a Big Four accounting agency, to complete a life-cycle analysis on the product is a tool that can dispel the potential hesitancy of large offtakers. Having an accurate sense of the environmental impact can potentially create a dual revenue stream. Not only can the physical product be sold, such as bioplastics, but the carbon credit of each item additionally has a value. Separating and accounting for the distinct value streams can provide additional revenue.

The Renewable Portfolio Standards mentioned earlier created a demand market for wind and solar energy production. The customers in that scenario were highly rated utilities, which meant there was a limited chance of counterparty risk (i.e., that the purchasing entity would fail to fulfill its part of the deal). For some new technologies looking for a buyer today, the counterparty risk is higher because offtakers might not necessarily be as highly rated by rating agencies as utilities. Sometimes one purchase commitment, even if significant, is not enough to commercialize a technology fully. Industry coalitions present an opportunity to increase the offtake volume and reduce the counterparty risk. Lab participants mentioned the Hydrogen Council as an aggregator bringing together demand for hydrogen. Identifying multiple hydrogen customers could help justify the costs of installing a hydrogen fueling station, for example. While a Fortune 500 company purchase guarantee can be instrumental for mainstreaming a business, the clean technology business still has leverage in the deal. With increasing pressure for all companies to announce environmental sustainability plans, smaller companies developing needed technologies can seize the opportunity to play a role in legitimizing the larger company's public commitments.

In analyzing many technologies, performance target thresholds are based on current levels instead of a future trajectory. To design the most helpful purchase agreement, there should be a forward-looking acknowledgment clause that articulates the expectations of where future production or impact from the technology will be. Integrating a graduating performance improvement over time can help a buyer justify the higher costs today to purchase a cheaper and cleaner product in a decade. To encourage offtakers to commit earlier than they usually would, the producer could offer equity shares in the business. This will align incentives to reach commercial scale.

The delicate negotiation for any entrepreneur is deciding how much of their company to trade for an investment. Lab participants felt offering 20 percent of a company through warrants or options linked to purchase guarantees was feasible. This would give the offtaker the chance to acquire a share of the business at an agreed-upon price for a limited time in hopes that the purchase commitment will help the company grow. The limited time is key because it forces companies interested in the deal to act rather than wait to see how the market plays out. Companies with a multibillion-dollar market capitalization might not be interested in an ownership clause for a portion of a smaller business. In that case, purchase guarantee contracts should include a Most Favored Nation statement for future purchases. A Most Favored Nation clause indicates equal treatment of countries, or in this case purchasers, in a trade agreement. This would lock in the lowest possible price for future commitments. While a tier 1 offtaker might already expect to get the lowest cost because it is committing to the highest volume, this is a viable and attractive incentive to tier 2, medium-size offtakers.

FIGURE 5: OFFTAKE AGREEMENT MODEL



Source: Milken Institute (2021)

NEXT STEPS

- Create standards around environmental assessments of all products to account for the carbon abated or avoided. If effectively estimated, the carbon credits can be sold separately from the physical product to create a dual revenue stream.
- Identify industry coalitions that can serve as an aggregator platform for offtake commitments.
- Integrate forward-looking acknowledgment clauses to account for the future value of a lower emission product.
- Understand if ownership or future price guarantees incentivize the customer and integrate an option into contracts to negotiate stricter commitments.

CONCLUSION

The headline numbers to address climate change are daunting. That a sustainable climate transition will require investment of $3.5 trillion per year, or $100 trillion total, by 2050 seems unfeasible for many reasons.[48] However, it is important to unpack that number to understand where the investment opportunities are over the short-, medium-, and long term. As institutional investors focus on scaling up their sustainable investing mandates, capital allocators want to invest in the opportunities with the most significant environmental impacts. As new technologies are introduced to solve the global emissions problem, financing mechanisms that reduce the barriers to investment are necessary. Establishing consistent co-investment and offtake opportunities will allow meaningful amounts of capital to flow into projects on the cusp of commercialization. For technologies with higher risk, pooling together assets through a blended capital investment fund or securitization-like offering will reduce the due diligence burden that today asks investors to put all their eggs in one basket. Simplifying the market for traditional capital to play a role will help companies achieve their net-zero targets on time.

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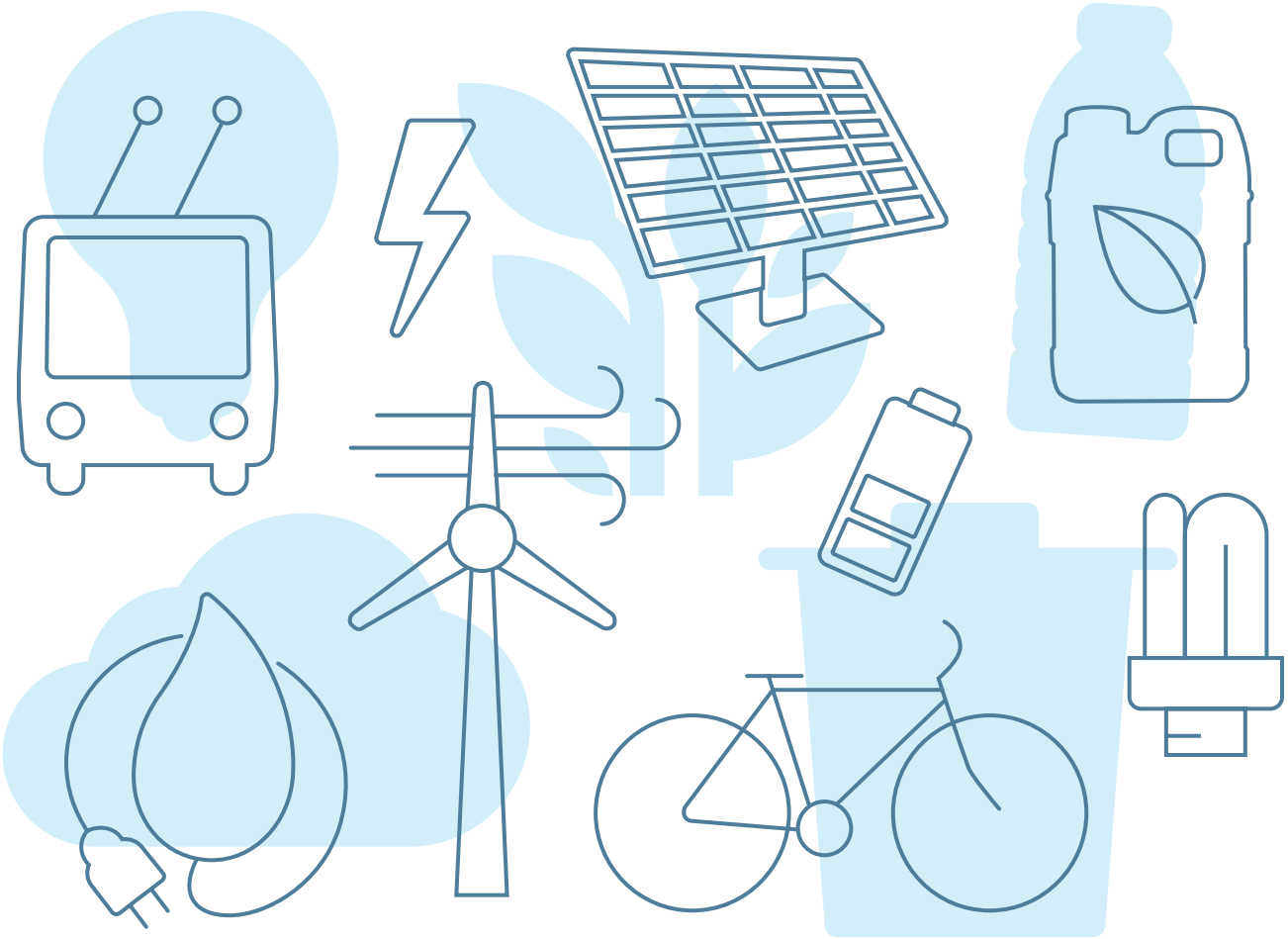

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