



FOREIGN AFFAIRS

Capitalism's Green Revolution

How Private Finance Can Help Decarbonize the Economy

BY KASSIA YANOSEK AND DAVID G. VICTOR **November 29, 2023**

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After decades of talking about climate change, governments and firms are finally taking action. As they gather in Dubai for the latest UN Climate Change Conference, many of the countries and organizations that pledged to cut emissions to “net zero” by 2050 at the conference in Glasgow in 2021 are now following through with policies and plans. Among them is the United States, which passed a trio of big new spending laws in 2022. The biggest, the Inflation Reduction Act, sets aside over \$370 billion to cut emissions.

Turning the ambition to eliminate warming pollution into reality will require much larger capital investments. Although it is hard to pin down the exact costs of completely transforming the world's industrial systems

by midcentury, the best estimates—such as those from Goldman Sachs—put the total at roughly \$4 trillion per year over the coming decade, or about four percent of the global economy. Today, global investment in clean energy totals around \$1.1 trillion per year, even with government spending in this area rising to all-time highs.

States alone cannot be expected to fill that gap. The trillions of dollars required are simply well beyond what government budgets can support amid their other pressing public priorities. The potential for scale from private sources, however, is great. A particularly promising opportunity lies with private investment funds that deploy large pools of capital backed by institutional investors, such as pension funds, sovereign wealth funds, endowments, and insurance companies. A growing share of these funds is already flowing into clean energy, where they are uniquely positioned to help transform the industrial system. They could make a much greater difference in the future with the right policies and business models in place. Unlike publicly traded energy and industrial companies, whose shareholders put a priority on near-term cash flows, these private investment funds have the flexibility to make long-term bets on new technologies and infrastructure.

Unlocking this source of capital investment requires models that are financially attractive to funders and practical for business partners. Those models can be replicated to much larger scale as more private investors realize the opportunities in clean energy. But over the last few years, promising examples have emerged—all based on partnerships and transactions between private capital and companies that have the expertise to build and operate new clean technological systems. Common across most of these models is the idea that existing firms with skills and

infrastructure combine with new sources of capital—a conversion we have called “brown to green.” These incumbent firms are in industries that need to curtail their carbon-intensive operations and can do so with the right investments. Recognizing the value of these models and using them at a much larger scale is essential to turning bold ambitions for clean energy into reality.

GO DEEP

Although investors are increasingly willing to spend on the green transition, more than 80 percent of capital flows into clean energy last year went to technologies for which the risks are lower and the business models for deploying clean energy systems are most mature. Capital providers are investing heavily to develop wind and solar power, for example—technologies that are not only less costly than traditional generators powered by fossil fuels but also whose business case is widely understood. Big investments are also flowing into supplies and technologies linked to electric vehicles as demand for those cars rises. Across all these clean technologies, the investment case is linked in part to attractive subsidies.

Investing in proven technologies can take decarbonization only so far. Even with these investment trends, total world emissions of carbon dioxide—the leading cause of climate change—still reached a record high in 2022. More wind power, solar power, and electric vehicles have been shaving a few percentage points off what global carbon emissions would otherwise have been. But although that is a contribution to reining in emissions, it is what experts call “shallow decarbonization,” and it is not enough. Stopping climate change requires that emissions plummet to nearly zero rather than just dip. That is “deep decarbonization,” and it will

require bigger, more disruptive, and riskier transformations in energy and industrial systems.

Progress on deep decarbonization hinges on two technological transformations. One is shifting to zero carbon power, known as “clean electrons” (such as those from renewable or nuclear energy). The other is finding replacements for conventional fossil fuels such as diesel and jet fuel, often called “clean molecules.” Nobody today knows what the right blend of electrons and molecules will be in a future clean energy system—which is one reason that the risks of transformation are so large and investors have so far backed only the most familiar options. The bulk of progress seems likely to hinge on electricity, as clean electrons are useful in their own right—for example, in charging electric vehicles—and are also one of the most promising (if still costly) ways to make clean molecules. McKinsey’s 2023 Global Energy Perspective sees the world’s electricity demand more than doubling by 2050. Studies by other groups, such as the International Energy Agency, offer similar estimates.

Decarbonization of the power sector requires that electric power systems deploy more than just solar and wind, which are intermittent sources of energy. To be clean and reliable, the grid will also need to include power plants that can provide baseload power, such as new nuclear or geothermal generators. There will also be roles for batteries and other devices that can store electricity for long durations and for advanced systems that control these power grids so that electricity supplies remain steady.

On the clean molecules front, there are many promising technologies. Some involve capturing carbon from conventional fuel after it is burned. Others envision switching away from fossil fuels and manufacturing new fuels such as hydrogen, ammonia, synthetic diesel, or methanol in ways

that do not cause pollution. Clean molecules are likely to be particularly important in sectors such as shipping, trucking, aviation, and steel—all areas in which electrons probably cannot do the job of deep decarbonization on their own. One of the most intriguing opportunities comes from hydrogen, which can be used instead of natural gas and coal in industries, such as steelmaking, that require high heat and new chemical processes. But although many engineering studies point to huge potentials for hydrogen, financial risks will abound until there are markets that can reliably link customer demand for clean hydrogen with supplies. Last year, for instance, despite all the press about hydrogen opportunities, less than one percent of global clean industry investment actually went to clean hydrogen projects.

SHOW ME THE MONEY

Of the roughly \$1.1 trillion that flowed last year into new energy technologies and systems, only about one-fourth came from government subsidies and tax credits. (Big government programs such as the Inflation Reduction Act are just getting started, and the outlays are spread over many years.) The rest of the investment, about \$800 billion in all, comes from two private-sector sources.

One source, which invested about \$400 billion last year in clean energy, is publicly traded companies that are already active in energy and industry. A few are firms, such as Tesla and the electric utility NextEra, that have built business models focused on scaling green technology. But many are traditional “brown” firms that are seeking a market advantage by moving to clean energy, which they are doing by redeploying a portion of their capital into new investments.

In theory, these forward-leaning industrial incumbents are precisely the

actors that should be inventing and building new industrial processes that enable deep decarbonization. They have, after all, the engineering and marketing skills along with infrastructure needed to build and operate clean energy systems. But despite those advantages, these firms are not actually redeploying much capital into new processes. That is because, in most cases, financial profiles of these projects and businesses lack the well-understood risks and reliable cash flows that their shareholders expect. Clean technologies have risks and time horizons that many of these firms' traditional investors—such as public shareholders—will not adequately value when they measure corporate performance each quarter.

They are beset, in other words, by a challenge identified long ago by Clayton Christenson in his book *The Innovator's Dilemma*. Companies often focus their capital allocations on investments in projects and businesses that they are really good at doing today, not necessarily what is needed for them to be successful in the long term. This is particularly true of publicly traded firms in today's energy sector, the biggest of which are typically oil and gas companies—whose shareholders expect capital investments to generate reliable cash flows from familiar technologies.

Some firms are attempting to crack the decarbonization dilemma. But the most forward-leaning ones find traditional investors wary. The oil and gas industry is at the epicenter of this struggle. According to a recent McKinsey analysis of large-scale U.S. and European oil and gas companies, U.S. firms have outperformed their European rivals for the last two decades, and the performance gap has widened since 2019. This timing coincided with the period when European firms started doubling down on their low-carbon business strategies. Today, they are trading today at a 40 to 50 percent discount compared with their U.S. peers. It is

therefore little wonder that many of these firms are pulling back from their green investments. Shareholders are unhappy, and managers have realized that many of their low-emission investments, such as in renewable electric power generation, involve industrial processes that are not related to what these firms are particularly skilled at doing.

The other source of investment in new energy technologies and systems comes from private capital markets, also totaling about \$400 billion last year. This capital holds more promise for funding transformations in clean energy. Private investment funds, which manage a total of more than \$12 trillion in assets today, have started allocating larger shares to clean energy and industrial opportunities. Green infrastructure often offers the prospect of regular cash flows over many years, which aligns with the financial needs of such institutional investors. Pension funds, for example, need to match their investments with the longtime horizon of payouts to retirees. And private equity has historically played a role in backing new opportunities when industries are undergoing disruption.

Following this logic, the supply of private capital specifically earmarked for decarbonization—often called energy transition funds—has skyrocketed. Last year, it even dwarfed fundraising for traditional energy, \$160 billion to \$20 billion. There are numerous examples. Brookfield, Apollo, KKR, and TPG are all large investment firms that have raised multibillion-dollar energy transition funds—some of them upward of \$10 to 15 billion—over the past 18 months to two years. This investing is particularly impressive in today's financial environment of high interest rates, which, overall, has made it harder to raise private investment funds.

Some of the deals investors have made are emblematic of what is needed for the energy transition. Consider, for instance, the \$12 billion bid in

March 2023 from Brookfield Asset Management, a large investment manager, and EIG, a private equity firm, to take the publicly traded Australian energy company Origin Energy private. Origin serves one-third of the country's retail electricity market, and as a privately held company, its electricity business is now able to take bigger risks and be a lot more disruptive. In this case, it is shedding its dependence on coal and shifting to renewable power. That kind of brown-to-green transformation can support coal-rich Australia in achieving deep decarbonization.

The acquisition of Aera Energy by investment groups provides another case in point. Previously controlled by ExxonMobil and Shell, the company accounts for one-fourth of California's oil and gas production. The new owners are similarly focused on brown to green, using the firm's existing assets to deploy renewable power generation across Aera's vast land holdings. The firm is also retrofitting existing oil and gas infrastructure so that some of the pollution caused by producing fossil fuels can be captured and put safely underground—a skill that leading firms in the oil and gas industry are developing. Within a decade, the new enterprise hopes to be carbon-neutral.

Brown-to-green partnerships thrive on combining the skills of industrial incumbents with new sources of capital. Through this process, whole new industries could emerge. One harbinger of that future is the November 2023 announcement of a \$550 million partnership between Occidental Petroleum and BlackRock to fund the development of the world's largest direct air-capture plant in Texas. Once operational, the corporations say, the plant will remove carbon dioxide directly from the atmosphere on the order of 500,000 metric tons per year, which roughly translates to the amount of emissions generated by burning about one million barrels of

oil.

Although the details of these partnerships vary from deal to deal, the overall story rhymes. The flexibility and patience of private capital combines with specific businesses or technologies of an existing firm. A new partnership emerges—through joint ventures or other transactions that carve out novel technologies or businesses—so that the original core business does not block disruptive new ideas.

GETTING IT DONE

A theme at this year's climate conference in Dubai is turning pledges into specific plans that slow and stop climate change. Success requires motivation, skills, and capital.

The good news is that all those elements are combining through new kinds of partnerships, each of which can be used at a much larger scale. Some of these models involve investment funds' simply buying industrial firms, as Brookfield and EIG did with Origin Energy. Alternatively, investors and firms can form joint ventures to invest in specific projects or entities, as BlackRock is in helping Occidental establish the direct air capture plant. Joint venture arrangements are financially isolated from corporate balance sheets, allowing firms to support new lines of business that can help achieve deep decarbonization. These partnerships, meanwhile, are useful to investors because the incumbent companies involved have close relationships with energy customers—and are themselves huge sources of demand.

But overall, the scale of investment and effort remains too small. For all the promise of these partnerships, they are mainly focused on individual technologies and businesses rather than the shift in whole industrial

systems needed to make deep decarbonization a reality. To help fix this problem, governments have a key role to play in funding the development of new systems and markets.

This will require a shift in how states incentivize the energy transition. Today, much like private capital, most government funding is focused on technological widgets, not whole systems. The total amount of new U.S. funding for clean industrial technologies, for instance, is measured in hundreds of billions of dollars. By contrast, funding allocated to the development of new systems is only in the low tens of billions.

Systems thinking requires not just paying attention to new technologies for clean energy supply but also stimulating demand. One of the biggest risks holding back investors is uncertainty about whether novel methods for ensuring a clean energy supply will find willing buyers. Here, again, governments can help. In some parts of the world, for example, states have helped generate demand by holding auctions that award government funding to cover the price gap between the cost of producing a green molecule or electron and what buyers are willing to pay. The United States is setting aside a portion of its hydrogen hub funding specifically for creating demand. Government can also help by creating diagnostics that evaluate the performance of their funding in furthering systemwide goals.

As new technologies and their supply chains advance, costs go down, and the need for government support shrinks. Fledgling technologies are then able to compete on their own, build market share, and seed technological revolutions. But today's investor and industry partnerships typically are not backing the riskiest of technologies and systems, so there remains a particularly important role for states in funding innovation and risky technologies in their earliest stages. Also critical is government support

for companies that are learning how to develop and operate new systems reliably and affordably. The U.S. Department of Energy has programs, such as ARPA-E and the Loan Programs Office, that are designed to fill gaps in clean energy financing through grants and loans and have proved effective in making early technologies more commercially competitive. Other countries can create similar programs, but more coordination of these national efforts is needed globally because innovation is ultimately something that benefits the whole planet.

Governments, however, are not alone in backing innovation. There are emerging private-led systems that play similar roles. One is Breakthrough Energy Ventures, a pool of privately raised capital originally established by Bill Gates and other high-net-worth investors to combine a drive for financial returns with a mandate to address a critical financing gap in the clean energy market. This mandate allowed the fund to back high-risk technologies that investment managers with purely financial fiduciary goals would not touch. More recently, spurred by a supportive policy environment and the transition-driven success of companies such as Tesla, new funds have been raised to focus on riskier technologies, with the belief that some of those bets could pay off handsomely.

There is still a lot of work to be done, including in sustaining public support for this big shift in industrial activity. For all the promise of private investment funds, \$400 billion per year of clean energy investment is still perhaps one-tenth the level the world needs. Private capital markets can help, such as with new mechanisms that will allow individual investors to back clean energy funds alongside institutional investors. Actors will have to find ways to provide direct financing to emerging economies, which have both the greatest needs and the greatest obstacles

to investment. Novel methods for attracting capital will be needed, such as mechanisms that help investors reduce their exposure to local currency risks and highly uncertain macroeconomic conditions.

The clean energy system of the future will be capital-intensive, which means that its behavior will be highly influenced by where funds are willing and able to flow. That means the pace of the clean industrial revolution will hinge even more on the logic of capital, which requires

aligning investors with the risks and the long time horizons needed for industrial transformation. But investors are ready—and more will flood

Foreign Affairs with the transition. They just need the right partners and incentives

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