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Climate Innovation and the New Capex Cycle

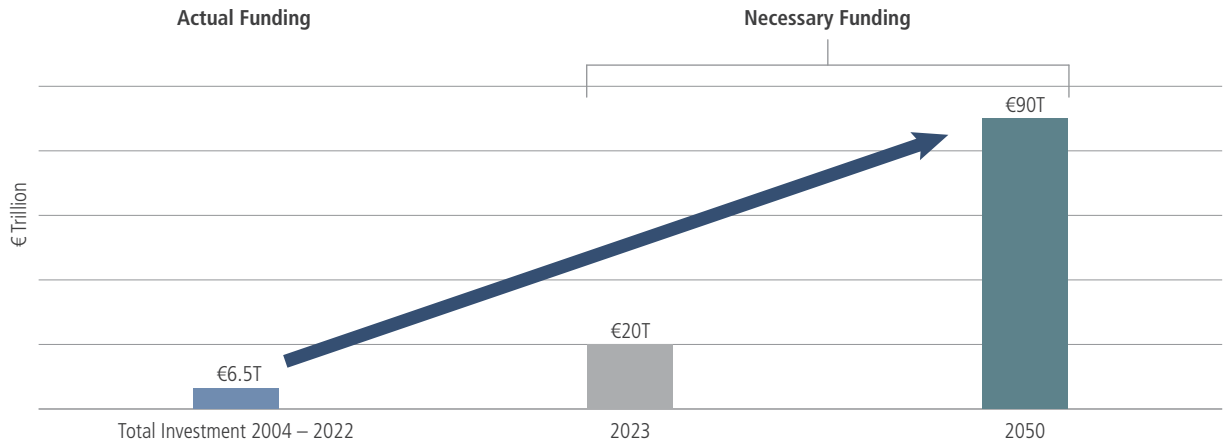
Despite the urgency of climate change, we believe that this should be a time for optimism, driven by a convergence of technology and policy that could jumpstart efforts to address climate challenges and present a timely opportunity to invest in a secular growth story. All the technologies needed to achieve the Paris Agreement goals are in place,[1] with government action and funding likely playing a key role in their deployment, especially when partnered with the private sector. The resulting capex cycle could have significant benefits for key corporate players and investors while helping the world transition to a cleaner future.

[1] IEA, *World Energy Investment 2022.*

The importance of taking action on climate has never been greater. To reach the goals set forth by the Paris Agreement, investment will need to almost triple compared to levels of investment being made today, implying an approximate €20 trillion funding gap from now through 2030 and an almost €90 trillion gap through 2050.[1]

Yet we believe there has also never been a time for greater optimism. The convergence of technology and policy to achieve global climate ambitions is at a unique inflection point. According to the Intergovernmental Panel on Climate Change (IPCC), all technologies necessary to achieve the Paris goals already exist, though some have yet to scale. And we are just beginning to realize the significant and influential role that government funding—whether through the U.S. Inflation Reduction Act (IRA) or European Green Deal Industrial Plan (GDIP), among others—can play when partnered with technology and solutions from the private sector.

GLOBAL FUNDING GAP TO REACH 1.5° CLIMATE GOAL



Source: IEA, *World Energy Investment 2022.*

Thus, we believe that investing in climate innovation offers both a secular growth opportunity and a boon to society. This, in turn, is spurring a new, historic capex cycle that relies on technological innovation to progress to a cleaner future.

We believe investors have an opportunity to benefit from investing in climate innovation in three key ways:

(1) By investing in companies with superior technologies that are creating defensible, expanding economic "moats";

(2) By investing in companies whose technologies support real assets required to enable decarbonization that can complement, not conflict with, fossil fuel capacity additions; and

(3) By participating in a reshoring boom stemming from the reindustrialization of established economies.

The Birth of a New Capex Cycle

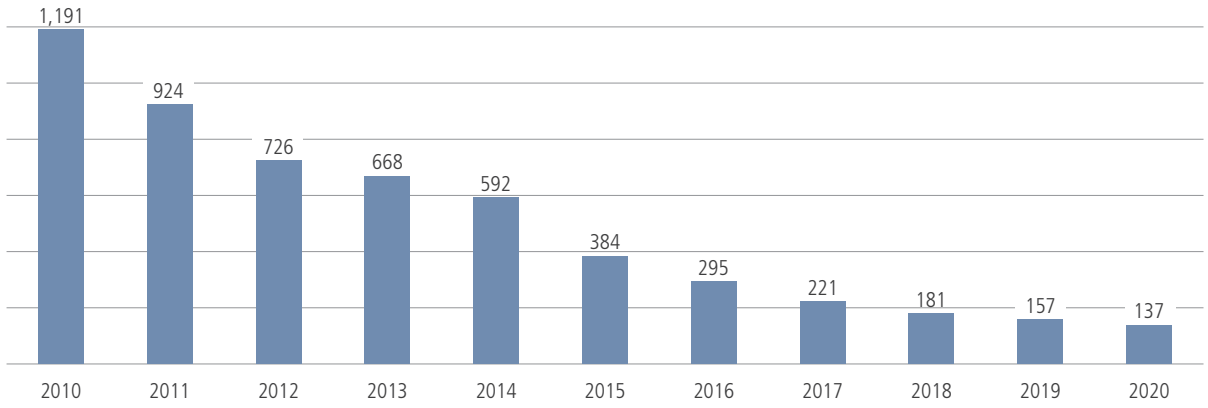
Similar to the landscape after World War II, many governments appear motivated to enact capital investment on a massive scale to drive growth. What is different this time is that this new capex cycle will likely be more driven by the private sector, with governments choosing to deploy tools like tax incentives, loan guarantees and capex grants to shift production and consumption toward low and zero carbon options.[2,3] To this end, the conventional wisdom that companies are just sources of emissions is being increasingly upended—in fact, companies are providers of solutions, both through transformative business models and incremental improvements.[4] Lessons from COVID-19 and the impacts on supply chains that are still being unwound also exposed critical areas of underinvestment when juxtaposed with expected rising future demand. Consider the U.S. electrical grid. Historically underinvested, from the late 1970s to the early 2000s, the U.S. transmission grid expanded at about 2% annually.[5] However, annual demand for electricity in 2030 will be 14 – 19% higher than 2021 levels, according to an analysis from REPEAT (Rapid Energy Policy Evaluation and Analysis Toolkit), as population growth and broader electrification trends take hold. It's worth noting that it takes 10 years or longer to build new electricity transmission projects, per WIRES, a nonprofit trade association that promotes investment in the North American electric transmission system.[6] This suggests that significant capacity must be added, practically starting today, to address future needs. This trend has had significant impacts on certain suppliers. For example, it supports accelerating earnings growth and record backlogs for Quanta Services, a provider of infrastructure services that participates in electric power buildout and utility-scale renewable projects.

The Role of Technological Innovation

Innovation drives faster progress by decreasing costs across a number of fronts to spur uptake and scaling of climate technologies. Take, for example, the electric vehicle battery. Lithium battery costs have fallen by 98% in three decades. Even just a decade ago, the battery alone would have cost USD $30,000 – $60,000, about the price of a car today.[7] Without such rapidly declining cost curves, we would not have been able to move from essentially no commercially sold EVs to present day, where one in seven passenger cars purchased globally in 2022 was an EV, per the International Energy Agency. One key beneficiary of the acceleration in EV sales is Korean mid-cap battery cathode material company L&F, which in February 2023 signed a nearly USD $3 billion deal to supply battery materials to Tesla.

LITHIUM BATTERY PRICES HAVE PLUNGED

Volume-Weighted Average of Lithium-Ion Battery Prices in All Sectors (USD)



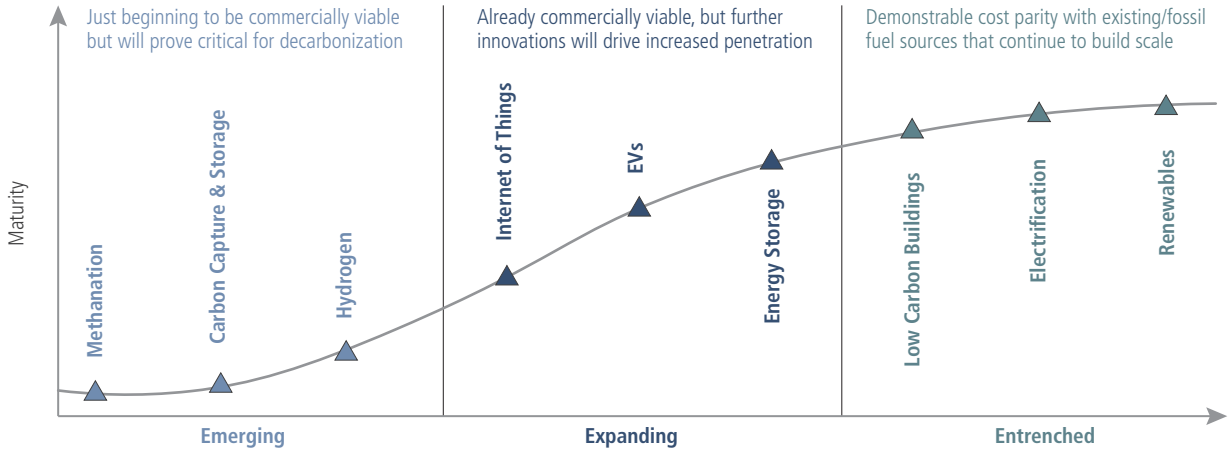
Source: Bloomberg, 2020.

[2] "Governments That Invest in Climate Innovation Invest in Growth," Boston Consulting Group, July 21, 2021.
[3] Spazzapan, Irene, "A Historic Capex Boom Could Converge With the Climate Crisis to Create a Wave of Climate Technology Investment," Systemiq Capital, November 28, 2022.
[4] McKinsey & Co., "Climate Investing: Continued Breakout Growth Through Uncertain Times," March 13, 2023.
[5] Clifford, Catherine, "Why America's Energy Grid Is a Climate Problem," CNBC.com, February 17, 2023.
[6] Keefer, DW, "Report Aims to Tie Long-Haul Transmission to Carbon-Reduction Goals," Energy Central, January 17, 2020.
[7] *The Economist*, "Lithium Battery Costs Have Fallen by 98% in Three Decades," March 21, 2021.

In relation to climate innovation, we favor investing along the technology maturity curve in pursuit of alpha. We observe the following framework. *Entrenched* technologies demonstrate cost parity with existing and/or fossil fuel sources while continuing to build scale, for example, utility-scale solar and onshore wind. *Expanding* technologies are already commercially viable, but are still experiencing rapidly declining cost curves that should further penetration, for example in EVs. *Emerging* technologies are just beginning to be commercially viable, but we expect they will prove critical in decarbonization pathways, for example, carbon capture and storage.

OPPORTUNITIES ACROSS THE MATURITY CURVE

Investment Categories in Climate Innovation



Source: Neuberger Berman, 2023.

Innovation is fundamental to both mitigation and adaptation approaches (see below) since technological advances can help decrease the dollars required for infrastructure investments.[8] To this end, the amount of energy required on average to produce a unit of GDP has fallen by 26% since 2000, underscoring that reduction of energy intensity is hugely important in the context of overall climate action—as much as changing the energy mix to low-carbon sources itself.[9] We see opportunity to support both mitigation and adaptation, the latter of which has historically been under-represented in typical climate strategies. For example, construction software provider Procore Technologies analyzes embodied carbon in every project designed, which helps construction projects reduce material waste and determine suitable lower-carbon alternatives for the required materials.

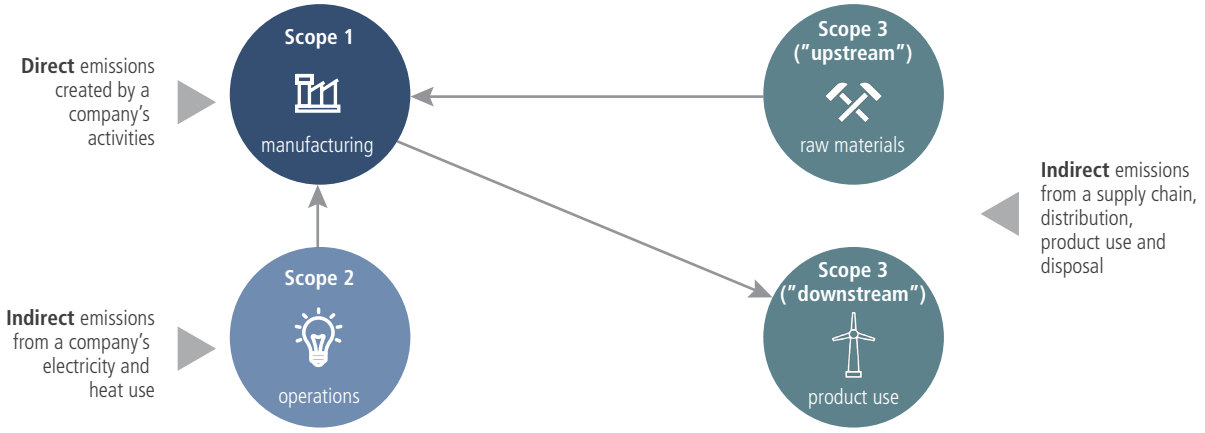
Mitigation involves the avoidance or reduction of greenhouse gases, achieved by either reducing the sources of these gases or increasing their storage.

Adaptation means adapting to life in a changing climate to reduce risks from its harmful effects.

[8] Mitchell, Tom, "Boosting Climate Adaptation With Innovation," Climate-KIC, January 25, 2021.
[9] IEA, *World Energy Investment 2022.*

While we believe that Scope 1 and 2 emissions reduction—which relates to a company's own operations—is critical, we find that combining mitigation and adaptation approaches also helps target greenhouse gas emissions reductions on a Scope 3 (value chain) basis. This offers a significantly larger decarbonization opportunity and expanded investment universe for those investors who desire to invest in companies that are part of the emissions reduction movement, given that Scope 3 typically accounts for 40 – 70% of a company's total emissions across most sectors.

SCOPE 1 – 3 EMISSIONS: OVERVIEW



Climate Innovation and Fossil Investment Can Coexist

The conflict in Ukraine, rising energy prices and snarled supply chains have catalyzed an existential realization on the part of governments: that reducing energy dependence is worthwhile, as is diversifying the energy supply base. These developments have spurred new investment in energy, both with renewable capacity additions and an expansion of fossil supply. While we believe that decarbonization pathways will ultimately be reliant on the proliferation of clean sources of generation, we think investors should view investment in climate innovation as a complement to the capex cycle taking place in fossil fuels, while placing appropriate constraints on fossil fuel companies to have a clear transition plan going forward. In other words, a successful energy transition will require investments in climate innovation to be made "on top of"—not "instead of"—investments in conventional energy.

Two key factors underpin our view that climate innovation and fossil fuel investment are not mutually exclusive.[10] First, the promulgation of hydrogen as a viable alternative fuel source—especially relevant to decarbonize sectors that electricity cannot reach, like heavy transport—will require commercializing "grey" and "blue" hydrogen that derives from fossil fuels, primarily natural gas. This, in turn, can help support the development of "green" hydrogen that is powered by renewable energy, which today makes up less than 1% of global hydrogen production. One key leader in the hydrogen infrastructure ecosystem is the French industrial gas company Air Liquide, which is pursuing major projects to develop electrolysers and creating applications in biogas reforming. About 30% of Air Liquide's capex is aligned with EU Taxonomy green initiatives, and this share is expected to grow.[11]

Second, it is a curious reality that climate innovation can benefit from capex pivots by fossil fuel companies pursuing transition plans. Notably, Deloitte estimates that the global oil and natural gas industry may be able to deploy up to $838 billion over the next decade, or around 20% of cumulative capital spending, to optimize businesses and pursue growth in new energy ventures.

[10] Davis, Carolyn, "Global Oil, Natural Gas Companies Juggling Capital to Green Up Portfolios," NGI, May 23, 2021.
[11] Air Liquide, 2022 Sustainability Report Conference Call Transcript, Friday, March 24, 2023.

With the continued focus on energy security, it is also worth bearing in mind a fundamental idea: Energy security is not only about increasing energy supply; it is also about making energy use more efficient. While there exists a massive coordination problem—especially in the EU, which despite being the world's second-biggest combined economy behind the United States, must devise policy across a patchwork of states—aligning incentives can be a valuable tool to enact this change. For instance, Germany is both the largest European gas consumer and was also the largest importer of Russian gas prior to the Ukraine crisis. Its "electricity price brake" starts by calculating the energy needs of a household that makes reasonable efforts to curb energy use, then subsidizes the retail price of electricity up to that level but not beyond it.[12] While the program is in early stages, it offers an example of how policymakers are examining ways to reduce energy consumption in concert with increasing energy supply. This ties into private-sector efforts. For example, Hitachi, the Japanese diversified digital industry and grid company, offers several solutions to drive energy savings across electrical grids and buildings and is investing over 11bn Euros over a three-year period to drive R&D of high-efficiency products, energy management systems, and hydrogen-related technologies.[13]

Reshoring and Rise of Reindustrialization

Finally, we cannot consider climate action in isolation from powerful trends reshaping the global order: rising geopolitical tensions, reimagining of supply chains and recognition that reindustrialization may be necessary to support more resilient economies. Policy support like the U.S. Inflation Reduction Act and the EU Green Deal Industrial Plan highlight the degree to which developed economies are grappling with the reality that to catalyze innovation requires investment at home. This shift could also have powerful implications for the reduction of greenhouse gas emissions and energy consumption involved in the production of green technologies. For instance, according to research published in *Nature*, if the U.S. could fully bring "c-Si PV" solar panel manufacturing back home by 2035, estimated greenhouse gas emissions and energy consumption would be 30% and 13% lower, respectively, than if it had relied on global imports since 2020.[14]

That said, reshoring and reindustrialization does not have to be a zero-sum game for individual economies. LG Energy Solutions (LGES), a South Korean battery maker that is the largest in the world outside China, offers compelling support for this assertion. After the passage of the U.S. Inflation Reduction Act, LGES resumed a stalled U.S. battery project with an almost USD $6 billion investment in Arizona, in addition to announcing an over USD $4 billion battery plant in Ohio with Japan's Honda Motor Co.[15]

The Future of Climate Innovation

As governments and private sector alike collectively engage in climate action to address one of the most critical challenges of our time, we believe investors can embrace the compelling potential of climate innovation to accomplish several important aims: to profit from the structural growth opportunities that will derive from new technology development; to provide and direct capital to companies that are creating the most impactful technologies; and to participate in the creation of a greener, more sustainable society.

[12] Zettelmeyer, Jeromin, Simone Tagliapietra, Georg Zacchmann, Connall Heussaff, "Beating the European Energy Crisis," International Monetary Fund, December 2022.
[13] https://www.forbes.com/sites/sap/2022/04/04/how-hitachi-is-making-the-decarbonization-of-society-a-reality/?sh=1b3a97a9125a
[14] Haoyue, Liang, Fengqi You, "Reshoring Silicon Photovoltaics Manufacturing Contributes to Decarbonization and Climate Change Mitigation," Nature Communications, March 8, 2023.
[15] Reuters, March 24, 2023.

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