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The London Accord CO_2

Thinkpiece for The London Accord

A Role for Philanthropy—Mobilizing Risk Capital for Critical Research and Early-Stage Technologies

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Summary

The research papers developed under the London Accord represent the increasing interest of capital markets in climate change mitigation and adaptation. On the one hand, climactic upheaval creates significant undefined risk, and requires the creation of new knowledge and metrics for better decision-making in a landscape where risks are difficult to foresee and define. On the other hand, mitigation and adaptation efforts are creating new markets and investment opportunities on a scale that is potentially unprecedented. Inherently global in dimension, these efforts will also need to be diverse and varied, as there is no single solution to climate change. Indeed, the processes of mitigation and adaptation will demand the engagement of nearly every sector of the economy and society. The dynamics at play in the process make this one of the most significant moments in human history—climate change is above all, an evolutionary challenge, and our response to the challenge, a conscious evolutionary shift. As a result, climate change will likely be a significant driver in the world economy for the foreseeable future. For these reasons, long-term adaptation will require much more than a green-technology boom—it will require an overall economic shift, away from a carbon-based economy towards a low or zero-carbon, green-economy.[1]

The philanthropic response to the climate change challenge has been diverse. Philanthropic investments have varied across a wide range of strategies and scales, from investments in programs that build basic public awareness of climate change, to investments in mechanisms for generating and collecting carbon-impact disclosures from the world's leading corporations. Indeed, the list of philanthropic investment opportunities for addressing climate change is seemingly endless. Like so many others around the world, philanthropists and their organizations find themselves in the process of deliberating how best to respond to the challenge, in a manner that both accelerates and enables mitigation and adaptation. As this deliberation continues, and the sector explores and implements a number of strategies, this paper focuses on one high-impact, philanthropic-investment category that we believe deserves increased attention and discussion.

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[1] For purposes of this thinkpiece, the term "green" is used to describe a carbon-free or low-carbon economy and the technologies that will enable such an economy, though we acknowledge that the term "green" can embody larger environmental and sustainability themes.

It is our belief that strategically-invested philanthropic capital targeting early-stage technologies and critical research can play a pivotal role in the development of the new research base and infrastructure needed for a truly green economy to emerge. Ultimately, these investments would play an enabling role for the markets because they would ensure a supply of material for future deal-flow while also assisting to diminish the risk associated with immature technologies currently in the marketplace. This would prime the pump for increased investment from the financial sectors.

We propose that the philanthropic sector strongly consider how it can both empower and enable the global marketplace to do what it does best—generate new industries, produce efficiencies and drive down costs in those new industries, and facilitate mechanisms for their broad distribution—for the benefit of the environment and society. Our interest should be in ensuring that the emerging "green-boom" is more than a one-time, unique event; market-based investment and engagement must be sustained over a long-period of time to successfully mitigate and adapt to climate change.

We further propose that traditional streams of funding for critical research and early stage technologies may need to be temporarily supplemented with philanthropic capital in order to propel the promotion of green science and technology to the level and scope needed for long-term adaptation. Philanthropic investments in this space should be structured to help jump-start the large-scale flow of government funding necessary to build the research and knowledge base required to sustain and support the emerging green economy over the next several decades. In the process, philanthropy might also help to structure a more robust model for interaction between research institutions and industry. Philanthropy has unique relationships and sway with the scientific community, strong links to industry, the financial sector and policy-makers, as well as resources available on a scale that can help researchers, their institutions and universities, re-imagine their research agendas and develop new models for unleashing powerful ideas into the marketplace. This opportunity arrives at a time when the philanthropic sector is experiencing tremendous growth and finds itself in a state of reinvention, willing to take on the largest challenges facing humanity, support innovative solutions, and collaborate across sectors and borders to take those solutions to scale.

We should note that much of our discussions comes from an American perspective. We believe, however, that our thoughts and recommendations for global philanthropy are broadly applicable.

The Challenge: An Overview

In reviewing the London Accord sectoral papers, and from conversations in the U.S. and around the globe, it is clear that there is a growing understanding in financial markets, as well as in the philanthropic sector, that "enlightened" capital has the potential to change the world for the better while at the same time creating vast amounts of new wealth. In the process, the concept of "wealth" is being redefined, through a first-time, civilization-wide, recognition that the health of the planet and its resources are a part of the wealth equation. For the markets, this may have initially resulted from rational concern: there is too much risk in allowing the continuing degradation of the atmosphere and planet. Increasingly, climate change is being seen as a

strategic issue by financial markets and leading corporations, central to the future of whole businesses and economic sectors. This shift in thinking has the potential to completely transform our economy and the world. The question becomes, how do we get from this emerging enlightenment to the sustainable world we are collectively imagining? And what is the potential for philanthropy to help enable and accelerate the process?

We begin by looking at the challenge from within the context of a system. One effective metaphor is the simplified image of a manufacturing line. At the beginning of the production line, the system requires inputs in order for the system to deliver the desired finished product at the end of the line. In addressing climate change, we must ask ourselves what "product" we want our system to manufacture. As a start, it would seem that we want it to include diverse sources of clean energy, low or zero carbon-impact methods of transportation, sustainable cities, limited waste, a restorative economy that puts back what it takes from the natural system and improved quality of life for Earth's inhabitants. Changes in virtually every sector of society will be required to generate this end-product, from policy reform to education reform to the creation of new financial tools and metrics.

One clear and evident pre-existing condition required to make this shift possible is the development of new technologies and targeted technological innovation. Such innovation is the fundamental basis for the London Accord—and its sectoral papers lay out the opportunities and market obstacles to moving forward in those areas. This paper presents a view from the philanthropic community on an ecosystems approach where philanthropy can work with the research community and the markets to reduce those obstacles and the accompanying financial risk to an acceptable level.

In the post-Internet boom economy, philanthropists are increasingly results-oriented, seeking to ensure that their investments are wisely made and stewarded. In the area of climate change and sustainability, philanthropists seek to leverage their capital for maximum systemic impact. As such, we believe the focus should squarely be on bottlenecks in the system—the bottlenecks that limit a market evolution in those sectors necessary for breakthroughs that can overcome our current crisis. Some recent attention has been paid to the use of mission-related investments (MRIs) and program-related investments (PRIs) as tools for mobilizing a portion of endowment assets towards green and social investing. These are potentially formidable mechanisms for channeling significant pools of assets towards emerging green sectors and industries, which in turn would attract more private capital to those sectors. These initiatives are still in development, and greater attention is clearly needed. In fact, endowment managers might look to the results of the London Accord to evaluate how their endowment might be invested in market-based, carbon reduction initiatives. We, however, focus on another significant opportunity for philanthropy: the use of an ecosystems approach to maximize investment, leverage and research in the key underlying science and early-stage technology needed for long-term mitigation and adaptation.

Revisiting the factory-line image, we look closely at a specific class of inputs: innovation, invention and the creation of new knowledge. While many researchers see these as an end product in themselves, they are simply a starting point for the development of new industries, economic clusters, and market opportunities. Capital markets today are demanding investment opportunities in technologies that will enable mitigation and adaptation. Tremendous amounts of capital have already been mobilized and/or concentrated into a variety

of funds, but the supply side—the researchers, universities and research institutions—has been relatively slow to deliver.

This is a critical bottleneck that the the philanthropic community is positioned to address. Venture capitalists, and even markets, have great enthusiasm for rapid return on investment. This has become even more noticeable in recent decades, as the “big hit“—the next Microsoft or Google—has developed as the new icon of success. The reality is that most decision makers rarely optimize a decision over a timeframe that would in the end make everyone better off, including the decision maker. As a result, much of the capital currently available, especially for novel technologies, might be categorized as "impatient" for its focus on short-term results and rapid return on investment. This could create a difficult climate for innovators and players in the renewable energy and related industries, where profitability will likely require both significant capital and a long lead time. As seen most recently in the Internet and telecom booms/busts, markets that are saturated with "impatient capital" can be susceptible to instability. We propose some of the ways that philanthropic capital might help to overcome this impatience. Our goal should be to identify a process designed to build stability into early-stage climate mitigation markets, through the insertion of "patient capital" or “growth capital,” in the form of philanthropy, that fills some of the gap between where we are and where markets need to be.

Why Philanthropy?

As a first step, though, the question must be asked, "why philanthropy?" In proposing an increased role for philanthropy in funding and promoting green science and technologies, we are supplementing traditional market approaches that have been successful for decades. We believe there are several needs that force this new paradigm, some related to science and technology funding patterns over time, others more purely market-oriented.

The first question is quite simple: isn't the funding of early-stage science and technology a fundamental role of government? In many ways, the answer is yes; basic science and technology funding has been the purview of government, and government remains and will continue to be a critical player in such funding. Overall, however, government funding for science and technology is in decline. Furthermore, in its current model, government funding is not well adapted to promote the kinds of technology breakthroughs needed in the current crisis. First and foremost, governments fund science through a series of agencies whose agendas are often politically determined and whose operations and funding targets adapt slowly to changing needs. By the very nature of bureaucracies, these institutions are also reluctant to fund across using a holistic, cross-agency strategic approach of the kind that is needed at this time.

Perhaps more importantly, government science funding in the past two decades has become increasingly risk-averse, with an over-supply of good science and technology proposals and an undersupply of funds available to demand pre-validation of proposed research. Philanthropic capital is being used in some cases to overcome that risk aversion by providing funding to proposals that could not be funded through any other means; a leading measure of success is whether funded research receives follow-on funding through government and foundation grant proposals based on their results. Such a mechanism for pre-validation

science is even more important in climate change and sustainability, where funding is needed in entirely new fields of research where a limited or no track record of government science funding exists.

In this sense, early-stage, high-risk philanthropic capital can be an important driver in generating new government funding in many of the areas being addressed in the London Accord. Such early-stage funding could serve to validate novel science and technology, enough to attract follow-on government funding and, more importantly, folllow-on private capital. Successful grants in these areas can also promote awareness among various government agencies of the opportunities within broader research, political and market environments. In this way, philanthropic capital can be seen as feeding into the government science funding paradigm, helping it to overcome the obstacles that currently exist.

A second set of questions that arise are more market-focused: why can't the world's leading corporations play the role that we advocate for philanthropy? And with the opportunity for implementing market mechanisms—such as a carbon tax or cap-and-trade programs—won't the market respond effectively, without a need for philanthropy's help?

The first response to those questions is that we take a utilitarian rather than a utopian view of the current crisis, and believe that the efforts of rational actors in the political or market spheres must be supplemented to respond to the crisis in a timely and effective manner. The amounts of capital available in the philanthropic community, and the opportunity they present for leveraging dramatic progress on breakthrough science and technology, are a potentially powerful mechanism for addressing the global climate crisis. It might be overly risky to rely solely on government action—which has been slow-moving in response to the crisis, and still depends on multilateral negotiating processes—or on a still developing cap-and-trade system, even if we knew the systemic environmental and climatological response to cap-and-trade. Indeed, there is no evidence that there is sufficient new science or technology available at this time to bring about long-term adaptation to the current climate crisis, let alone to respond if the crisis gets worse and the planet moves into abrupt climate change. Long-term adaptation requires a more holistic approach, and while cap-and-trade will play a leading role in the coming decades, it is only part of the whole answer. Rather, the crisis demands a diverse set of strategic approaches from various and multiple players.

Perhaps more importantly, a sustained response to the current crisis demands the emergence and adaptation of technologies that do not currently exist, something that both multinationals and the global markets cannot be expected to do alone, especially in light of the urgent nature of the crisis. Even leaving aside the current disarray in U.S. and global financial markets resulting from the misallocation of risk in the sub-prime housing crisis—a disarray that has dramatically increased risk aversion in capital markets—carbon exchange markets are too immature to reach the efficiencies needed to make them effective. In their current state, carbon exchange markets are also unable to keep up with the exponential growth in China's energy production, limiting the effectiveness of the "cap" portion of cap-and-trade, at least to date. Carbon exchange markets hold tremendous promise but they face a variety of challenges that we must collectively overcome over the next several years.

Turning to multinationals, experience of the last several decades has indicated that technology revolutions are often fueled by small, start-up companies—Microsoft vs. IBM, for example—who grow fast enough to

require multinationals to adapt their business model. Even the emergence of hybrid vehicles came as part of the ongoing revolutionary approach of Japanese automakers, who successfully deteriorated Detroit's dominance in the American automobile market through a relentless pressure for smaller, more fuel-efficient vehicles. The increasing dependence of multinationals on an "open innovation" research model is essentially a recognition both of the need to adopt new technologies before they become risks to core businesses, and also of the limitations of internal corporate research programs to develop the breakthrough technologies that reshape entire markets.

For these reasons, we focus on bringing attention to the opportunity for philanthropy to play a more significant role in funding science and technology designed to address, mitigate and ultimately reverse climate change. The London Accord's sectoral and cross-sectoral papers have demonstrated significant levels of risk in many of the markets they address; the role for philanthropy that we propose is one of "risk diminishment," designed to reduce risk sufficiently that it falls to levels acceptable to the markets. In this process, success can breed further success: the strong emergence of biotech in California's Bay Area, in Cambridge, MA, and in San Diego, pushed other regions around the United States to invest in life sciences research and to seek out life sciences companies and investments that could replicate the discoveries, treatments and jobs that emerged in those three regions. A similar process can be jump-started by philanthropy today, in working with research institutions, universities, communities and industry clusters to spur the large-scale development of a green economy.

Science & Technology Innovation for a Green Economy: An Emerging Model

The state of innovation funding has been seriously influenced by the experience of the last two decades, when venture capital has become the lead investor in many of the key technologies and companies that emerged during that time. The experience of that time has both positive and negative implications for the successful shift away from a carbon-based economy towards a green-economy. There are many lessons to be learned from our recent history.

How the Green Technology Revolution Differs from the Tech and Internet Booms

It could be argued that the successful emergence of the information technology and telecom sectors during declining industrial investment in research and development—beginning with the divestiture of AT&T, through the collapse of Bell Labs, and followed by the increasing importance of quarterly returns on stock performance—was possible because the industry did not require significant capital investment in economic and industrial infrastructure. In fact, by the time that the tech boom began, the industrial infrastructure underlying computers and wired telecommunications was already fully in place.

With the development of certain key technologies, such as the desktop computer and wireless communications, new companies and industries were enabled overnight, and there was significant

opportunity for new technologies to emerge with very low barriers to entry. This dynamic was exacerbated throughout the tech boom of the 1980s and 1990s, with increasingly smaller amounts of funding available for infrastructure investments, and combined with deregulation, reductions in government oversight of core infrastructure needs. These trends continued to expand, with ever more money pursuing ever more esoteric technologies. The market crashed and the process hit a dead-end when fiber-optic and wireless network capacities created bottomless opportunities for information flow between nodes, but no infrastructure or usable content to link those networks to any customer base. Throughout the period, there was little economic incentive promoting infrastructure investment, and no requirement from government that such investment take place.

The other economic boom of the 1990s, the emergence of biotech, followed a different model where biotech start-ups developed over time into a risk management strategy for large pharmaceutical companies. Biotech clusters that emerged in Silicon Valley, the Boston/Cambridge region, San Diego and elsewhere spun out from dramatic increases in National Institutes of Health investment in biomedical sciences. With the success of some early companies, venture capital came to see biotech as a new investment opportunity. By its nature, however, biotech involves an extended development timeframe and limited opportunities for exit. In most early-stage companies, those trends were compounded by over-dependence on a single technology, with limited opportunities to overcome market shifts or research dead-ends. These risks became more evident around the time of the tech crash of the late 1990s, when biotech investment capital dried up in parallel with that in tech and telecom.

The financial model for new technologies heavily favors high-profit investments at the top of their food chain. Venture funding, which plays a critical role in moving research into the market, has focused increasingly on breakthrough products that reshape markets—the next Microsoft or Google. Such an approach tends to disfavor smaller, though potentially promising technologies at the expense of the next big “winner.” This could be a vulnerable strategy in light of the current crisis: considering the complexity and scale of the problems being faced, the limited understanding of the nature of those problems, and the lack of sufficient knowledge about how solutions will affect one another once implemented at scale, we are unable to predict the likelihood that such “winners” will be sufficient to resolve the situation. Furthermore, as demonstrated in the telecom and tech crash of the early parts of this decade, and more recently in the overproduction of ethanol in the American Midwest, such targeted investment cycles can lead to collapse when there is limited infrastructure investment to support new industries.

One implication for mitigation and adaptation technologies is the likelihood that, while many of the coming advances could be spawned by the institutional research community, those advances will only move to the market through an economic model more akin to that of the 1960s through the mid 1980s than the one that has existed in the years since. Under this older model, consumer need was defined by products showcased by leading corporations and developed through small ‘job’ shops or captive industry sectors who did the high-risk R&D for small profits but significant security.

In fact, some of the most dramatic advances in greening the economy in recent years have come from large industry rethinking approaches to their markets: McDonalds in changing packaging to make it more eco-friendly, providing a reduction in packaging volume and energy used; Wal-Mart in reducing product and

package sizes to cut costs, reduce shelf space and thereby lower fuel consumption and prices. Other companies have identified niche areas of the economy where they can leverage their size or market share to pursue new markets, while at the same time moving towards a diminished carbon impact: General Electric and renewable energy, Siemens and clean energy and water supply solutions, and Levi's and locally-sourced organic cotton. By mainstreaming these technologies from the top rather than bottom-up, the companies are in some ways reinventing, or at least reintroducing, older market models where change is driven by larger blue-chip companies who shape the behavior of smaller supplier and competitor companies developing products for and around them.

This model presents its own unique challenges. Once companies have mined the low-hanging fruit—reductions in volume of liquid detergents, for example—further advances will require similar basic research and early-stage development as that redefining other markets. Developing such partnerships, however, will require a new model for partnerships between the research community and industry: during the earlier heyday of such partnerships, 'time to market' was not the critical factor it has become today, and the many delays and false starts inherent in such ties were acceptable. That is no longer the case.

The implications for the needed investment into mitigation and adaptation technologies are compelling: in greening the economy, neither the current model of innovation, nor the model that came before it, will be entirely sufficient. Investments in this space will require longer-term strategies; they will also require greater focus on the industrial and infrastructure investments needed to generate products from the new ideas and technologies emerging from the institutional research community. Such a process will require the reemergence of corporate research and development programs to drive these industries, but that will likely require the development of new models for interaction between institutional research labs and the more closed, internally-focused labs of leading corporations than has previously existed. The "open innovation" model mentioned previously is not yet a complete reality; an effective new partnership model has yet to fully emerge.

Moreover, mitigation and adaptation technologies will require novel approaches to infrastructure funding, at a time when such funding has declined dramatically. At least in the U.S., the lack of infrastructure investment before the tech crash was directly related to deregulation in power, utility and telecommunications, making those companies highly responsive to financial markets while at the same time reducing economic incentive to invest in infrastructure. Similar disincentives still exist, both as a result of policy initiatives that focus on the politically-inviting (corn farmers in the Midwestern US), and because of market inefficiencies. The natural absence of a coordinating mechanism within the markets could likely lead to over-investment in high-profile technologies.

For these reasons, strategic philanthropic investments in green research and technologies may present a unique opportunity to help develop the new research base and research infrastructure needed to underpin the emergence of a truly green economy. Corporate research funding in recent years has focused primarily on short-term opportunities, and there is a natural lag in the culture change needed to provide a longer-term view. With increased pressures on government budgets in developed countries due to factors such as the aging of their populations and, in the U.S., from the war in Iraq, it is also unlikely that government funding can entirely bridge this gap, at least in the immediate future. Though these adaptations will likely take place over

time, the question is: can the world afford to wait? A clear role for the philanthropic sector begins to emerge from this analysis. Indeed the question becomes: what can philanthropy do to become a catalyst for growth of the new research base and research infrastructure needed? And what strategies can philanthropy pursue to leverage its investments to increase the flow of government and corporate spending into this space?

Science & Technology Funding for a Green Economy: The Need for an Ecosystem Approach

In regards to science and research funding, philanthropy continues to act largely within its historical parameters. Traditionally, individual foundations targeted pre-defined needs and objectives in response to perceived concerns. Once they had identified their program priorities, foundations pursued them with individual researchers, research institutions, and universities. There has been little effort to coordinate philanthropic investment in science and research around the globe, and less to effectively coordinate those investments with market and/or government programs. Philanthropic investments in science and research at the level of the individual proceeds in an even more ad hoc manner. The traditional approach of research institutions and universities to philanthropy has focused, not surprisingly, on the same discipline-centric approach that drives internal institutional structure.

This current system of philanthropic funding in the US, and increasingly around the globe, is similar in form to the Vannevar Bush government agency funding paradigm: researchers, institutions and universities compete in broad areas of activity—such as basic life sciences, engineering, or policy development—and the best-structured or most responsive proposals are funded. Such a paradigm is not well suited for the integrated needs of our emerging green economy, primarily because it can lead to fragmented funding streams; this results in lost opportunities for leveraging assets and/or funding to benefit parallel science and technology advances. The general result is that philanthropy, up until now, has reinforced traditional disciplines instead of new interdisciplinary initiatives. The funding scheme for science and research relevant to climate change will have to be entirely different. We believe an ecosystems approach provides a powerful alternative model.

The single-most important precondition of market success is efficient operation throughout the stream of activities needed to develop inputs, prepare and transport them for manufacture, transport them into the marketplace, and develop consumer demand. Greening of the core sectors needed to turn back climate change is limited by the lack of such efficiency within their own supply and demand matrices, and the extreme efficiency of the competing technologies that must be displaced. Various topic-focused papers developed under the London Accord process indicate a clear consensus that the target markets are still immature and not entirely ready for the significant investment needed for transformation to a green economy.

The philanthropic sector is uniquely positioned to provide some of the risk capital needed to propel this transformation forward. Major philanthropic institutions around the world, and the philanthropic community emerging from the technology and Internet booms, have strong connections into the universities and other research institutions that will serve as the birthplace and cradle of new technologies. However, philanthropy currently lacks a mechanism for the necessary knowledge-sharing and cross-communication to determine how philanthropic investments can be harnessed to impact the greater “ecosystem” needed to develop

green science and technologies in areas as diverse as biofuels, energy efficiency, bio-based plastics and composites, and alternative energy production.

Efficient markets involve constant communication within the marketplace, between suppliers and manufacturers, between manufacturers and distributors, distributors and sellers, and sellers and consumers. Each player within an efficient market has the necessary knowledge to contribute to the overall distribution system, and communicates that knowledge effectively upstream and downstream. Every market, in essence, is an ecosystem, and operates effectively and efficiently because each player knows their role and plays it. Philanthropies should consider a similar ecosystems approach to funding critical research and early-stage technology. Chart A is a case study of biofuels/synfuels research, and as explained below, clarifies the need for such an approach that leverages critical science overlaps.

Chart A: The Science In Biofuels

Discipline	Corn & Sugar-based	Cellulosic	Algae	Coal/ Synfuel
Plant biology: research to enhance fitness and yield of switchgrass, algae and other biological energy sources, including the discovery of new cellulose consuming organisms and the isolation of new algal species producing high hydrocarbon content.	N	N	N	U
Plant biochemistry: research into methods to genetically optimize the biological formation of new biofuels, including metabolic engineering of algae for improved biofuels and structural biology of improved enzymes for consumption of plant material; high-throughput analytical chemistry to identify chemical processes that are either beneficial or inhibitory to fermentation process.	N	N	N	U
Plant virology: research into long-term impacts of the above on viral resistance of existing plants.	N	N	U	U
Biomass process design: thermochemical treatment of biomass to break down for subsequent fermentation or other processing to valuable fuels, chemicals, and materials.	N	N	N	N
Combustion chemistry/chemical engineering: research into the chemical kinetic description of combustion of renewable fuels and blends with gasoline in the context of current engine technology: fuels matching current technology have higher potential for integration into the current transportation or stationary power infrastructure.	N	N	N	N
Mechanical engineering: since principal route for introduction of renewable mixed alcohol is by way of blending with gasoline, **engine studies** are needed to evaluate performance, octane, and emission characteristics of mixed alcohol/gasoline blends in lieu of ethanol/gasoline blends. Such research will be needed both in the area of novel ethanol blends from non-sugar-based sources (switchgrass, algae, etc.), as well as for other alternatives such as butanol or other hydrocarbons. All will likely first appear in commercial use through blending with gasoline or diesel.	N	N	N	N
				N = Necessary; U = Unnecessary

Chart A outlines the various elements of research that must be pursued to enable efficient biofuels/synfuels markets. While only a few present obvious price obstacles to the development of the market, most if not all are necessary to the full development of efficient markets. Two sets of facts leap from the chart. First, the science and technology development under competing biofuels are highly complementary: similar biology and biochemistry research is needed, meaning that philanthropic capital invested in biofuels can best be leveraged through networks that enable partnering and cross-pollination. Secondly, while the primary focus in current institutional research is on the biological side of the equation, more research needs to be done on other stages of the production process that would enable new fuels to slide easily into the market once biological obstacles have been overcome.

Similar and more robust matrices could be developed, and similar leveraged research networks created, for every critical area of integrated research necessary to support and accelerate the emergence of green industries. Again, comprehensive research initiatives focused on broad understanding of the science will have far greater opportunities for impact in all such sectors than the individual researcher model that most research institutions tend to pursue, or the single company sponsor model that corporate donors follow. This ecosystem model may be ultimately transferred to the public and/or private sectors.

The interrelationships that exist within various elements of the science and technology realm, parallels one of the underlying principles of the London Accord—the idea that cross-analysis of sectors might identify those portfolios of new technologies that work best together. The London Accord's ecosystem approach to the markets—balancing the core technologies against one another to better identify the winners—is entirely transferable to the research environment, where a constant awareness of the need to cross-leverage science can play a critical role in speeding the research, development and deployment of new technologies.

Moving Forward

We propose that philanthropic capital be invested in critical research and early-stage technologies in much the same way that capital enters the marketplace: through a market-focused understanding of the opportunities and risks, and a market-focused assessment of the areas of greatest return. Our measures of return must take into account the intangibles. In this instance, the return we seek should also have tangible commercial implications; our efforts should ultimately help launch new industries and break through critical market bottlenecks to enable the sustained emergence of a green economy.

We outline four areas worthy of further exploration. All of these are presented in outline form, to offer some direction to discussion and negotiation within the philanthropic community itself, and with research institutions, government and industry. Such a dialogue will be necessary to flesh out these concepts into plans and programs than can be implemented within a reasonable timeframe. The basic goal is to find creative ways to bridge the gap between society's science and research mechanism—research institutions and universities—and the markets. In light of the scale and urgency of the crisis, this conversation cannot begin too soon.

Creating Leverage Opportunities: Building a Philanthropy Ecosystem

The global focus on climate change and sustainability presents significant new opportunities for the pooling of philanthropic resources in order to both maximize resource effectiveness and reduce risk to philanthropists. With philanthropic capital being the primary source of "risk capital," risk reduction might seem counter-intuitive; however, risk reduction in a philanthropic environment would focus on maximizing opportunities for success, rather than minimizing the chance of failure.

In an "opportunity maximization" environment, philanthropies might seek to pool their funding, or co-fund new initiatives, in ways that connect multiple philanthropic collaborators with several research institutions, rather than just one. If five donors, instead of giving individually to five institutions, were to combine their resources in this manner and hold back some portion of their commitment to provide follow-on funding only to successful institutions, they would create vehicles that more effectively force change and new opportunities in their funding. This is part of building an ecosystem approach to giving.

To succeed, philanthropic funding in this category must be results-focused. However, few large-scale philanthropies have the local presence or the combined science, technology and market expertise to successfully monitor their funded programs, let alone provide ongoing funding and advisory support for them. Universities and research institutions have large communities of such "knowledge capital" that is often seeking ways to support the university's mission. Many of these same constituents—alumni, companies and local and state governments—have more limited resources to give, but can give in a more targeted, more focused manner than a large national foundation. The power of these ecosystems is virtually untapped by philanthropy in support of its own missions and funding.

As an example, one or more global-scale philanthropic institutions could seek to provide funding for new research networks in alternative energy that leverage existing research skills in various institutions across the country. In addition to requiring cross-disciplinary research, other requirements could include:

- some set percentage of local philanthropic support to match the institutional funding provided;
- an Advisory Board group or groups from related industries (local if available) that can provide technology, advisory and financial support to the institution; and
- an Advisory Board group of alumni working in related industries to provide similar technology, advisory and financial support.

There is a clear opportunity to leverage large-scale philanthropic funding to build a community of smaller, local philanthropic-minded individuals to support climate change and sustainability research initiatives. These individuals, who can serve as a bridge between the research institution or university and its larger philanthropic partners, will provide the kind of engaged monitoring that is needed for accountability to be more than just a byword.

The best way to begin such a process would be through national philanthropies engaging local philanthropists in dialogues around common core objectives, and to use that process to define networking opportunities. Many local philanthropists seek to support their research institutions and universities in order

to build the local economy over the long-term; such individuals can be enlisted in those elements of research initiatives that link technologies and future employees into industry.

Such broad-based initiatives, which focus on local economies as well as on broader science and technology issues, would also present an opportunity to bridge the divide between universities and capital markets in support of technologies that will facilitate the shift away from a carbon-based economy. This will require that we harness the innovation currently occurring in the philanthropic sector to design models that will achieve this objective.

Innovation Funding: the Ultimate Risk Capital

The greatest gap in funding available for research today is the lack of funding for pure discovery research and very early-stage technological innovation. As described previously, government science funding, like many of its corporate counterparts, is increasingly risk-averse. Philanthropy has a unique opportunity to pursue such innovation funding in areas tied to global climate change and to encourage others, in particular in government and multinational funding organizations, to support innovation that would otherwise never emerge. Risk capital is particularly needed for innovations with applications for climate change adaptation in developing countries, where businesses may be unlikely to invest in initial R&D.

The London Accord has identified many of the core sectors needed to resolve the crisis that we are currently facing; and it has laid out a roadmap for progress in those sectors. The parallel science innovation needed to implement that progress can easily be identified, and new vehicles for innovation finance created. This is an area which cries out for attention.

Philanthropy as Risk Reduction

A second funding opportunity, of equal importance and impact, lies at the other end of the discovery process: the transition from the research environment into the market. This bridge is another area where philanthropy might step in with new and innovative models.

Many of the London Accord sectoral papers find that there are substantial levels risk in many of the current markets for mitigation and adaptation technologies. Given the high risk profile in today's markets, another option for philanthropic capital would be to seek methods that minimize risk. Incubators are one useful model. But there is another option: funding risk reduction directly. This would involve the establishment of risk reduction funding pools that seek to attract greater levels of private capital into many of the markets still perceived as bearing high levels of risk. The most appropriate models might be the approaches used by the World Bank's International Finance Corporation (IFC) and the U.S. Export-Import Bank (Ex-Im), both of which provide loan and guaranty programs that minimize risk.

The goals of IFC, as well as the Ex-Im Bank, focus on reducing risk within emerging markets, and they have extensive experience in environmental remediation and related fields. Adapting such approaches to

philanthropy would involve significant forethought and dialogue, especially to prevent adverse selection, but could provide a significant impetus to the development of new technologies and industry clusters.

This is particularly true in reference to the "cluster" economies that have been the most successful in high-tech and biotech. Such economies are successful precisely because they become ecosystems. For technologists and entrepreneurs, the availability of research resources, venture funding, and fellow entrepreneurs brings down the cost of starting companies and doing business. For venture investors, the number of entrepreneurs and technologists in a region is directly related to the number of investment opportunities, making such regions highly attractive. For highly-skilled employees, the presence of multiple, related companies provides migration opportunities and a great degree of career stability within a specialized field. And the faster and deeper such economies grow, the more they integrate and become self-supporting, feeding an ongoing cycle of growth.

The mobilization of philanthropic capital into regional economies, through the use of innovative financing vehicles that incorporate investments from surrounding corporate and government stakeholders, could have a significant impact on the development of new industry clusters. This is particularly true in those regions where such clusters have already begun to emerge or where they complement existing industries.

Risk Reduction Through Focus on Government Policy

Philanthropists have a special role in society, one that can often be leveraged for government action. Yet the environment is a particularly difficult topic in politics, especially within the United States, where stagnant debates have continued for decades. Even with the flurry of activity among private actors and businesses to address climate change, and their demand for government action, our political actors have been slow to respond at a scale appropriate to the challenge.

We believe that there are opportunities for approaches that could dramatically impact the government response to climate change and sustainability. First and foremost, given the recommendations for philanthropic funding in innovation grants to spur greater government grant opportunities, it is important to pressure the political system to better fund climate change and sustainability related science and technologies. It will do little for the overall ecosystem if philanthropy spurs greater activity for fields in which there is no follow-on support.

A second step would involve working with government funding agencies to identify key interdisciplinary science funding opportunities that bridge the parochial disciplinary boundaries within government agencies. There is an immediate need in this area, in that institutional scientists already find their grant applications falling between the cracks. This challenge could intensify over time with the emergence of more cross-disciplinary initiatives focused on innovative science and technology.

Final Thoughts

The London Accord provides critical insight into the market perception of the opportunities and challenges inherent in climate change, creating a source of highly valuable data for the philanthropic sector. This is especially true as the sector seeks mechanisms for harnessing the power and scale of the markets to address climate change. As market players have begun to mobilize, their tremendous potential for positive impact is becoming clear. Long-term adaptation will require much more than the green-technology boom that is emerging from this mobilization, however—it will require an overall shift, towards a low or zero-carbon, green-economy. Philanthropy is uniquely positioned to help overcome a targeted set of identified obstacles to the sustained development of this new economy. It is our belief that strategically-invested philanthropic capital, targeting early-stage technologies and critical research, can play a pivotal role in the creation of the new research base and infrastructure needed for a truly green economy to emerge. Ultimately, these investments would play an enabling role for the markets and ensure ongoing engagement and investment from the financial sectors in climate change mitigation and adaptation.

Climate change is unequalled in terms of its truly global nature, making the challenge the responsibility of everyone. And as grandiose as the challenge is, it comes at a special time in our collective story; indeed in no other period in human history have private actors had so much power to change the world. There is a tremendous amount of work to be done, in every sector of the economy and society; and the urgency of the crisis demands that we accelerate our efforts across the board. Here, we have taken a very focused view, looking at a critical piece of the overall dialogue that we believe deserves greater attention. Ultimate success, however, will be determined by society's collective ability to shepherd in a sustained transformation that will enable us to effectively address the implications of climate change, while setting a new course for humanity—towards a more balanced existence on this planet. In the end, that will be the greatest legacy of this era.