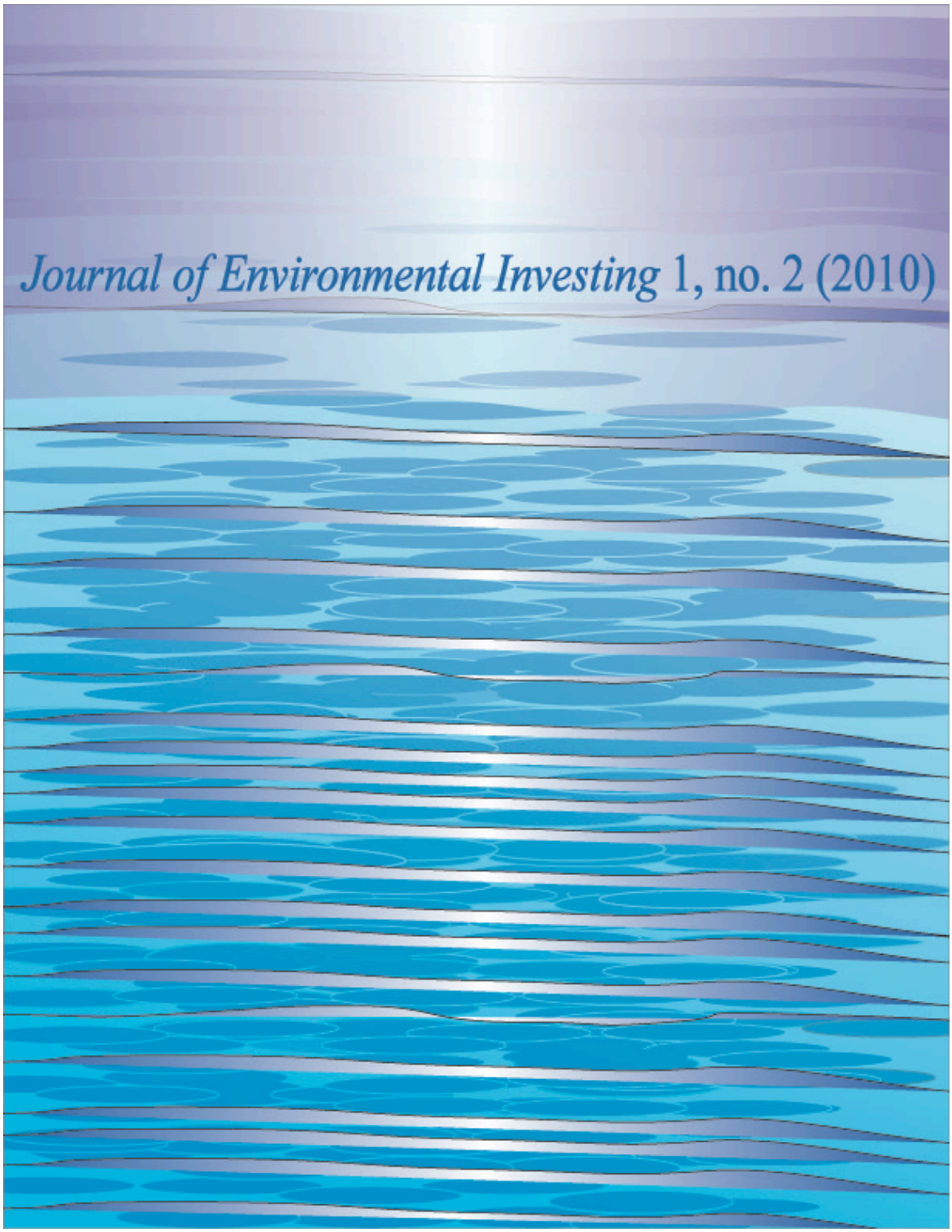

Cover design by Nancy Gelband

Journal of Environmental Investing 1, No. 2 (2010)

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"Keep Learning and Doing"

Angelo A. Calvello, PhD
Editor in Chief

As readers of the *Journal of Environmental Investing* know, Dr. Stephen Schneider passed away on July 19, 2010. Dr. Schneider was a seminal thinker on climate science and climate change who pushed both colleagues and opponents to understand and quantify the environmental challenges we face and to create scalable, effective solutions.

At COP 15 last year, I met with Dr. Schneider and discussed my idea of starting the *Journal of Environmental Investing*. He immediately saw the need we'd be addressing and he encouraged me to aggressively press on with the formation of the JEI. To codify his encouragement, he gave me a copy of his book *Science as a Contact Sport,* with the inscription "Getting the investment on track for sustainability is essential. Keep learning and doing."

His inscription nicely encapsulates the mission of the JEI. Our goal is to get the investment piece right so that we can tackle and solve critical, time-sensitive environmental challenges. But getting the investment piece right also requires getting the science, economics, policy, and technology "pieces" right. That's why the JEI takes an interdisciplinary approach, an approach that includes both learning and doing. This should be clear from the content of our second issue and from the makeup of our editorial and advisory boards (both of which have been instrumental in keeping us on track).

So I invite academics and practitioners from all relevant disciplines to help us "keep learning and doing." Get involved in the discourse on environmental investing; think critically about the challenges and opportunities; actively contribute to the development and deployment of market-based solutions.

Thanks for your support,

PS At the JEI, we try to practice what we preach. In November, we launched the Journal of Environmental Investing Scholarship Program (JEI SP). The Program's aim is to encourage and support graduate students doing original research in an area of environmental investing. Details can be found at www.jeisp.org.

Point of View

How Important is Clean Energy Investment to the SRI Community – and is SRI Important to Clean Energy Investors?

In summer 2010, we conducted a survey of U.S. public pension funds regarding their socially responsible investment (SRI) policy and their investments in clean energy.

The response rate to the survey was less than 10%, and the five funds that returned the questionnaire generally found SRI and reporting on environmental, social, and governance (ESG) policies not that important. Clean energy, as a category of investment, did not seem to be tracked.

Following the lack of response from U.S. pension funds, we attempted another approach – distributing the survey through a U.S. SRI advocacy group. Unfortunately, that effort was at least as dismal, yielding only one response.

Notwithstanding its failure, in terms of the response rate and the statistical irrelevance of the six completed questionnaires, we believe that it would be informative and useful to obtain survey information on the SRI and the clean technology policies of U.S. public pension funds and SRI advocacy groups. During the past five years, a plethora of institutions have analyzed these issues among other constituencies: business at large, clean technology firms, consumers, the energy industry, the financial industry, the financial media, and the investment community (for example, by the Green Transition Scoreboard® maintained by Ethical Markets). Specifically connecting SRI commitment and clean technology investment, however, has not been attempted.

Given that U.S. public pension funds are a key source of long-term financing in the U.S. financial market, their position on these topics should be of interest to other investors and public policy makers as well. Determining the extent to which clean energy investment matters to SRI advocacy groups and the extent to which they track those investments should similarly be of interest.

While our surveys did not yield many insights, they did suggest what we consider to be fundamental disconnects between the perception of those committed to SRI and the actual practices of funds with respect to clean energy investment.

Clearly, SRI is gaining traction in many countries, and a number of regional/international initiatives to promote SRI have become influential. At the same time, as more and more funds have adopted the United Nations Principles for Responsible Investment (UN PRI), the question arises to what extent clean energy investment is reflected in SRI initiatives

and to what extent UN PRI signatories follow through in clear related investment policies – generally and with respect to clean technologies specifically.

In 2008 Mercer, one of the world's largest investment consultants, rated fund managers on their strategic responses to ESG issues, including "questions on the way portfolio managers incorporate the potentially 'material' costs of issues such as climate change and reputation risk on human rights and social issues in their share buy and sell decisions" (Wheelan 2008). On November 1, 2009, Bloomberg joined UN PRI and announced its new screen, including ESG data. But to what extent are strategic responses being reflected in actual investment practice?

Regulators should be interested in the answers to these questions as well. On December 18, 2008, Denmark passed legislation requiring financial institutions to report on their SRI policies, and listed companies as well as state-owned companies to report on their corporate social responsibility (CSR) policies, beginning in 2010. It will be extremely interesting to read the first edition of these reports. Recently, both the U.S. Department of State and the United States Agency for International Development (USAID) issued policy statements promoting clean energy in their activities in developing countries. Would a better understanding of U.S. investment practice provoke a look at public policy at home?

According to a 2009 survey of 90 of the Netherland's pension schemes (conducted by the Dutch Association of Industry-wide Pension Funds (VB), the Dutch Association of Company Pension Funds (OPF) and the Union of Occupational Pension Funds (UvB), 73% of the schemes have adopted a responsible investment policy. The percentage has more than doubled since 2006. Only 13 of the schemes surveyed reported that they had no policy (Wheelan 2010).

We believe it would be useful to compare U.S. pension funds with their peers in other countries – but we don't believe this should be limited to policy; we'd like to see a comparison that includes better information about actual investment practices, including investment in clean energy.

Via this contribution to the Points of View section of the Journal of Environmental Investing, we hope to draw attention to the issues raised by our unsuccessful surveys, with the aim of repeating the surveys in 2011. We welcome your thoughts on these early, dismal results and the way forward to making the next set of surveys a success.

Eleanor Bloxham
Geoffrey Mazullo
December 10, 2010

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Biographies

Eleanor Bloxham is CEO of The Value Alliance and Corporate Governance Alliance (www.thevaluealliance.com), a governance advisory firm founded in 1999.

Geoffrey Mazullo is Principal of Emerging Markets ESG (www.emergingmarketsesg.net) and Adjunct Professor of the School of American Law (SAL) in Gdansk and in Wroclaw, Poland.

Turning Green into Green: Social Past, Financial Future

Shari Young, Private Equity Consultant, Global Private Equity*
Hewitt EnnisKnupp, Inc., an Aon Hewitt Company

Abstract

Turning Green into Green: Social Past, Financial Future

Green investing has historically been a socially responsible investment strategy to give institutional investors and their beneficiaries some comfort knowing they were supporting the environment. As environmental concerns impact large multinational companies, policymakers, and individuals worldwide, institutional investors have begun to recognize green investing as a financially attractive sector. The green opportunity set is broad; it includes renewable energy, energy storage, energy efficiency, environmental services, and environmental resources. While growth drivers support exposure to the green sector, there are many inherent risks to green investing, including market, execution, technology, financing, commodity pricing, and regulatory changes. This essay serves as a primer on green investment merits and considerations. Now that green investing is motivated by financial gains, investors should consider risk-adjusted returns as the main criterion for investment selection.

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Turning Green into Green: Social Past, Financial Future

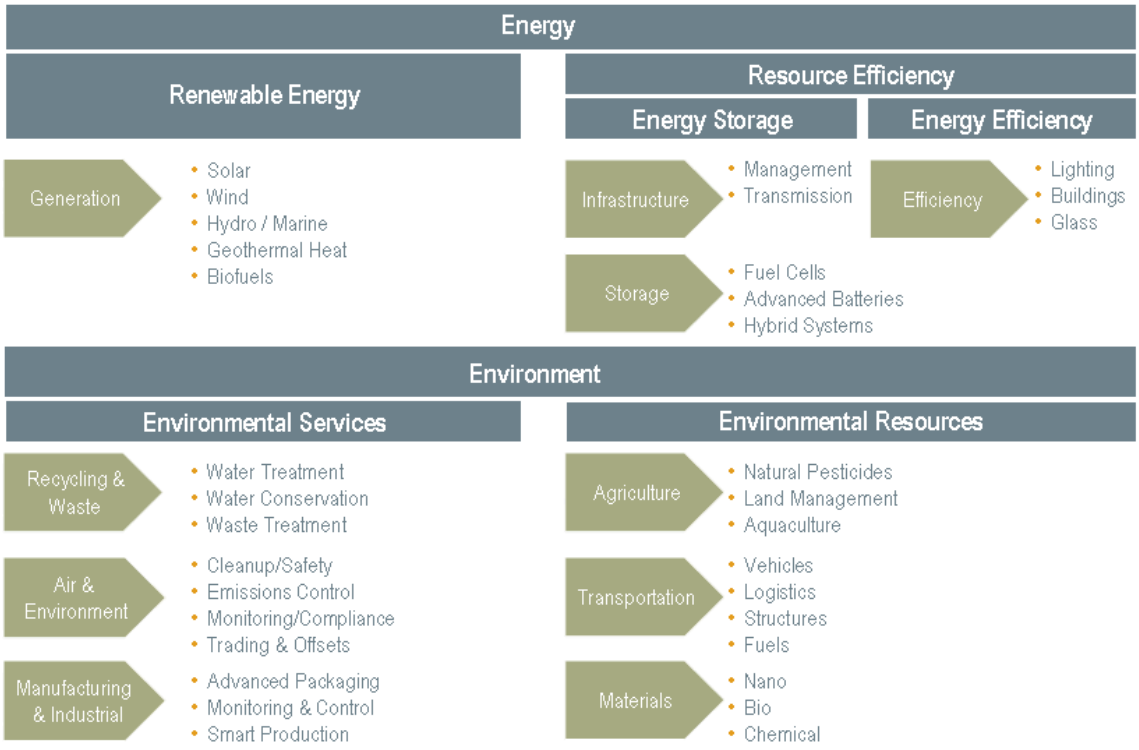
Environmentalists may finally be able to crack open the bubbly. Large multinational companies, global policymakers, and citizens alike are intensifying their focus on the long-term impact of climate change on the economy and their bottom lines. Some may have once viewed environmental concerns solely as a social problem, but climate change is increasingly recognized as a broad, worldwide issue that may be as transformational as the Industrial Revolution or the Information Age.

Similar to historical paradigm shifts, the impact stretches far beyond energy and utility companies. Climate change issues, more broadly defined as green considerations, impact not only how energy is generated, stored, and transferred, but also how products are manufactured, transported, and recycled. Many believe that green considerations will not only alter the energy and utility companies' strategy, but they are likely to change the way large multinationals, policymakers, and individuals operate into the future. The landscape is characterized by both attractive investment opportunities and uncertainties such as regulatory, financing, and technology risks.

The Green Landscape

The term "green" typically evokes images of wind farms and solar panels on roofs. In fact, the landscape for green investment is significantly broader (Figure 1). It includes renewable energy, energy storage, energy efficiency, environmental services, and environmental resources. Although green strategies cut across industries, companies operating in these sectors all strive to reduce environmental impact while improving the productivity of natural resources. These companies represent a diverse range of assets, products or services, and company stages.

Figure 1: Green Landscape



Source: Hewitt EnnisKnupp.

Green Investing Growth Drivers

As climate change has risen to the top of the agenda for an increasing number of corporations and legislators, green investing has shifted away from a socially responsible investment strategy to a broad sector strategy. Public market and private capital investors alike have begun to recognize the strong return potential available from investing in a sector dominated by macroeconomic growth trends. These growth drivers make green investing a compelling sector for consideration.

- **Energy Self-Sufficiency.** As worldwide demand for energy, water, and other natural resources continues to outstrip supply, our current consumption patterns are acknowledged to be unsustainable over the long term. Although some countries have a rich domestic supply of these natural resources to meet society's demand, others rely on imports. The financial and political costs of trading these resources can be high. The United States and many other countries have called for energy independence to reduce their reliance on imports. This independence may be achieved through discovery and innovation of clean technology and clean energy

resources that can supplement today's use of oil, coal, and natural gas. Those with significant resources are less likely to financially and legislatively support alternative energy research.

- **Regulations and Incentives.** Over a decade ago, countries around the world joined an international treaty known as the United Nations Framework Convention on Climate Change (UNFCCC) to consider ways to curb global warming. A subset of these nations approved the Kyoto Protocol, an international agreement linked to the UNFCCC that establishes binding targets for 37 industrialized countries and the European community to achieve stabilization of greenhouse gas concentrations in the atmosphere. It was adopted in Kyoto, Japan in December 1997 and came into effect in February 2005. The Kyoto Protocol is a legally binding legislation that has driven government stimulus packages, loan guarantees, and tax incentives designed to improve the environment. These tools have created demand for innovative green investing opportunities, including carbon methane capture projects and carbon trading. The Kyoto Protocol, which expires in 2012, will be superseded by an updated regulatory agenda outlined by the newly developed Copenhagen Accord. The Copenhagen Accord is a roadmap developed by the UNFCCC during its December 2009 meeting in Copenhagen that will create international policies and measures. In addition to setting global policy, G20 nations have recently supported climate change initiatives by committing a combined $400 billion of $2.6 trillion in economic stimulus allocations to clean technologies (Cleantech Group LLC 2009).

- **Technology Development.** For consumers and multinationals to shift away from traditional energy toward renewable energy, renewable energy needs to be cost-competitive with traditional energy. Technology innovation has evolved to such an extent that green energy is becoming more price and performance competitive. According to the Utility Solar Assessment Study, solar power is beginning to reach cost parity with conventional energy sources. Installed solar photovoltaic (PV) prices are projected to decline from an average of between 15 and 32 cents kWh in 2007 to between 8 and 18 cents kWh in 2015 (Clean Edge Inc. and Co-op America 2008, 6). This is expected due to a combination of factors, including improved cell efficiency and reduced silicon commodity prices. As solar prices decline and the costs for traditional energy rise, the study predicts that solar power will achieve pricing parity with traditional energy in 2015. According to the U.S. Department of Energy, the average cost of electricity across residential, commercial, industrial, and transportation sectors was 9.9 cents per kWh as of August 2010 (U.S. Energy Information Administration 2010).

In the past five years, these drivers have shifted consumer and corporate accountability's response to green issues. Multinational corporations were initially driven by pressure to take corporate responsibility and manage their public relations, and were later encouraged by tax incentives. Many have now broadened their focus on green by integrating it into an overall business strategy. As an example, in July 2009, Exxon Mobil announced that it is committing $600 million to research and develop algae-based biofuels. This investment is the energy company's first public validation of the need for alternative forms of energy. Multinationals are not only trying to reduce their carbon footprint and install solar panels in their plants and retail operations, but also lobbying legislatures to accelerate corporate and consumer support of such efforts. Wal-Mart, for instance, has a dedicated sustainability team that in July 2009 announced a sustainability index that formalizes a methodology to gather sustainability information about its products sold and to share this information with its customers. It asks consumers: To what degree can our daily purchases affect the environment? Consumers will likely embrace this additional transparency, as they have begun making direct connections between the environment and their personal health.

Corporations and investors will only embrace these green initiatives if there is a potential favorable return on the investment. Global financial markets have supported initial public offerings of high-growth renewable energy, resource efficiency, and environmental services and resource companies on such worldwide exchanges as London's Alternative Investment Market (AIM), NASDAQ, and the Frankfurt Stock Exchange. The aftermarket performance of less mature green offerings has been mixed since investors prefer supporting profitable companies with a proven revenue model that can demonstrate its ability to efficiently scale. Many companies are sitting on the sidelines, waiting to go public until the market becomes less volatile and their business models are more proven. Strategic buyers (that is, corporate investors) and financial buyers (that is, private equity, real estate, hedge funds) are also interested in this sector, as demonstrated by their merger and acquisition activity.

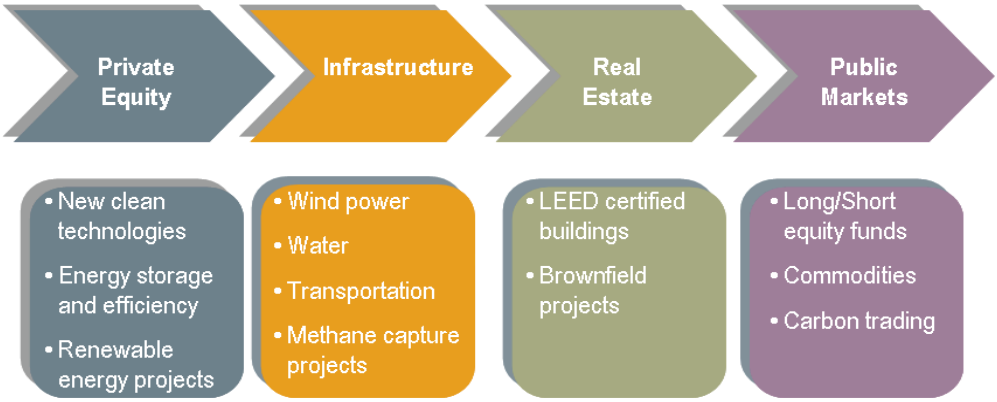
Green Alternative Investment Opportunities

HSBC estimates that 4% of the market capitalization of the world's public equity market derives over 10% of its revenue from climate change. HSBC defines climate change to include (1) low carbon energy production (for example, bio-energy, diversified renewables, gas, hydro/geothermal/marine, integrated power, nuclear, solar, and wind); (2) energy efficiency and energy management (including buildings efficiency, energy storage, fuel cells, industrial solutions, and transport efficiency); (3) water, waste, and pollution control; and (4) financials (for example, carbon trading and investment companies) (HSBC 2009). Yet, public equity investment does not provide access to the full

opportunity set. The differences in the sectors and stages in which green companies operate produce different financing requirements.

The public markets and private markets, including private equity, infrastructure, and real estate, both offer green investment opportunities (Figure 2). Private equity investment opportunities range from venture capital investments in thin film solar, smart grid, and battery storage technologies to growing renewable energy companies to energy buyouts. Investors interested in green assets can evaluate green infrastructure and real estate opportunities. Infrastructure funds will finance water treatment facilities, methane capture projects, and green transportation. Real estate funds invest in Leadership in Energy and Environmental Design (LEED)-certified buildings, agriculture-related carbon credits, wetland mitigation environmental credits, and brownfield projects. The U.S. Environmental Protection Agency defines brownfield projects as real property whose expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off green spaces and working lands. Some energy buyout, infrastructure, and real estate investors will also consider wind farms, depending on their risk-adjusted return requirements. Investors may also take advantage of the growing and evolving green energy market through thematic-based long/short equity funds to exploit alternative energy market inefficiencies, commodities, and carbon trading.

Figure 2: Sample Green Investment Opportunities

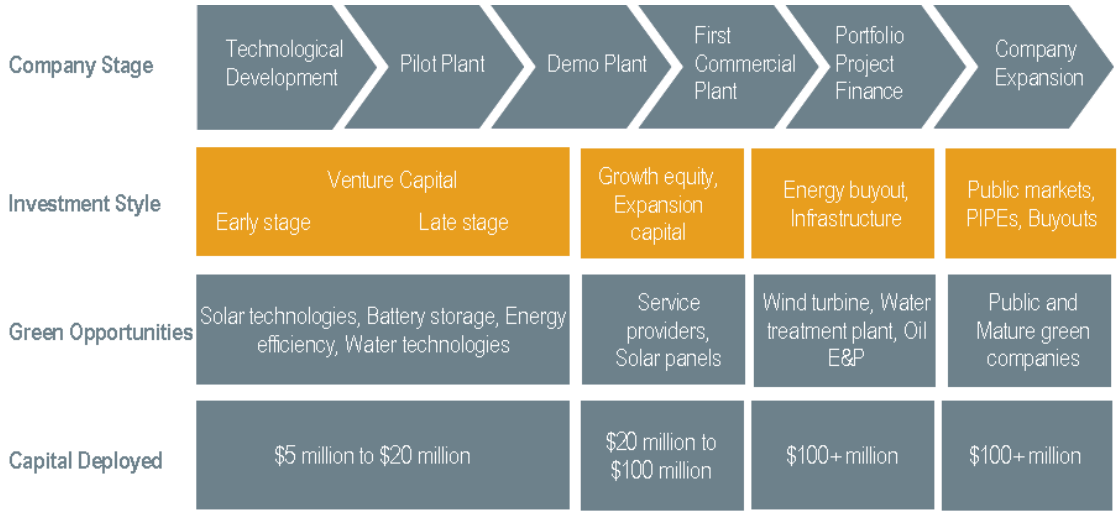


Source: Hewitt EnnisKnupp.

Green Private Equity

Private equity investors use numerous strategies to target green companies that operate at various stages of development (Figure 3).

Figure 3: Green Opportunities within Private Equity



Source: Hewitt EnnisKnupp.

The expected return on capital and risk declines as a company becomes increasingly mature. Venture capital funds will invest in companies that pioneer water, solar, and energy storage technologies all the way through funding pilot plants to commercializing the product. Growth equity funds will provide capital to scale a company, and buyout funds will acquire companies to broaden their product lines or streamline costs. In addition, many core energy funds have now carved out an alternative energy allocation to finance clean coal or wind farms. Each strategy requires varying degrees of capital that reflect the stage and size of a company. For instance, a venture capitalist could make a $250,000 seed investment, while an energy fund may invest over $100 million to finance a project's growth.

The green private equity universe includes both funds that are dedicated to the green sector and those that are more diversified. The attractiveness of a dedicated or diversified fund depends on the stage of the company and private equity sub-strategy. Investors in green private equity should research and select only managers who have expertise and a track record investing in this sector.

Venture capital investors take significant technology risk in addition to regulatory and market risks. These early-stage companies may be less capital-efficient than desirable, and the scale of investment required is much larger than in more traditional venture capital sectors. Venture capitalists have also noted that exit timeframes may extend further than those in traditional early stage investments. As an evolving sector, venture capitalists also take on market risk by investing in earlier stage companies.

Expansion stage and growth equity funds focused on the green landscape target profitable companies with high growth rates. Their investment thesis is that these companies can benefit from the growth of this sector without taking technology risk. Diversified buyout and energy funds that make a portion of their investments in green tend to be as attractive as funds that do not invest in the green sector. Energy funds do not anticipate achieving a premium for green deals because the large number of investors in the sector has inflated asset prices. These funds would earn a premium only if they undertake construction risk.

Green Infrastructure

Over the past century, countries around the world have built airports, highways, ports, water treatment and waste facilities, and power plants to support their growth and industrialization. Despite this large historical investment in infrastructure, there continue to be significant opportunities for infrastructure funds to invest in both industrialized nations and emerging markets. Booz Allen Hamilton estimates that there is a $41 trillion global need to build and repair infrastructure through 2030 (Booz Allen Hamilton 2007, 69).

Industrialized nations need to improve and upgrade their infrastructure, yet their governments are unable to fund the demand through public sources as they have in the past. Instead, they are partnering with private capital to fund these projects. As emerging markets such as China and India continue to exhibit high growth and become increasingly industrialized, they will continue to require significant infrastructure investment.

Much of this infrastructure development over the past century has been unfriendly to the environment. Many of these assets rely heavily on fossil fuels and use or generate a significant amount of carbon. As awareness of and demand for environmentally friendly projects have increased, developers have recognized the need to reduce the environmental impact of these projects. Currently, renewable projects represent 7% of total infrastructure deal volume worldwide (RREEF 2009, 19).

Given the current poor condition of infrastructure within the United States, there is also strong demand to rebuild infrastructure, including incorporating green improvements. Approximately 25% of capital set aside for infrastructure projects in the American

Recovery and Reinvestment Act (ARRA) (between $82 billion and $111 billion) is designated for green projects. This capital supports climate change initiatives that include modernizing the power grid, providing funding for technologically proven renewables, and improving public transportation to reduce emissions.

An investor seeking to commit capital to green infrastructure can invest in a dedicated green infrastructure fund, although there are only a few partnerships that offer such a focused strategy. The majority of diversified global infrastructure funds will commit a portion of their capital to green projects that include waste and water treatment plants, recycling facilities, green mass transit systems, power grids, solar energy plants, and wind energy farms. Although the focus on climate change may not necessarily be the primary force behind a globally diversified fund's acquisition of an infrastructure asset, many of these assets are considered green.

Similar to traditional infrastructure projects, renewable energy infrastructure projects are typically quasi-monopolistic assets with steady income streams and high up-front capital costs. Significant scale is required for a successful project. These projects are often regulated and face high barriers to entry as a result of permitting restrictions and high capital requirements.

Unlike traditional energy, renewable energy projects should have minimal ongoing costs during their life as they do not have perpetual fuel costs. They also tend to have power purchase agreements that produce highly predictable fixed revenue streams.

Investors should project a return premium for greenfield projects that have a build-out or construction phase, or for higher-risk projects. Although some green infrastructure opportunities may be higher-risk greenfield projects, others are lower-risk brownfield projects and may not command a return premium.

Green Real Estate

Investors seeking to invest in green real estate have limited options in terms of strategies and vehicles (Figure 4). Green real estate can be accessed either directly through a dedicated green real estate fund or indirectly through an established real estate fund that may develop and/or refurbish assets in compliance with green principles. Dedicated green funds typically use a value-added or opportunistic strategy, and are therefore higher-risk investments than a core strategy that may include a portion of green assets in a portfolio. There are only a handful of dedicated green real estate funds in the market today; separate accounts are an option for larger mandates.

Figure 4: Green Opportunities within Real Estate

Source: Hewitt EnnisKnupp.

The most common green real estate funds build or renovate and then sell buildings that are LEED-certified. LEED is a third-party verification that a building or community is designed and built using characteristics that are environmentally sustainable. Some examples include buildings with efficient water-saving devices or advanced recycling systems. These funds typically focus on the office and multifamily sectors in the United States.

One challenge dedicated green real estate funds face is the constantly evolving standards set by the U.S. Green Building Council (USGBC). Another is little tenant incentive to pay a green premium. As a result, very few managers have seen a green premium through rents, occupancies, or sales prices. Many dedicated green funds are losing their competitive edge as other real estate funds undertake development or repositioning strategies and seek LEED certification.

We believe a dedicated green real estate fund is not a compelling investment opportunity since these funds have not yet yielded a return premium. The increased cost of compliance with LEED is not meaningful. Over the long term, green real estate may become mainstream as all new properties strive for the certification. Properties can further distinguish themselves by achieving gold or platinum certification, but there may be

substantial cost to this status that is typically not rewarded. Investors may also be already exposed to green assets through established real estate funds.

Investors might consider brownfield opportunities, in which a real estate manager will clean up a site or convert a condemned structure into a new-use building. In the example of a manager who rehabilitates a derelict industrial property with contaminated land and soil, the improved property will then be vetted by a third party and certified by government entities. Brownfield projects may also include responsible land stewardship, where a portion of the reclaimed land is put into a conservatorship, such as a park. Brownfield funds are primarily domestic and typically focus on urban infill locations. It is important for potential investors to recognize that due to the environmental cleanup involved, investments are highly risky and may be more expensive than expected, requiring additional capital and reducing potential returns.

Investors who seek to invest in green real estate and brownfield projects should select managers with strong track records and a long history of investing in the strategy. Top-performing managers will use their network of highly skilled joint venture partners. Further, we believe managers need to have in-depth knowledge to identify the markets and tenants that are green-friendly prior to commencing a project. This requires a thorough understanding of domestic and emerging markets that may offer environmental programs and credits. In addition, if applicable, the manager should be certified by the USGBC through its LEED program.

Beyond LEED-certified buildings and brownfield projects, some fund managers seek to monetize environmental assets, such as agriculture and wetland mitigation. These managers can augment asset returns by producing environmental credits that can be traded through brokers, including carbon, wetlands mitigation, water quantity and quality, and biodiversity offsets. This strategy produces returns that combine current income with significant upside from the growing environmental credit markets.

Some agriculture managers target investments that promote sustainable land management practices and capture the opportunities from environmental credits. One example is farming with techniques to limit soil erosion, mineral depletion, and pollution. These will generate carbon credits that the manager can then sell in the carbon market. Another method to facilitate green investing is to reserve a portion of acreage for wind power generation. The manager will lease the land to a developer that will build and manage the wind farm.

Wetland mitigation is another strategy that combines environmental assets and credits. The Wetlands Protection section of the Natural Resources and Environmental Protection Act of 1994 requires landowners to replace wetlands that may be destroyed through

development by creating new wetlands in another location or by restoring them. Wetland mitigation bankers facilitate compliance with permits by offering wetland credits to offset environmental impacts on wetland functioning and acreage. Credits are awarded to a landowner only if the project improves wetland functioning. This allows development on a wetland without repercussion.

The market strategies for agriculture and wetland mitigation funds, and their related credits, are emerging in a sector that is constantly evolving. An attractive investment strategy now might quickly become obsolete. There is currently a small investable universe of these types of opportunities.

Green-Related Public Equity Funds

Institutional investors are becoming increasingly aware of the impact of green on the future earnings potential of companies. To fully assess the fundamental values of target companies, investors need to understand the environmental, social, and governance (ESG) factors impacting the companies. One of these is climate change. A consortium of 41 asset managers, pension funds, and foundations sent a letter to the Securities and Exchange Commission (SEC) in June 2009 to request enhanced disclosure from public companies regarding the potential impact of climate change on future earnings. The authors believe a greater understanding of the ESG factors will help managers make better long-term investment decisions.

Asset managers with thematic fundamental analysis strategies support these additional disclosures to assist them in implementing strategies. Many of these managers have explored equity strategies that take advantage of the soaring global energy demand and consumption patterns, corporate and consumer attitude shift, and regulatory incentives that will continue to stimulate investment in green companies and projects.

Equity managers may offer both long-only and long/short funds focused on green investments. Long-only funds will purchase companies with the best growth outlook given the manager's view of regulation and technology. Some long-only equity managers have created a negative screen to filter out companies that do not include green principles in their operations strategy. These managers believe that failure to consider green principles will ultimately impact their bottom line. Other long-only equity managers have created a portfolio of companies that operate across the green landscape.

Indices have been developed based on this investment principle, including the HSBC Global Climate Change Index, which is composed of global companies operating in low-carbon energy production, energy efficiency and energy management, and water, waste,

and pollution control. HSBC believes these companies are best suited to profit from the challenges presented by climate change.

Long/short funds will buy similar high-growth companies while selling short those they expect to underperform given anticipated changes in the industry. One strategy that long/short hedge funds employ is to take sector-based views of alternative energy. Managers will devise a strategy that is consistent with their long-term views of the political environment and advancement of alternative energy. A manager who believes in the long-term opportunity of solar power, yet believes ethanol to be less attractive, could take long positions in solar power companies while selling short ethanol-producing firms. Another strategy includes buying shares in green utilities and selling short conventional utilities. This strategy would make sense if a manager anticipates rising clean-up costs for traditional energy utilities and rising goodwill for clean energy companies. This strategy assumes these issues have not yet been fully priced in the equity market.

Carbon Trading

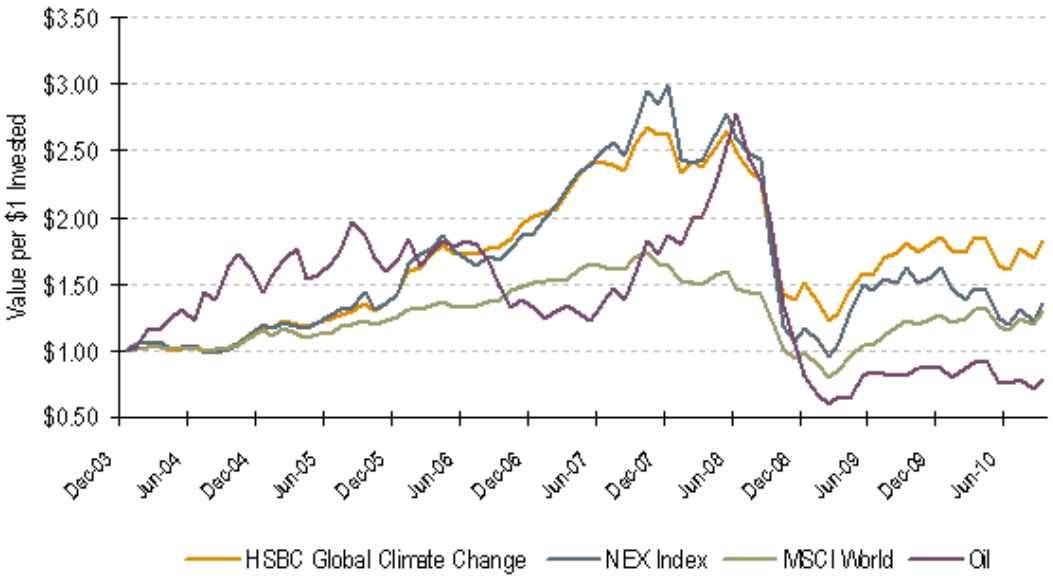
The Kyoto Protocol includes mechanisms to reduce climate change. These mechanisms have resulted in a growing demand for emissions trading such as European Union Allowances (EUAs) and Certified Emission Reductions (CERs). EUAs are credits generated by the government. Each EUA allows an entity the right to emit one metric ton of carbon dioxide. Entities that emit beyond their cap must obtain additional allowances from another entity that emits carbon dioxide (cap-and-trade) or purchase CERs, which are generated by carbon projects that reduce carbon emissions. EUAs and CERs are the two transaction types that frame the cap-and-trade and carbon projects investment approaches.

At the onset of these international regulations, the European Climate Exchange and the Chicago Climate Exchange were developed to facilitate the trading of carbon futures and options. These exchanges are driven by the supply of and demand for carbon credits. A government may set a limit (a cap) on emissions that is consistent with a carbon stabilization level. Businesses can meet the emissions reduction requirement a variety of ways, including installation of pollution controls and implementation of efficiency measures. The regulations also allow the sale or purchase of EUAs, known as cap-and-trade. Businesses that can reduce emissions are able to sell excess credits to other businesses that need to reduce emissions but tend not to because it is either too costly or strategically prohibitive.

The total trading volume of greenhouse gas in the United States and Europe differ substantially, with volume correlating to Europe's stronger regulation (Figure 5). The global carbon credit market traded 8.7 billion tons of carbon credits valued at $144.3

billion in 2009 (Ecosystem Marketplace and New Carbon Finance 2009, ii). Countries throughout Europe have initiated varied cap-and-trade legislation that has supported the 175% compounded annual growth rate of the European Union Greenhouse Gas Emission Trading System (EU ETS) trading volume since the inception of the Kyoto Protocol requirements.

Figure 5: Total Greenhouse Gas Trading Volume in the U.S. and Europe



Source: European Climate Exchange, Chicago Climate Exchange.

In the United States, where there is currently no government-mandated compliance program, trading volume has remained low. United States policymakers had reviewed a landmark energy cap-and-trade bill, sponsored by Representatives Henry Waxman (D-CA) and Edward Markey (D-MA), that may have driven a significant increase in the carbon trading market volume by impacting the supply of and demand for carbon credits. However, this bill has stalled in the United States Senate and cap-and-trade is now considered a dead issue.

How much the non-binding Copenhagen Accord can supersede the Kyoto Protocol's post-2012 time period will depend on the extent to which it becomes politically binding. Its success will also depend on the level of each country's emission targets. The United States has pledged to reduce emissions by 17% and the European Union promised a 20% reduction of 2005 levels by 2020. The outcome will drive the future volume and price of the EU-ETS options and futures contracts.

Beyond cap-and-trade strategies, investors can invest in green carbon finance projects that generate greenhouse gas emissions credits. Carbon cap-and-trade regimes generally allow for the import of credits on green carbon finance projects from other countries. Carbon projects that are approved to generate carbon emissions credits include renewable energy sources and technologies such as solar energy, wind energy, hydropower, and biomass energy (for example, biofuels and geothermal energy). Many methane recovery, fuel switching, and energy efficiency projects have also been approved to generate credits. These projects are typically located in developing countries such as China, Brazil, Russia, Ukraine, and India. In some instances, a project will capture revenue from generating alternative energy as well as through selling carbon emissions credits to potential buyers.

Unlike EUAs, project-based credits need to be created through energy generation projects, which results in assumption of additional project development, performance, and regulatory risks. Recent experience has demonstrated that investors need to research green carbon projects thoroughly, as there is a risk that some projects may be considered ineligible to generate carbon emissions credits. The United Nations, which certifies the eligibility of projects for participation in carbon trading, has changed the standards for project approval over time.

Green Investing Considerations

In evaluating the numerous alternative investment opportunities in the green sector, it is important to understand that, in addition to traditional investment risks, there are other significant risk factors to this developing sector. Its high-growth evolving nature fosters investment opportunities, but also challenges investors to evaluate companies, assets, and equities long term. Factors that potential investors should consider include market, execution, technology, financing, and commodity pricing risks as well as regulatory changes.

Market and Execution Risk

Although the market recognizes the significance of green investment opportunities, there is no certain way to know which alternative energy technology will be most widely accepted. Companies may quickly find that a market they sell to has fallen out of favor as other forms of alternative energy become more widely accepted. Many managers do not have extensive track records in the green sector and are unfamiliar with navigating the execution risks. For example, infrastructure and real estate managers face environmental risks that may affect their performance, including soil and ground water contamination, and remediation of asbestos, lead paint, and radon.

Technology Risk

The technologies impacting the green landscape are cutting edge, yet in many instances, unproven. Until the technologies can demonstrate their maturity and scalability, demand may be low and prices higher. This supports the notion that renewable energies are unlikely to become mainstream until the products achieve pricing parity with traditional energy sources. Supply-side constraints or oversupply of core materials such as silicon will dramatically impact the economic opportunity for some technologies. As technology continues to develop and prices decline, renewable energy, which represents 8% of United States energy consumption, will become a more widely accepted form of energy (U.S. Energy Information Administration 2010).

Financing Risk

Green companies and projects can be highly capital intensive and are typically structured using a combination of equity and debt. Recent volatility in the financial markets due to the economic downturn has hindered the ability of green companies to raise equity through an initial public offerings, with many who have continued to postpone going public until the market stabilizes.

Many projects require significant up-front capital and costs are mainly fixed, such as renewable energy infrastructure projects and green real estate investments. The current recession has constrained the European and United States financial institutions that are the traditional suppliers of debt capital to these investments. These debt sponsors became more reluctant to lend capital to green projects. Many investments were unable to close or were delayed, as the projects now required a club of banks to complete the financing package. The cost of capital, one of the key factors that will determine their economic success, has become expensive in this challenged economic environment.

The result has been fewer green deals being executed in the United States and Europe. This allowed China, which was less impacted by the financial crisis, to surpass the developed world to become the largest investor in sustainable energy investment in 2009.

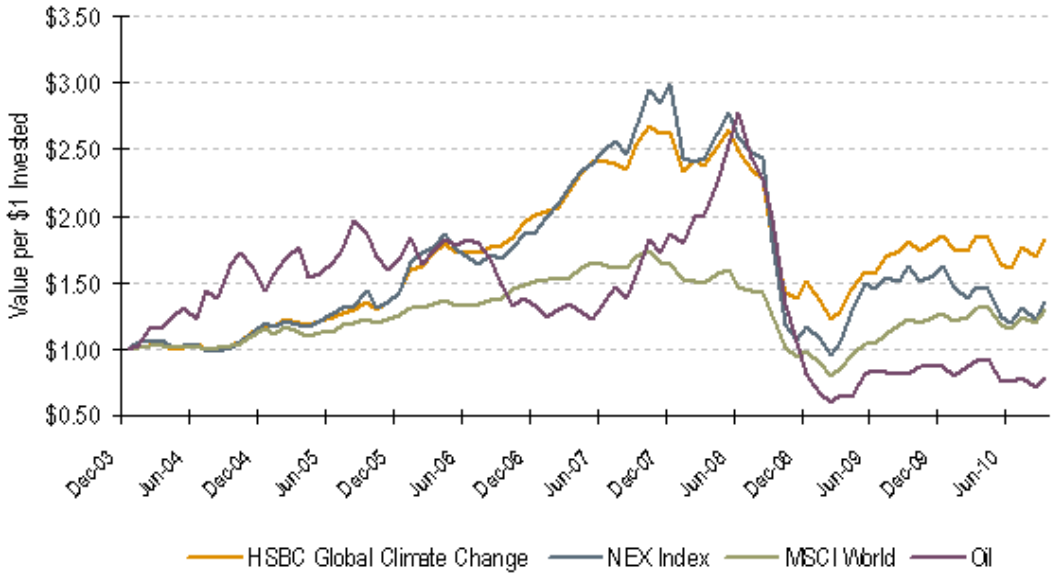
Public Market Risk

The performance of green investments is highly susceptible to the pricing of commodities and valuations of companies and assets. Highly volatile commodity prices, particularly oil, impact the adoption of alternative energy. As the price of oil neared $150/barrel in the summer of 2008, interest in alternative energies soared; then, as prices fell below $40/barrel, opportunities became less compelling.

This correlation is explained by today's high cost of alternative energy. On average, renewable energy is considerably more expensive than oil and gas because of fluctuating core material pricing and the higher cost of small-scale production. As market adoption of alternative energy increases and technology innovation improves, we would anticipate costs to decline. Once conventional energy and alternative energy achieve pricing parity, we would anticipate an increased correlation between commodity prices and renewable energy indices.

High commodity prices also drive valuations of alternative energy companies higher (Figure 6). Valuations of alternative energy companies also increase due to the projected supply/demand imbalance of oil reserves.

Figure 6: High Commodity Prices Impact Climate Change Index Valuations



Source: Bloomberg.

According to the strongly debated Hubbert Peak Theory, which predicts the peak and decline of production from oil wells and fields, the production of oil may have peaked in late 2006 (Energy Watch Group 2007, 12). This is consistent with an International Energy Agency (IEA) analysis of 800 oilfields that demonstrated a 6.7% annual decline in oil production that is expected to grow to 8.6% by 2030 (International Energy Agency 2008). If this decline of oil supply turns out to be factual, it will become a significant issue for the world economy given the anticipated 45% increase in global energy demand between 2006 and 2030.

Oil supply can increase with new mining technologies and sites, such as oil shale or deep water drilling. We anticipate this supply/demand imbalance will drive up oil prices and valuations for alternative energy companies. As valuations increase, the risk of equity investments increases and the expected returns decline. Skilled managers who invest in green companies and projects can offer substantial returns if they know how to minimize public market risks as they execute their investment strategy.

Regulatory Risk

It is important for an investor in green opportunities to understand global and national energy policies, as regulatory changes create risks and opportunities that will significantly impact investment returns. These regulations are constantly changing. They typically endorse a menu of mechanisms to curb climate change and foster financing and technological innovation.

To illustrate, the goal of the Kyoto Protocol was to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere. It allowed countries to meet their GHG limits through three mechanisms: (1) emissions trading, (2) the clean development mechanism, and (3) joint implementation. These three mechanisms have driven the development of investment innovations such as the carbon trading market and green carbon finance projects.

It is noteworthy that the United States did not ratify the Kyoto Protocol and does not currently have any federal policy on emissions reduction. Historically, this has been left up to each state, resulting in a hodgepodge of legislation that includes: carbon pricing, which includes cap-and-trade and carbon taxes; incentives and subsidies, such as investment tax credits and renewable energy credits; and, standards that obligate electric utilities to produce a specified fraction of their electricity from renewable energy. The absence of an established policy has resulted in weak supply of and demand for GHG reduction credits on the Chicago Climate Exchange (Figure 5).

Once the United States determines a federal policy that corresponds to the new global protocol being developed, many of the current tools used to curb GHG emissions will disappear. However, the Waxman-Markey climate bill that passed the House of Representatives in June 2009, which supports carbon cap-and-trade, along with other bills, has stalled in the United States Senate, as the federal and state governments continue to move forward with proposed legislation. Cap-and-trade is currently considered a dead issue at the federal level.

The United States' pledge to reduce emissions by 17% of 2005 levels by 2020 matches the Waxman-Markey emissions reduction proposal. As many countries in Europe have

developed climate change policies, these regulations are creating market mechanisms and investment opportunities, and driving healthy trading volume on the European Climate Exchange.

The Copenhagen Accord establishes an international plan to review and monitor compliance with emission reduction commitments, including development of a consistent set of standards to measure country targets. To limit global temperature increases caused by man-made GHG to two degrees Celsius, it relies on individual countries to establish their own pledges rather than establishing international emission reduction limits.

The Copenhagen Accord also builds a financial framework to support these efforts, with a $100 billion commitment by 2020 from industrialized nations to support the more developing countries' adaptation to and mitigation of the effects of climate change. To fund this commitment, the United States will provide public and private funding using a variety of not-yet-determined strategies. Sources may include taxes, allocations from the cap-and-trade system, or the development of an International Monetary Fund plan. The United States' ability to raise the necessary capital will depend on the outcome of climate change legislation to support a nascent cap-and-trade financial market and comply with the Copenhagen Accord.

Companies and investors are paying close attention to the discussion. The outcome is likely to eliminate some investment opportunities while providing a window for new ones. Part of a manager's ability to add value lies in the capacity to navigate the regulatory environment or select companies that are less impacted by regulation, depending on an investment strategy.

Conclusion

There is an increasing supply/demand energy imbalance throughout the world. Consumers and multinational corporations alike are changing attitudes toward alternative energy. Two motivations are to enhance corporate responsibility and to minimize costs. Green investing is a global transformation that will impact large multinational companies, policymakers, and individuals worldwide. For institutional investors, this presents both uncertainty and opportunity.

The inherent risks in green investing, which include market, execution, technology, financing, commodity pricing, and regulations, make it complicated to evaluate alternative assets.

Now that many institutional investors have recognized that green investing across asset classes can be financially attractive as well as socially beneficial, managers need to

ascertain the level of in-house knowledge that will give them a clear edge in the global market. Those managers with in-house knowledge of environmental policy, global capital markets, and specialized knowledge will have better insight to evaluate the opportunities and risks in their green investment strategies.

Many green investment opportunities are compelling. Some are less compelling because they are still emerging or subject to changing regulations. Investors who want to obtain green exposure can invest across the more attractive green investment strategies rather than develop a specific allocation to the green sector. Investors who seek remunerative green exposure should examine the attractive green investment strategies that exist in private equity, infrastructure, real estate, and public markets (Figure 7).

Figure 7: Green Investment Opportunities

Private Equity	Infrastructure	Real Estate	Public Markets
• Dedicated Green Venture Capital • Diversified Venture Capital • Green Growth Equity • Renewable Energy Buyout	• Dedicated Green Infrastructure Funds • Diversified Infrastructure Funds	• Dedicated Green Value-Added Funds • Diversified Value-Added Funds • Dedicated Green Opportunistic Funds • Diversified Opportunistic Funds • Brownfield Funds • Wetland Mitigation Funds	• Long-Only Green Equity Strategies • Long/Short Green-Related Equity Strategies • Carbon Trading Strategies

Source: Hewitt EnnisKnupp.

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Biography

Shari Young is a private equity consultant in the Global Private Equity group at Hewitt EnnisKnupp and is a member of the Investment Committee. She consults on the private equity programs for numerous public and corporate pension plans, endowments, and foundations. Shari has sourced and conducted due diligence on funds and co-investments across the full spectrum of private equity.

Prior to joining Hewitt EnnisKnupp, Shari focused on growth stage venture capital investments at Chicago Venture Partners and was a Summer Associate at Sterling Venture Partners. Previously, she was an investment banking analyst for ThinkEquity Partners and senior analyst at First Annapolis Consulting, a boutique strategic consulting and M&A advisory firm focused on financial services.

Shari holds a B.B.A. with distinction in finance and marketing from Emory University Goizueta Business School and an M.B.A. in finance, accounting, and entrepreneurship from the University of Chicago Graduate School of Business.

Combating Global Warming in Emerging Markets with Carbon Efficient Indices

Alka Banerjee
Vice President, Global Equities, S&P Indices

Abstract

Combating Global Warming in Emerging Markets with Carbon Efficient Indices

While substantial efforts are being made to combat global warming, one innovative technique enables investors to choose their investment profiles along carbon efficient lines. Standard & Poor's Indices launched the world's first carbon efficient index for emerging markets in December 2009 under the sponsorship of the International Finance Corporation (part of the World Bank Group). The idea is to allow investors to achieve market returns (as per a standard emerging market index) and yet lower their exposure to companies with large carbon footprints.

Large institutional investors use indices for passive replication as well as benchmarking and are tied to provide at a minimum market returns as per established indices. This approach can be a disincentive for investing along sustainable lines where returns can deviate frequently from established benchmarks.

This case study explores how the index is a tool to focus attention on the importance of carbon emission and its increasing importance to global investors. Widespread adoption of the index would provide an incentive for emerging market companies to improve carbon efficiency.

Combating Global Warming in Emerging Markets with Carbon Efficient Investing

With the 2012 expiration of the Kyoto Protocol on global warming looming large, emerging markets, which have begun to surpass the United States as some of the largest emitters of carbon (per the most recent available data released by U.S. Energy Department's Carbon Dioxide Information Analysis Center for 2007), are taking a central role in the debate over how to reduce emissions. As global attention turns to these countries, Standard & Poor's has designed an index that allows for reduced carbon emission exposure in investors' portfolios while it closely tracks the broad emerging-market returns.

According to the most recent numbers available, developed countries continue to lead the world in terms of per capita emissions; however, the largest emerging market countries are fast becoming the biggest carbon polluters, explaining why total global emissions have risen alarmingly in the last decade (Figure 1).

Emerging markets are polluting more for several reasons: Manufacturing services have moved increasingly to emerging markets, which has resulted in increases in carbon emissions in those locations; an increase in the worldwide demand for commodities has led to more exploitation of the natural resources in those emerging markets; and the rapid growth of emerging-market economies has led to population explosions in developing countries, along with an attendant demand for energy, materials, and infrastructure. It follows that carbon emissions have increased and the environment is an immediate casualty. While per capita emissions in these countries are still several notches below those in advanced economies, emerging markets are catching up fast, and their total emissions have already exceeded those in many developed markets.

Figure 1: Top 20 Carbon Emitting Countries in the World

	2007	2006	
Country	National emissions (thousands of tonnes of carbon)	National emissions (thousands of tonnes of carbon)	Emissions per person (tonnes of carbon)
CHINA (MAINLAND)	1,922,687	1,664,589	1.27
UNITED STATES OF AMERICA	1,547,460	1,568,806	5.18
INDIA	479,039	411,914	0.37
RUSSIAN FEDERATION	435,126	426,728	2.99
JAPAN	357,534	352,748	2.80
GERMANY	210,480	219,570	2.67
CANADA	153,659	148,549	4.55
UNITED KINGDOM	148,818	155,051	2.56
REPUBLIC OF KOREA	142,230	129,613	2.68
ISLAMIC REPUBLIC OF IRAN	133,961	127,357	1.81
ITALY (INCLUDING SAN MARINO)	125,015	129,313	2.19
MEXICO	124,450	118,950	1.13
SOUTH AFRICA	120,520	113,086	2.39
SAUDI ARABIA	119,374	104,063	4.38
BRAZIL	110,833	96,143	0.51
FRANCE (INCLUDING MONACO)	103,845	104,495	1.71
INDONESIA	99,648	90,950	0.41
AUSTRALIA	96,168	101,458	4.90
SPAIN	94,468	96,064	2.18
UKRAINE	84,448	87,043	1.86

Ranking of the world's countries by 2007 total CO^2 emissions from fossil fuel burning, cement production, and gas flaring. Emissions are expressed in thousand metric tons of carbon (not CO^2).

Source: Tom Boden, Gregg Marland, and Bob Andres, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory http://cdiac.ornl.gov/trends/emis/overview_2007.html

In our view, governments alone can't fight the battle against carbon emissions. The task is too large and the scope too wide. Thus we think that a public-private partnership is a must to make carbon reduction a reality. A process by which stock market mechanisms reward companies that are more carbon efficient can be an effective way to deliver the eco-conscious message to the private sector.

One popular approach so far has been to create equity indices and investment tools that focus on companies whose primary interest has been in producing clean technology and clean energy. This approach has its uses: It highlights the specific companies that are leading the charge in the green space and betting that consumers will reward them with increased revenues and earnings, which the market will reflect.

However, it is an inescapable fact that the need to achieve market returns dictates the flow of a large amount of institutional money. Niche investment strategies that cater to an audience of socially responsible investors haven't crossed over into the mainstream market, mostly because the relatively smaller size and liquidity of the 'clean' companies hampers huge investments. What is required, in our view, is a broad market strategy that can meet the dual objectives of replicating a broad market and rewarding carbon efficiency at the same time. Pension funds, sovereign funds, and other government bodies with large assets can make a difference if they support an agenda that promotes carbon efficiency and yet allows them to satisfy their responsibilities to achieve market returns at the same time.

S&P/IFCI Carbon Efficient Index Replicates the Risk Return Profile of the S&P/IFCI LargeMidCap

On the heels of the launch of the S&P U.S. Carbon Efficient Index in March 2009, Standard & Poor's, with the financial support of the International Finance Corporation (IFC), the private sector arm of the World Bank Group, began work in the area of emerging markets. The idea was to replicate the risk-return profile of the S&P/IFCI LargeMidCap Index for emerging markets, but with an emphasis on carbon emissions. The resulting S&P/IFCI Carbon Efficient Index, which launched on December 10, 2009, in Copenhagen, Denmark, closely tracks the investment performance of the parent index while the index constituents provide a 28% reduced exposure to carbon emissions.

Challenges in Working with Emerging Markets' Carbon Footprint Data

The S&P/IFCI Carbon Efficient Index, like its parent, includes 20 emerging markets and more than 800 stocks. Market weights within the index range from nearly 20% for countries like China and Brazil to less than 1% for Hungary and the Philippines. Frequently, smaller markets lack sectoral diversity, and a limited number of companies contribute nearly 100% of their emissions. Carbon footprints, as calculated by Trucost PLC, a company that provides comprehensive data on corporate environmental impacts, are naturally highest for companies in the utilities, energy, and materials sectors. A simple exclusion of these companies from an index provides a vast sector bias toward investing in financials and technology companies, an approach unacceptable to most investors. Carbon footprints differ greatly between emerging markets, and between sectors within the same emerging market (Figure 2). Such varying differences further increase the complexity of designing an emerging-market carbon efficiency index.

Figure 2: S&P/IFCI LargeMidCap Carbon Scores

Country	Average Carbon Score
Brazil	428.23
Chile	923.33
China	1,528.14
Czech Republic	1,089.82
Egypt	545.25
Hungary	372.64
India	1,768.75
Indonesia	1,308.13
Korea	353.75
Malaysia	921.79
Mexico	383.11
Morocco	39.05
Peru	367.71
Philippines	616.13
Poland	513.45
Russia	826.21
South Africa	683.23
Taiwan	361.70
Thailand	1,154.48
Turkey	424.56
Total	**853.36**

Sector	Min	Max	Range	Average
Consumer Discretionary	10.36	2,105.84	2,095.47	153.13
Consumer Staples	44.66	2,613.67	2,569.01	368.81
Energy	21.97	6,469.98	6,448.01	1,060.45
Financials	3.79	1,018.82	1,015.04	37.24
Health Care	55.78	715.56	659.79	162.92
Industrials	20.08	7,283.31	7,263.24	602.99
Information Technology	12.55	747.76	735.22	133.41
Materials	144.81	19,045.07	18,900.26	2,207.91
Telecommunication Services	10.59	827.42	816.83	46.10
Utilities	19.48	29,184.21	29,164.73	5,199.01
				853.36

Sources: S&P Indices and Trucost PLC.

How Reweighting Yields Reduce Carbon Exposure

Some market sector combinations are naturally conducive to applying some reweighting within the combination, while market sector combinations that have only few stocks or stocks that are all high polluters are difficult to reweight. To reweight within a sector, we rank stocks in terms of their carbon footprint using the same sectors as in the parent index.

Reweighting is possible if a market sector includes both high polluters and low polluters, where the market sector combination is responsible for a significant amount of carbon emissions and reweighting will result in real emission savings. As of the September 2010 rebalance, we have reweighted 21 market sectors out of the 136 in the S&P/IFCI LargeMidCap Index to yield a 28% saving in carbon emission exposure in the new portfolio (using Trucost PLC estimates). At all times, we kept the sector and country weights of the index at exactly the same proportions as the parent index. The reweighting is done annually to coincide with the annual rebalancing of the parent index. Based on a back-tested history of three years and nearly a year of actual performance, this methodology ensures a small tracking error with the parent index.

Statistical Results

More than three years of back-tested history and nearly a year of actual performance history since the launch give us some interesting results.

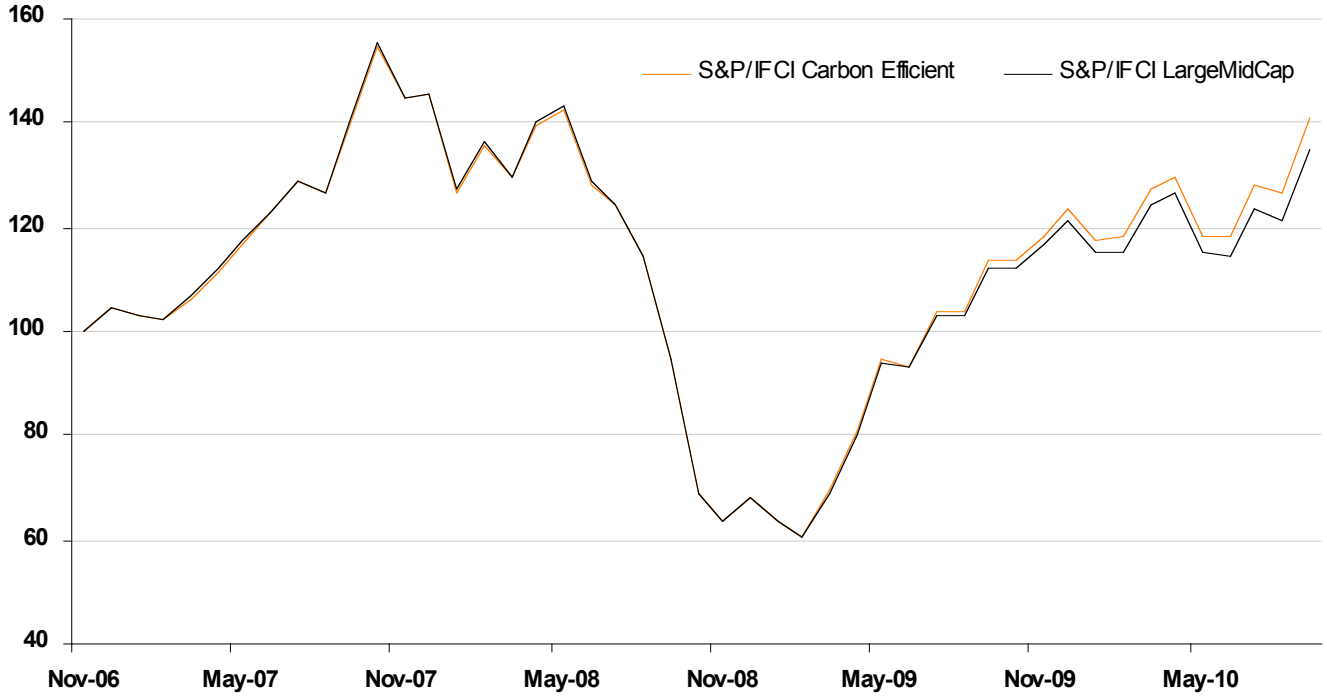
1. **A close tracking error.** The annualized tracking error of the S&P/IFCI Carbon Efficient Index to the S&P/IFCI LargeMidCap over nearly four years was a manageable 1.40% in the period from November 2006 to September 2010 (Figures 3 and 4). In each of the four calendar-year periods, the tracking error ranged from .99% in 2007 to 2.11% in 2008. In short, investing in the S&P/IFCI Carbon Efficient Index seems likely to ensure competitive emerging-market returns using a "greener" portfolio.

Figure 3: Annualized Tracking Error from Nov 2006 – Sep 2010

S&P/IFCI Carbon Efficient vs S&P/IFCI LargeMidCap	
Nov 2006 - Sep 2010	**1.40%**
2007	0.99%
2008	2.11%
2009	1.08%
2010 YTD	1.08%

Source: S&P Indices.

Figure 4: Index Performance Comparison (Nov. 2006 – Sep 2010)



Source: S&P Indices.

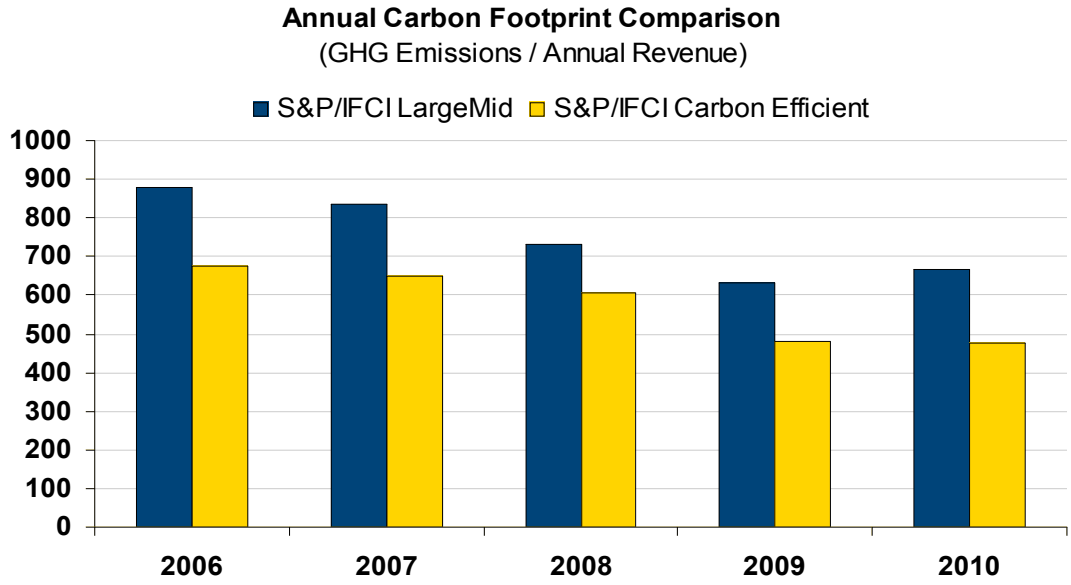
2. **Reduced carbon emission exposure.** Over the five time periods – 2006, 2007, 2008, 2009 and 2010 – the average reduction in a portfolio's exposure to carbon emissions using our new index was nearly 23% (using Trucost PLC estimates). In 2010, it was more than 28% (Figures 5 and 6).

Figure 5: Carbon Footprint of the Indices

Year	Carbon Footprint of the S&P/IFCI LargeMidCap	Carbon Footprint of the S&P/IFCI Carbon Efficient
2006	880.80	676.28
2007	833.57	651.00
2008	730.90	605.46
2009	633.87	480.44
2010	664.86	475.79

Source: S&P Indices.

Figure 6: Carbon Content



Source: S&P Indices.

3. **Analysis of an index with deletions.** As an exercise to see what would happen if we designed an index without high carbon emitters, we created a pro forma index that deleted all stocks of companies we identified as high polluters but that had been included in the new S&P/IFCI Carbon Efficient Index with a lower weighting. We tested the performance of this hypothetical 'clean' version against the S&P/IFCI LargeMidCap Index. The investment performance tracking error in this case grew noticeably to 2.6% over three years (Figure 7). This is important because a large tracking error introduces uncertainty over time on expected returns and can be an issue for investors that make large commitments, such as pension funds and sovereign wealth funds.

Figure 7: Annualized Tracking Error from Nov 2006 – Dec 2009)

S&P/IFCI Clean* vs S&P/IFCI LargeMidCap	
Nov 2006 - Dec 2009	**2.63%**
2007	1.43%
2008	3.80%
2009	2.04%

** S&P/IFCI Clean is the name of the pro forma index, where we have actually deleted companies from the index that had very high carbon footprints. Source: S&P Indices.*

Indices Can Drive Investor Attention to Carbon Efficiency

The S&P/IFCI Carbon Efficient Index is a benchmark that allows investors to track the performance of stocks in a broad-based emerging-market portfolio while reducing carbon emission exposure. The index has the same risk-return profile as the parent S&P/IFCI LargeMidCap Index. Eventually, we expect more investors will seek to reduce the carbon emission exposure of their portfolio while maintaining their risk- return profile. They should find that replicating one of the first such indices as a guide for greener investment strategies, which is what the S&P/IFCI Carbon Efficient Index attempts to do, is a useful investment strategy.

In order to have an impact on global warming, companies need to be motivated to perform better on the carbon efficiency scale. Indices bring attention to a specific theme, in this case, that of reducing the carbon footprint by investing in a low-carbon emission exposure portfolio, and thus giving investors the opportunity to achieve their goal of balancing environmental and financial factors. By highlighting this important issue and giving investors an option for selecting companies that recognize the importance of improving their carbon efficiency, indices provide an important role for the financial markets to play in the fight against global warming.

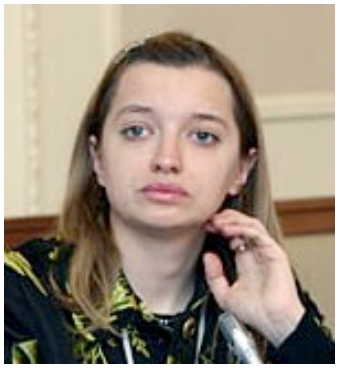
Biography

Alka Banerjee is vice president, global equities, at S&P Indices. Alka is responsible for the design and methodology governing Standard & Poor's global indices, focusing on creating new benchmarks for international equity markets and promoting their use amongst global clients.

Alka was closely involved with the transition of the premier IFC's Emerging Market Indices to Standard & Poor's in 2000, and the integration of the S&P/Citigroup Indices into the S&P Indices family in 2004. Alka's special areas of interest are global benchmarks, emerging markets, Islamic finance and environmental investing.

Prior to joining Standard & Poor's in 2000, Alka worked for The Bank of New York where she was responsible for the creation, maintenance, and marketing of The Bank of New York ADR Index. Before coming to the U.S., she worked in India for the State Bank of India for ten years.

Alka holds a master's degree in economics from Lucknow University in India and an MBA in finance from Pace University in New York



Rethinking Green Versus Conventional Investment Flows in BRIC+ Countries: Review of Emerging Trends and a Model For Future Research

Ivetta Gerasimchuk, PhD

Senior Advisor to Trade and Investment Program, WWF-Russia
Research Fellow, Cyprus International Institute of Management (CIIM)

Abstract

Rethinking Green Versus Conventional Investment Flows in BRIC+ Countries: Review of Emerging Trends and a Model for Future Research

The article explores the emerging trends and future potential for diverting capital flows from conventional to green activities in Brazil, Russia, India, China, Mexico, and South Africa (BRIC+ countries). At present, Chinese and Indian investors fund both environmentally unfriendly and green projects at a speedy pace, given these two countries' high rates of gross fixed capital formation and general independence from external financial markets. By contrast, in Mexico, in South Africa, and especially in Brazil and Russia, environmentally sensitive projects to a considerable extent raise funds in the form of foreign loans. Meanwhile, in all BRIC+ countries except Russia, the bulk of green investment comes from domestic sources of funding.

While recognizing the accomplishments of the previous research on the subject, the article identifies deficiencies in the available data. The author uses generalizations of evidence from case studies to propose a model for future econometric testing. It is hypothesized that 1) the longer the time horizon of the investment institution is, the sounder the environmental profile of its investments; 2) the more stringent and predictable the environmental regulations in host economies are, the longer the investor's time horizon is; 3) financial institutions with open and publicly accountable ownership structure have a longer-term orientation than those with closed and opaque ownership; 4) investors' interest and expertise in diversification beyond environmentally unfriendly industries extend their time horizon.

Rethinking Green Versus Conventional Investment Flows in BRIC+ Countries: Review of Emerging Trends and a Model for Future Research

The single most important determinant of tomorrow's global environmental footprint is today's investment in both the private and public sectors. At this very moment, as the center of gravity in the universe of investment and economic growth is shifting toward BRIC+ countries (Brazil, Russia, India, China, Mexico, and South Africa),[1] we are faced with a unique opportunity: the opportunity to analyze and attempt to redirect capital flows from conventional high-carbon and high-pollution development patterns toward green infrastructure while these rapidly developing economies are still at the early stages of investing in long cycle assets.[2]

Introduction

The current green investing effort is still dwarfed by the massive flow of capital into extracting and polluting activities.[3] On a global scale, investments in the new renewable energy capacity[4] amounted to only about one third of capital flows into the upstream sector of the oil and gas industry in 2009.[5] Similarly, the climate finance to be distributed

[1] The acronym BRIC was first coined and prominently used by Goldman Sachs in 2003 in its Global Economics
Paper No. 99 titled "Dreaming with BRICs." The paper argued that, since they are developing so rapidly, by 2050 the combined economies of Brazil, Russia, India, and China could overtake the combined economies of the current richest countries of the world. In this article, a broader notion of BRIC+ includes two additional significant emerging market economies: Mexico and South Africa, which have been selected as venues of the Conferences of the Parties to the UN Framework Convention on Climate Change at the end of 2010 and 2011 respectively.

[2] Monetary figures throughout this paper are in US$ unless otherwise noted.

[3] This paper uses an approximated classification of all investments as *green* (investments into activities assisting in the prevention, mitigation, reversion or offset of negative impacts on the environment) and *conventional* (all other investments, that is, those following the business-as-usual pattern). Some of the conventional investments have a significant, direct environmental footprint and are referred to as *environmentally unfriendly* (for example, in the fossil fuel extraction, mining, pulp and paper, petrochemistry, and other sectors). Other types of conventional investments may have no considerable direct environmental footprint, but their indirect environmental footprint throughout the value chain may still be substantial. For example, financial institutions usually have small direct impacts on the environment, but may be investing in polluting industries.

[4] 2009 estimates include $115 billion in the U.S. (IEA 2010: 283) and $162 billion (UNEP 2010: 5) worldwide.

[5] 2009 estimates include $360 billion (Gismatullin, November 11, 2010) and $430 billion (based on IEA 2010: 101) worldwide.

through the UN Green Climate Fund launched in December 2010[6] is eclipsed by the existing global fossil-fuel subsidies.[7]

Lower profitability and hence longer payback periods are investors' most common justifications for favoring conventional investment targets over green projects. But these reasons do not explain the fact that some investors venture into the green economy while others do not. This issue, which is interesting in itself and is one of the central topics of this article, becomes increasingly important as we face the incipient shift of investment decision-making processes to BRIC+ countries.

Both conservationists and politicians have concerns regarding this realignment of investment forces given the controversial socio-environmental record of resource companies from BRIC+ economies, domestically and internationally. For instance, in 2006 Paul Wolfowitz, then President of the World Bank, accused China of ignoring universal human rights and environmental standards when setting up loan portfolios in Africa (*Les Echos*, October 24, 2006). Concerns about massive carbon-intensive investments by BRIC+ countries have also contributed to disputes over ideas about common but shared responsibilities of developed and developing economies with regard to the post-Kyoto international regime of climate change mitigation.

This article seeks to identify and analyze the drivers behind BRIC+ countries' investments in environmentally sensitive projects, both domestically and internationally, with the purpose of formulating recommendations for policy measures and further research in the area of diverting capital flows from conventional to green sectors of emerging economies. Given the deficiencies of the available data, the article is limited to simple quantitative analysis of general investment trends in BRIC+ economies and the proposal of a model for future econometric testing based on the generalization of evidence gathered by previous case studies.

The rest of the article is structured as follows. The second section discusses the existing theoretical approaches to the linkage between investment and its environmental footprint, as well as the existing data limitations. Study of the available data in the third and forth sections reveals an increasing interpenetration of capital flows between developed and BRIC+ countries, as well as within BRIC+ economies.

In the fifth section, the author uses evidence from case studies to propose a model explaining the choices between green versus conventional investment projects made by

[6] $30 billion by 2012 and $100 billion per year starting 2020 (Efstathiou, December, 11 2010).
[7] Global fossil-fuel consumption subsidies were estimated at $312 billion in 2009 (IEA, 2010). Producer subsidies are also significant in many countries.

financial institutions from BRIC+ countries and other countries. It is hypothesized that: 1) the longer the time horizon of the investment institution is, the sounder the environmental profile of its investments; 2) the more stringent and predictable the environmental regulations in the home and host economies are, the longer the investor's time horizon is; 3) financial institutions with open and publicly accountable ownership structure have a longer-term orientation than those with closed and opaque ownership; 4) investors' interest and expertise in diversification beyond environmentally unfriendly industries contribute to their longer time horizons.

The author concludes with recommendations for policy measures and research, which include: improving the machinery to enforce environmental regulations that the governments should make more transparent, predictable, and flexible, thus encouraging environmental information disclosure and analysis by investors; and strengthening investment cooperation between financial institutions from developed countries and BRIC+ economies.

Accomplishments and Shortcomings of the Existing Theoretical Approaches and Data

Research on the environmental profile of investments started in the period of the late 1970s to the early 1980s, and originally focused on evidence of environmental dumping from developed to developing countries. Incipient studies on the subject explained differences in the environmental performance of various companies (of the same industry and comparable in size) predominantly by variability of external factors. The research identified government regulations as the major factor of businesses' environmental practices and led to the origination of influential, albeit conflicting, hypotheses.

The pollution haven hypothesis suggests that strict environmental regulations are a barrier to international investments, which like water, flow down to the lowest level; in this case, to the lowest environmental standards. While some evidence from case studies supports this hypothesis, more comprehensive empirical research has shown that environmental regulations are far less important for choosing an investment destination than many other factors, such as labor cost, taxation system, or surrounding business infrastructure (OECD 2001: 10). By contrast, the Porter hypothesis, formulated by business strategist Michael Porter, maintains that strict but flexible environmental regulations contribute to competitiveness of both nations and individual companies by stimulating innovation and

cost-efficiency; therefore higher environmental standards may attract investments (Porter 1991).[8]

Gradually, other determinants of companies' environmental performance have been introduced to the research agenda (Reinhardt 2000; Gunningham et al. 2003; Vogel 2005). Among external factors such hypothesized determinants include, first of all, environmental demands of the consumers and the civil society as well as prices of natural resources, especially energy. Availability of environmentally friendly technologies is also an important determinant, although this can be both an external and an internal factor for an individual firm. Among internal factors, sound managerial practices and strategic corporate vision have been identified as important contributors to the corporate environmental performance.

However, scholars "still know little about why individual corporations behave the way they do in the environmental context" (Gunningham et al. 2003: 135). One of the reasons for this shortcoming is that there are gaps in methodologies of measuring environmental performance itself. Neither compliance or overcompliance of companies with technical ecological standards nor the scale of funds spent for environmental management purposes provides a comprehensive framework for cross-industry comparisons of firms of different sizes with various operational processes, location of industrial sites, business approaches, and information disclosure policies.

Therefore stakeholders, who require this type of information, in particular investors and civil society organizations, have been making broad use of voluntary benchmarking standards, scorecards, ratings, and rankings based on self-assessment questionnaires circulated among companies. Alternatively, these corporate profile questionnaires, scorecards, and reports may be filled in or verified by independent experts. For instance, the Carbon Disclosure Project and the Global Reporting Initiative are voluntary corporate benchmarking schemes that help investors assess the environmental profile of companies. Various ratings and rankings, such as the Dow Jones Sustainability Index, FTSE KLD family of sustainability indices, Global 100, and Newsweek's Green Rankings, also serve the purpose of comparing environmental profiles of corporations across different industries.

[8] For example, as a result of their increasingly greener domestic policies, China, Brazil, and India attracted $33.7 billion, $7.8 billion, and $2.7 billion respectively in investment into the new renewable energy capacity in 2009, or 37 percent of the global investment into the sector by financial institutions (UNEP, 2010). In 2008–2010 a number of countries, most prominently China, resorted to green stimulus as a measure of both economic recovery and improving national competitiveness. See the discussion in the third section of the paper, Who Is Funding Activities that Increase and Reduce the Environmental Footprint of BRIC+ Countries?

Nevertheless, while numerous initiatives in the area of environmental reporting and ratings undoubtedly play an important role in encouraging greener competition among companies, they have yet to mature to provide fully reliable metrics for measuring corporate environmental performance. Collecting quality data on environmental performance is expensive, and investors and other stakeholders have yet exhibited only limited willingness to pay for it. Further, companies may consider some of the information related to their environmental performance proprietary. Moreover, there is a considerable gap between the corporate decision-making process as a subject of environmentally related evaluations, on the one hand, and the actual impacts of a company on the environment, on the other (broad externalities that may require further research). As a compromise, the methodologies used by evaluators at present are often based on ticking "yes" or "no" boxes and may leave room for subjective judgments (Chatterji and Levine 2006). If companies fail to understand the environmental risks they face or the impacts they have, their answers to the questionnaire may be meaningless. Besides, the voluntary nature of the evaluation initiatives implies a selection bias, since most participating companies have already focused on greener practices as a possible competitive advantage. Conversely, environmentally unfriendly companies may evade external assessments. Some analysts also voice concerns about the independence of environmental ratings from influential companies that are subject to their evaluations. "Poor performers have incentives to invent and adopt unreliable, invalid, and non-comparable standards because stakeholders will find it difficult to differentiate which standards are valid... each additional certification and corresponding acronym can actually decrease overall welfare, even while increasing the amount of measurement (and resulting costs)" (Chatterji and Levine 2006: 31). An obvious example in this respect is the oil pollution debacle caused by BP's exploration activities in the Gulf of Mexico in spring 2010; prior to this incident BP had been ranking high in most of the sustainability indices.

Meanwhile, it is not only the direct environmental impact of companies that is of interest in this respect, but also their indirect ecological footprint. While the direct environmental impact of financial institutions is often insignificant, their indirect ecological footprint, that is the environmental impact of the projects they invest in or provide loans to, can be vast (Kolk et al. 2001). Investment institutions have, to a great extent, driven this research agenda. Since the late 1990s, development banks such as the World Bank Group, European Bank for Reconstruction and Development, KfW, and then networks of private financial institutions such as the UN Finance Initiative, UN Principles for Responsible Investment, Equator Principles Financial Institutions, Coalition for Environmentally Responsible Economies (CERES), and some others have started developing tools for assessing and managing risks related to their indirect environmental impact. In particular, a few scoping studies have outlined possible methodologies for measuring indirect carbon footprints for different type of institutional investors (WRI 2009; SAM 2009).

As a result, the knowledge about environmental impact of investments is being built bottom-up, from intuitive and qualitative hypotheses, case studies, and the application of proposed methodologies to individual investors' portfolios, to more general case studies that are industry-wide (Trucost 2009) or market-wide (measuring the carbon footprint of all companies included into Standards & Poor's 500 and FTSE100 indices). It is also noteworthy that there is generally a considerable lag between disbursement of the investments and their environmental outcomes, which makes ex-post analysis more reliable than real time assessments or projections.

Measurement of the environmental impact of investments at a national level is a much more complex task than estimating the ecological impact of an individual financial institution or a group of them. First, national investments take different forms, and while officially reported information about direct investment flows across BRIC+ countries is relatively consistent and transparent, loans and portfolio investments are characterized by much higher degrees of complication and opacity due to a large number of financial intermediaries involved and deficiencies in the disclosure of information. Second, official information on national accounts often misrepresents the actual distribution of capital flows.[9] The reason for omissions in the official statistics is that cross-boundary loans, as well as mergers and acquisitions between any two economies, often involve capital transactions via third countries, especially offshore zones.

Furthermore, official national statistics do not single out investments into green or environmentlly unfirendly activities, therefore data have to be aggregated through consolidation of announcements on individual projects related to modernization and energy efficiency, waste and water treatment, nature rehabilitation, and other relevant activities – an idea already pursued by the Bloomberg New Energy Finance initiative in the segment of renewables and energy efficiency.

Researchers have therefore attempted to fathom the environmental impact of investment flows in BRIC+ and other emerging economies by way of case studies. The initial focus has been on the role of inward foreign direct investment (FDI) flows for sustainable development (OECD 1999; Mabey and McNally 1999; UNCTAD 2000; Gallagher and Zarsky 2007). More recently, several reports commissioned by WWF investigated the environmental impact of BRIC+ economies' outward investment flows (for example,

[9] For instance, the Russian State Statistical Service estimated the stock of Chinese direct investment in Russia at the end of 2009 at $939 million, while the Chinese Ministry of Commerce reported it at $2024 million, and expert estimates put it at $5 billion. Furthermore, when reporting total cross-boundary capital flows, the Russian State Statistical Service does not include data on bodies of monetary regulation, commercial and savings banks, which account for the major share of the stock of Chinese investments in Russia (Simonov et al. 2010: 166–167).

Pamlin and Baijin 2007; Gerasimchuk 2009). With partial success, one of these studies for Russia has attempted to extend the scope of the analysis beyond direct investment to loans and their impact on the country's environment (Gerasimchuk et al. 2010).

A number of studies have also specifically focused on the determinants of China's outward investment flows. Using UNCTAD and World Bank datasets on host economies receiving China's outward direct investment prior to 2007, some researchers concluded, by way of econometric analysis, that China's direct investment is attracted by countries with vast natural resources and poor institutions (Buckley et al. 2007; Kolstad and Wiig 2009). However, analysis of more recent data, including not only direct but also other types of investment, rebuts this conclusion. For 2005–2009, the top six destinations of Chinese outward non-bond investment included not only Iran, Kazakhstan, and Democratic Republic of Congo, but also Australia, the U.S., and the U.K. Meanwhile, there are still serious data discrepancies between, for example, China's Ministry of Commerce and the Heritage Foundation (Scissors 2009). This example demonstrates that the situation in BRIC+ countries develops dynamically and more data are needed for solid econometric analysis of the subject matter of this article. A longer timeline of observations and more transparency on capital flows are required.

The task of consolidating comparable data on investment flows in BRIC+ countries and the measurement of the environmental footprint of these flows is beyond the scope of this article, but is essential for future econometric testing of the hypotheses based on evidence from case studies and presented below.

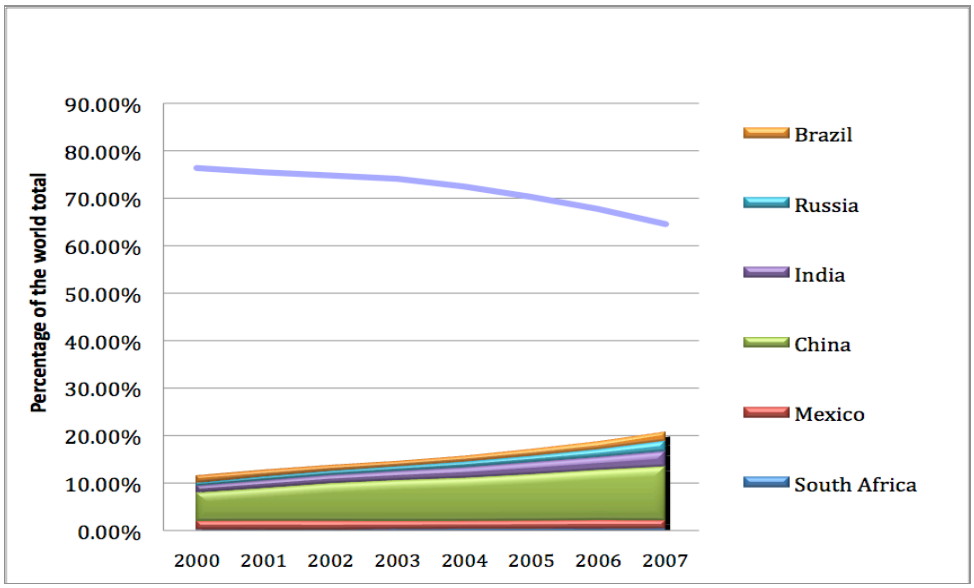
Who Is Funding Activities that Increase and Reduce the Environmental Footprint of BRIC+ Countries?

Representing a sharp rise from just a few years ago, in 2008 BRIC+ economies accounted for slightly over one fifth of the global GDP and gross fixed capital formation, approximately eight percent of the global outward direct investment, and a growing share of cross-border loans and other financial flows (MIGA, 2009) (Figure 1). BRIC+ countries' share of global pressures on the environment, however, is much higher. In particular, the six emerging economies are responsible for over one third of the global greenhouse gas emissions, almost as much as the share of all high-income Organisation for Economic Co-operation and Development (OECD) countries.[10] This means that the

[10] According to the World Bank's classification followed in this paper, the high-income OECD countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, the United Kingdom, and the United States of America.

carbon intensity of the group of six emerging economies is about 50 percent higher than the world's average. It is noteworthy that China has been by far the main source of growth of carbon emissions among all BRIC+ economies (Figure 2). Continuation of BRIC+ and other developing countries' carbon-intensive growth under the business-as-usual scenario will undermine the goal of preventing the levels of global warming associated with irreversible changes in the environment (a 2°C rise from preindustrial levels)—as will the business-as-usual development of the developed countries (Stern, 2007).

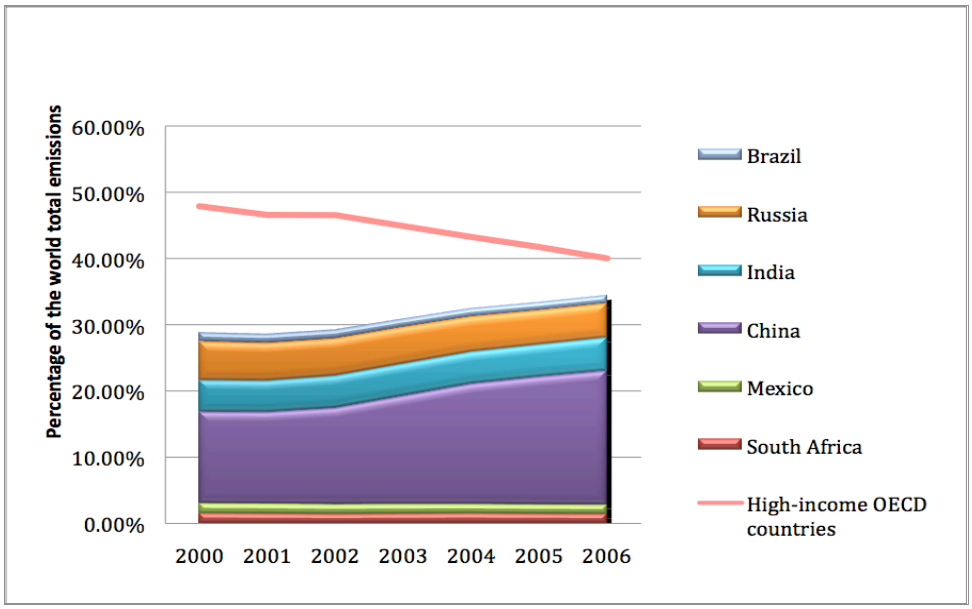
Figure 1: Gross Fixed Capital Formation: BRIC+ Countries Versus High-Income OECD



Source: World Bank 2010a.

Due to data deficiencies described in the second section of this paper, at this point it is difficult to quantify the proportions of environmentally unfriendly and green investments in BRIC+ countries funded by domestic versus foreign capital flows. Neverthless, evidence from case and industry studies makes it possible to suggest that while both international and domestic finance significantly contribute to increasing the environmental footprint of BRIC+ economies, international capital flows play a less significant role than domestic investments in greening these six countries (with a possible exception of Russia). This assumption is based on the following observations.

Figure 2: CO_2 Emissions: BRIC+ Countries Versus High-Income OECD



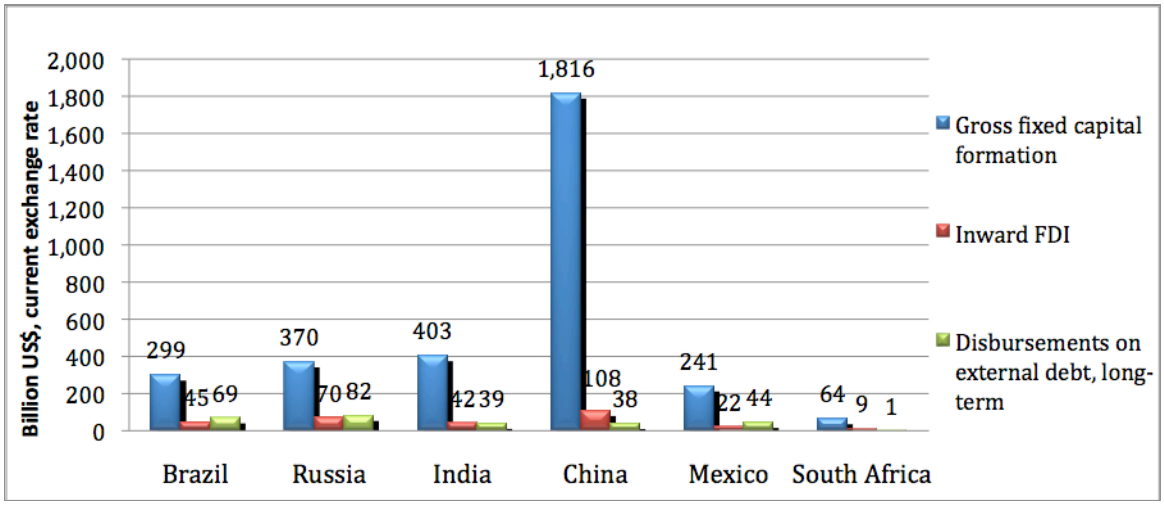
Source: World Bank 2010a.

Navigation through international investment news headlines and databases such as Dealogic reveals that companies from BRIC+ countries that tap international capital markets are, to a great extent, those active in environmentally sensitive industries, especially the energy and fuel sector. In particular, prior to the 2008–2010 financial crisis, all large fossil fuel and mining companies in Russia raised capital almost exclusively abroad, mostly in Western markets, but also in Japan, and especially recently, in China (Gerasimchuk et al, 2010).

Hence it is logical to hypothesize that external debt disbursements can significantly contribute to environmentally unfriendly investments in BRIC+ countries. The available information, in addition to the data on the overall gross fixed capital formation, is summarized to provide a snapshot of the main external sources of long-term (that is fixed capital-bound) investment in BRIC+ countries in 2008 (Figure 3).[11] These sources are inward foreign direct investment and disbursements on long-term extenal debt in both the private and the public sectors.

[11] The latest year-end data available; 2008 was relatively representative of the patterns formed over 2000–2008 in terms of BRIC+ countries tapping long-term investments from different sources.

Figure 3: Gross Fixed Capital Formation and External Sources of Investment in BRIC+ Countries, 2008



Source: World Bank 2010a; UNCTAD 2010.

However, the significance of foreign capital in funding the national environmental footprints varies across BRIC+ countries. In this respect, India and China are different from the rest of the economies in the group. Both India and China have very high rates of gross fixed capital formation (35 and 42 percent of the GDP respectively) and are largely independent from external financial markets (World Bank 2010a).

Conversely, Brazil, Russia, Mexico, and South Africa have much lower rates of gross fixed capital formation, ranging from 19 to 23 percent of the GDP (World Bank 2010a). Environmentally sensitive projects in these countries, especially in Russia and Brazil, to a considerable extent raise capital in the form of foreign loans.

Like environmentally unfriendly activities, green projects in BRIC+ countries receive funding both domestically and from external sources. In particular, the Clean Development Mechanism and Joint Implementation scheme under the Kyoto Protocol to the UN Framework Convention on Climate Change enables developed countries to offset their emissions through investments into carbon reduction projects in other countries, especially those where the abatement cost is lower. These projects are independently verified and in addition to business as usual.

Generally, the degree of attractiveness of green projects in BRIC+ countries is influenced by the overall host economy investment climate and risks, including those with respect to the local currency, its covertibility, and its exchange rate. China's yuan is commonly claimed to be undervalued, which implies relatively lower investment costs and helps the

country to attract foreign investment. Therefore the undervalation of yuan can be one of the factors in China's success as the predominant destination for international capital flows under the Clean Development Projects. Under the scheme, China attracted nearly $2 billion in 2009, or 72% of the global market (World Bank 2010b).

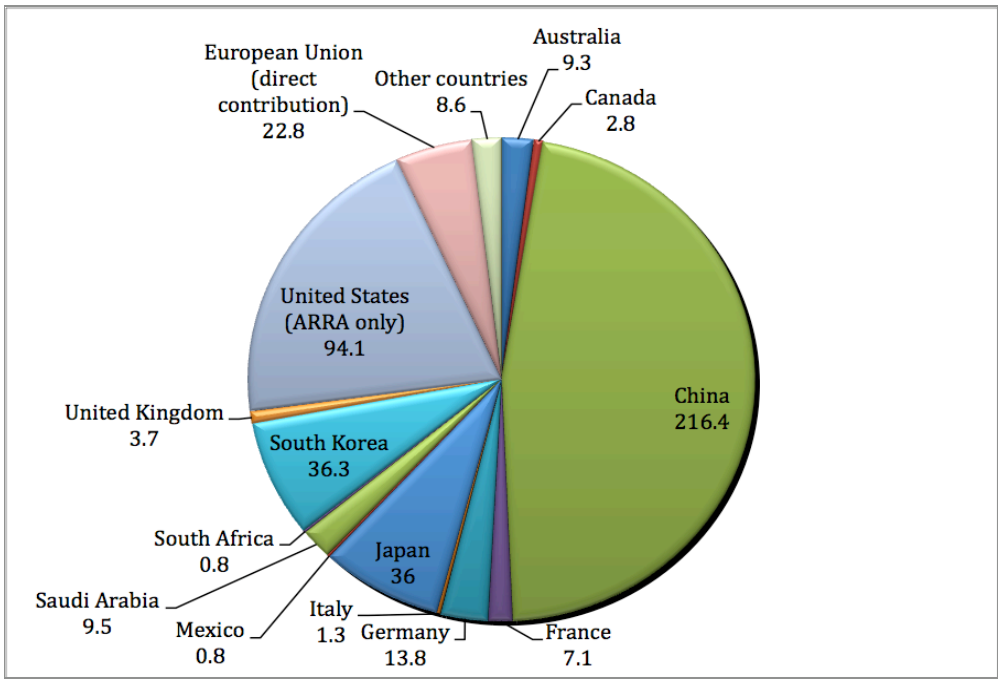
Overall, many potential green investment targets in BRIC+ countries experience difficulties with accessing international capital markets – unlike their counterparts in the environmentally unfriendly industries. Many domestic projects aimed at reducing negative impacts on the environment have to be implemented at the community level, and are of small and micro size. Such projects are often characterized by a lack of credit history, diseconomies of scale, and high transaction costs for foreign lenders and other investors.

Therefore, foreign investors can play only a limited role in greening the development of BRIC+ countries. Reduction of the environmental footprint of these economies depends mostly on domestic investors in both the public and the private sectors. Despite the data limitations described above, it is possible to identify some emerging trends in this area with the help of such recent phenomenon as green stimulus, which is public spending on environmentally oriented projects as part of anti-crisis measures.

Stimulus funds that have been earmarked for environmental purposes worldwide have a lifespan of three to five years (Figure 4).[12] Again, these data reveal heterogenity of BRIC+ economies since only three of the six countries—China, Brazil, and South Africa—have a green component in their stimulus packages. Moreover, China is the world's absolute leader by the size of its green stimulus, which amounts to $216.4 billion. Meanwhile, green stimulus is primarily oriented to new, or greenfield, projects, while investments to reduce the negative environmental impacts of the existing brownfield projects is also important.

[12] These purposes include support for renewable energy, carbon capture and sequestration, energy efficiency, public transport and rail, electrical grid transmission improvement, and waste and water treatment, among others.

Figure 4: Green Stimulus as of 1 July 2009, Billion US$, Current Exchange Rate



Source: Based on data from Barbier 2010.

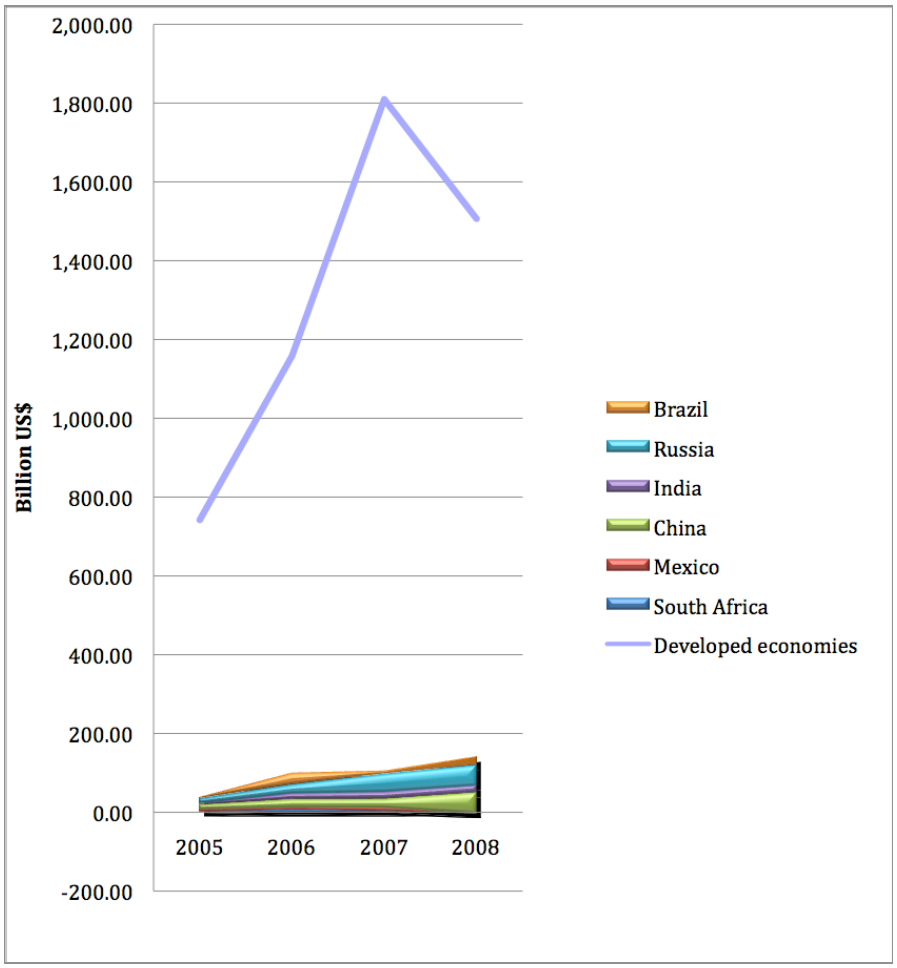
It is noteworthy that public spending generally has multiplication effects and complementarities with private investors. In particular, in the low-carbon development sector, it has been estimated that each US$1 spent by public funds results in US$2–$6 or even more in private investment.[13] However, given the novelty of green public spending in BRIC+ countries, the domestic private investors in these countries are still at early stages of exploring the business of environmental investing. The penultimate section of this paper takes a closer look at factors that can prompt them into redirecting their investment activities from conventional to green projects.

[13] The Clean Development Mechanism under the Kyoto Protocol to the UN Framework Convention on Climate Change has potentially facilitated "about $106 billion . . . of overall 2002–08 investment in projects that reduce greenhouse gas emissions for an average leverage ratio of 4.6. If industrial gas transactions are not considered, there is a much higher global leverage ratio at 6.5." (World Bank 2009: 41). For the period 2012–2020, the UN Secretary General's High-Level Advisory Group on Climate Change Financing estimated the global leverage ratio for private sector carbon finance at 2–4 on public flows and carbon market offsets (AGF 2010: 27).

Outward Investment Flows from BRIC+ Countries

In 2008 outward direct investment from all of the BRIC+ countries amounted to $140 billion, or about eight percent of the global total. Meanwhile, China and Russia accounted for as much as three quarters of these flows, each contributing slightly over $52 billion (Figure 5).

Figure 5: Outward FDI: BRIC+ Countries Versus Developed Economies



Source: UNCTAD 2010.

Before the 2008–2010 financial crisis, Russia ranked first among BRIC+ economies by volume of outward investment, but it should be noted that a large share of it was repatriated to Russia via third countries, especially offshore zones. However, a significant share of the remainder of Russia's outward direct investment was also channeled into environmentally sensitive projects in the former U.S.S.R. republics, Europe, and Sub-Saharan Africa (Gerasimchuk 2009).

Since the beginning of the financial crisis in 2008, examples of China's outward capital flows include the expansion of investments into such environmentally and socially controversial projects as development of oil-rich tar sands in Canada[14] (Goldenberg, February 14, 2010), coal mines in Australia (*Australian Journal of Mining*, June 22, 2010), oil deposits in Sudan, and tropical forest harvesting in West Africa (Bosshard 2008). China's external loans also have a growing environmental footprint. For example, in 2009 China Development Bank acted as the sole lender of $15 billion to the Russian state-owned oil producing company Rosneft and $10 billion to the state-owned oil pipeline operator Transneft. The loan was earmarked for construction of an oil pipeline from Russia to China (Mazneva, February 18, 2009).

However, more data are required to establish if such investments into environmentally unfriendly projects are representative of Chinese investors abroad that increasingly target not only natural resource industries, but also other sectors (Scissors 2009) (Figure 6).

Figure 6: Top Destinations of China's Outward Investment Flows. Non-Bond Transactions Over US$100 Million (2005–2009).

Country	Total, US$ Billion
Australia	29.8
U.S.	21.2
Iran	10.7
Kazakhstan	9.7
U.K.	8.2
Democratic Republic of the Congo	7.9

Source: Scissors 2009.

Outward investment from India, Brazil, Mexico, and South Africa has not yet become a similarly significant phenomenon, but the process is developing according to the same pattern. For example, Indian conglomerate Reliance Industries has announced plans to spend over $3 billion on three US shale gas joint ventures (*DNA India*, October 31, 2010).

[14] Chinese investors in Canadian tar sands include PetroChina, CNOOC Group, Sinopec, and CNPC.

The Drivers of Investment Flows In and From BRIC+ Countries: A Model Proposal

Determinants of environmental practices of investors and companies are the same for investors from both BRIC+ and developed economies. Therefore any differences in the environmental profile of investments from these two large groups of countries can be explained by their different exposure to external drivers and different interplay of internal and semi-internal factors (see the discussion of previous research in the second section of this paper).

If it is possible to suggest an overarching variable determining the environmental profile of investment, it will be the investor's time horizon, since environmental investments normally have much longer payback periods than conventional investments:

(1) $$\text{Environmental soundness of investment}_i = \alpha_0 + \alpha_1 \text{Time horizon of investor}_i + \alpha_2 \text{Control variables}_i + \varepsilon_i$$

Examples of control variables for the model have also been discussed previously (in the second section) and include, but are not limited to, prices of energy and other natural resources; green demands of investor's clients; green demands of civil society; green demands of business partners, particularly creditors and insurers; green practices of competitors; and availability of environmentally friendly technologies.

Hypothesis 1 is that α_1 is positive: the more long-term oriented the investor is, the sounder the environmental profile of its investments.

However, quantitatively estimating investors' time horizons is no less challenging than measuring corporate environmental performance as described in the second section of this paper. Meanwhile, case studies discussed below allow decomposing investors' time horizons as dependent on the stringency and continuity of regulations in host countries (β_1), investor's ownership structure and mandate (β_2), and investor's interest and expertise in diversification beyond environmentally unfriendly industries (β_3):

(2) Time horizon of investor $_i$ $= \beta_0$

$+ \beta_1$ Stringency and continuity of regulations in host country $_i$

$+ \beta_2$ Investor's ownership structure and mandate $_i$

$+ \beta_3$ Investor's interest and expertise in diversification beyond environmentally unfriendly industries $_i$

$+ \beta_4$ Control variables $_i$

$+ \varepsilon_i$

Consequently, the model proposed for future econometric testing is the following (Figure 7).

(3) Environmental soundness of investment $_i = \gamma_0$

$+\gamma_1$ Stringency and continuity of regulations $_i$

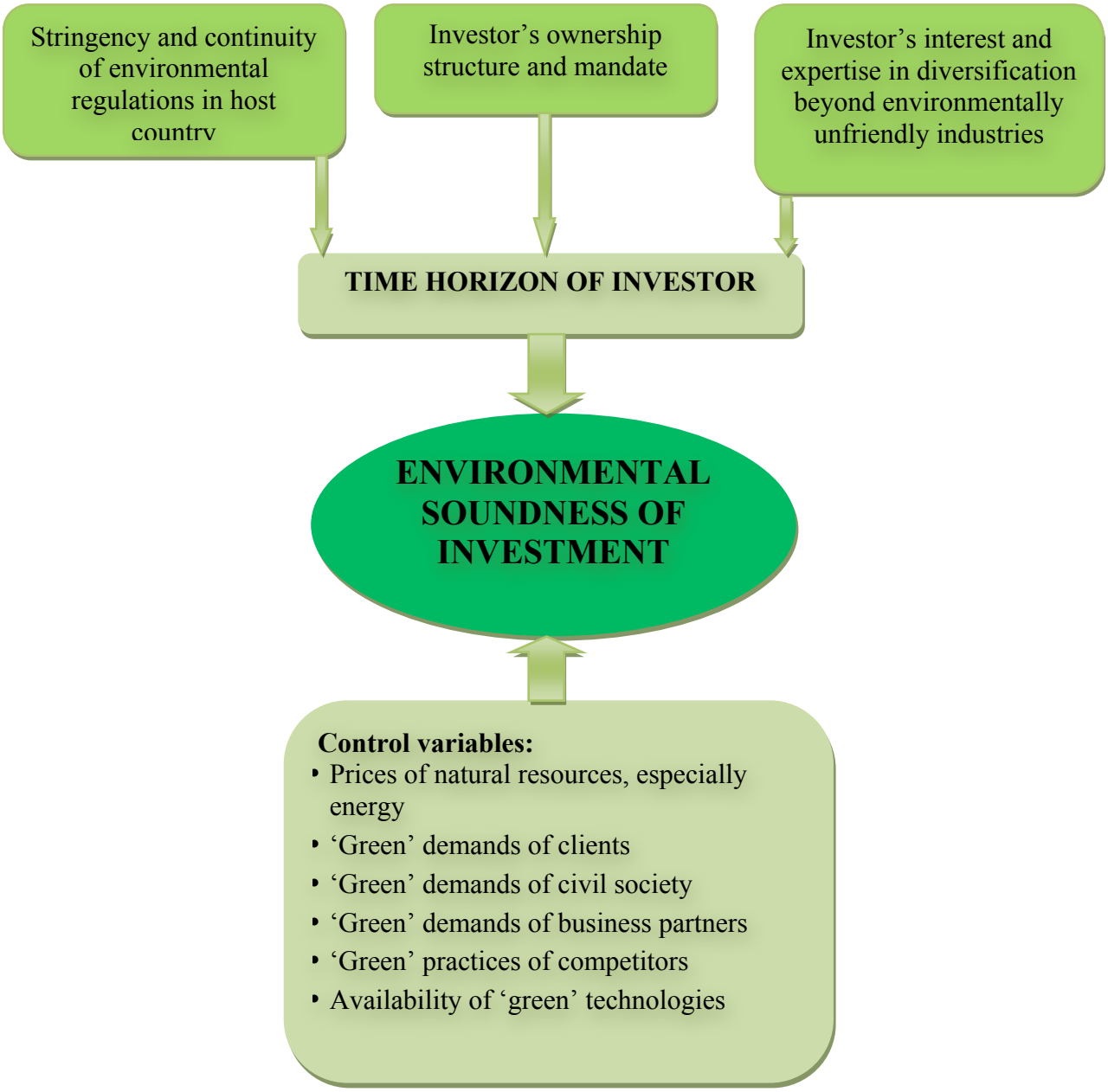
$+\gamma_2$ Investor's ownership structure and mandate $_i$

$+\gamma_3$ Investor's interest and expertise in diversification beyond environmentally unfriendly industries $_i$

$+\gamma_4$ Control variables $_i$

$+\varepsilon_i$

Figure 7: Drivers of Environmental Soundness of Investment: Proposed Model



Source: The author.

Hypothesis 2 maintains that the more stringent and predictable the environmental regulations in host economies are, the more long-term the investors' thinking is. This reasoning follows Porter and van der Linde (1995) in postulating that in order to encourage better environmental practices and competitiveness, green regulations should be strict but flexible. Flexibility requires performance-based regulations that set goals to be met by the industry without specifying the means, thus allowing business to innovate and use various approaches to achieve the goals.

In order to commit funds to environmentally sound investments, investors also require clear timelines for the introduction of stricter environmental standards without rolling deadlines. Meanwhile, it is not unusual for environmental regulations and timelines to change with the change of governments, which creates uncertainty and impedes green investments.[15]

All BRIC+ countries have declared their environmental targets, for example, commitments to greenhouse emissions reductions under the Copenhagen Accord. However, the regulatory signal they are giving to investors has more to do with a practical machinery of achieving these targets, such as the introduction of legislative frameworks enabling participation in international carbon finance schemes; elimination of fuel and pollution subsidies; public investment and public private partnerships in environmentally oriented activities; attractive feed-in tariffs for renewables; clear timelines for new technical regulations coming into force; and other measures.

With varying degrees of success, Brazil, India, Mexico, and South Africa have advanced in each of those directions, ensuring that capital flows are channeled into green projects not only through public investment vehicles but also through the private sector. China, with its more centralized system, has created its own model. In 2007 the People's Bank of China developed an environmental database of Chinese companies. It also requires commercial banks to review and weigh their clients' environmental history before approving credit applications. In the same year, the People's Bank of China, along with the Ministry of Environmental Protection of China and the China Banking Regulatory Commission, established a green credit system that aims to restrict the availability of loans to companies that are in violation of environmental laws (PBoC and WWF, 2008).

On the downside, in all of the BRIC+ countries there remains a gap between environmental regulations and their enforcement, and the investment into environmentally unfriendly sectors of these economies continues to grow. However, the increase of capital flows into the green economy in Brazil, India, China, Mexico, and South Africa testifies to changes in investors' attitudes. By contrast, in the absence of a practical regulatory framework for green investment in Russia, both domestic and foreign capital flows fuel predominantly environmentally unfriendly industries of this economy.

Hypothesis 3 assumes that financial institutions with open and publicly accountable ownership structures (for example, those that are publicly listed) have a longer time horizon than those with closed and opaque ownership. In the private sector, the latter are often driven by speculative interests of gaining quick profits to benefit a small group of

[15] For example, the U.S. signed the Kyoto Protocol under the Democrats, but failed to ratify it after the Republicans came into power.

individuals. For instance, a number of environmentally unfriendly assets that Russian investors purchased in Southern Africa and Australia in 2000–2008 were later resold, which demonstrates that these transactions were driven mainly by speculative interest.

Another type of closed ownership is that by the state, which in the case of BRIC+ countries can make a company or an investment institution a black box. Like any other investors, state-owned entities can be conduits of capital flows into green or conventional projects, or, most likely, both. Except through the exercise of government discretion, there is no other way to shift the balance between the two types of investment.

Listed companies that have an open ownership structure are usually in mature stages of their life cycle, that is, beyond the stages of short-term survival practices. Furthermore, financial institutions such as pension funds are long-term oriented by their mandate to operate. Johannesburg Stock Exchange, BM&FBOVESPA in Sao Paulo, and Shanghai Stock Exchange have all played an important role in greening investment flows in their respective countries by encouraging listed companies and financial institutions to report and disclose their environmental and social performance.

An open ownership structure also creates more opportunities for a less arbitrary decision-making process through potential representation of different interest groups, including foreign investors. Stakeholders, including civil society organizations, can better influence the decision-making process in these financial institutions through the dialogue with different members of the Board of Directors (or their equivalents). This is specifically the case in Brazil and South Africa, two of the BRIC+ countries with the most developed NGO sector.

Hypothesis 4 suggests that investors' interest and expertise in diversification beyond environmentally unfriendly industries can positively impact their time horizon. Investors tend to expand their activities in the industries they are most familiar with, which in the case of BRIC+ countries may explain the gravitation towards extractive industries. For example, both public and private Russian investors have been actively pursuing large-scale projects in the nuclear and hydropower industries in both Asia and Africa because the country tries to draw on the relevant expertise in these areas. However, investors also need to diversify their portfolios, and green projects can be a very attractive opportunity in this respect since this type of asset has no strong correlations with other types.

Precise definitions and methods of value measurement for the five variables (environmental soundness of the investment, time horizon of the investor, stringency and continuity of environmental regulations by the host countries' government, investor's ownership structure and mandate, and investor's interest and expertise in diversification beyond environmentally unfriendly industries) depend on the future aggregation of

relevant data. As previously described in the section on accomplishments and shortcomings, at present there are still some serious limitations in this area. However, given the increasing interest in green economy issues in the academic, government, and financial circles, overcoming this barrier appears to be only a matter of time.

Testing the model should also include checks for possible correlation between the stringency and continuity of environmental regulations in the host economy and control variables.

Concluding Remarks

What can one expect of investors from BRIC+ countries in terms of diverting capital flows from conventional to green activities? This question, posed at the beginning of the article, requires first, steadfast attention to the dynamic development of investment activities in BRIC+ countries, and second, much more empiric research than has been undertaken so far by academia and other interested institutions. Any "by definition" allegations about investors from BRIC+ economies being "dirtier" than their counterparts from the developed countries, or the other way around, lack solid foundation.

To make the agenda of green versus conventional investments more transparent, there is a need for consistent monitoring and reporting of relevant data at the national level in the same manner as national statistical agencies provide breakdowns of gross fixed capital formation or foreign direct investment by industry. Both private (for example, Bloomberg New Energy Finance initiative for the sector of renewables and energy efficiency) and public stakeholders (the Green Economy initiative of the UN Environment Program) have already begun monitoring and aggregating data on funding that is raised by environmentally oriented activities. However, in order to be better integrated into the decision-making processes by investors and their regulators, such information needs much more solid methodological consistency and broader accessibility.

Based on the available information analyzed in this article, it is possible to reach two conclusions. First, stringent, predictable, and flexible environmental regulations by governments are indispensible for diverting capital flows from conventional to green segments of the economy. With Russia as a laggard, BRIC+ economies have already significantly advanced in this direction by introducing legislative frameworks for national participation in international carbon finance schemes; eliminating fuel and pollution subsidies; initiating green public investment and public private partnerships; establishing attractive feed-in tariffs for renewables; designing clear timelines for new technical regulations; and undertaking additional relevant steps. Such measures extend investors' time horizons and enable a clear message that green investments that may appear not so

advantageous in the short term, may prove to be both profitable and sustainable in the long term.

Second, at present, investment institutions from the developed countries often see their counterparts from BRIC+ countries as competitors. Corporate clients trying to raise capital from BRIC+ economies also share this view when they cannot find funding in the high-income OECD countries. However, greening objectives require partnerships, not competition between investors from BRIC+ and developed countries. Increased cooperation between these two groups of investors can promote green investments by changing two variables in the equation: investors' ownership structure and their interest and expertise in diversification beyond environmentally unfriendly industries.

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Biography

Dr. Ivetta Gerasimchuk is Senior Advisor, Trade and Investment Program, WWF-Russia, and Scholar-in-Residence/Lecturer in Environmental Economics and Management at the Cyprus International Institute of Management (CIIM). Prior to joining these two organizations, she carried out research for the Institute of African Studies of the Russian Academy of Sciences, the Centre for Current Politics of Russia, and the Australian Embassy in Moscow. She is also a contributor of op-eds to *Vedomosti*, Russia's top financial daily, and other business media in Russia and internationally.

Gerasimchuk received her BA in International Relations, MA in Management, and PhD in Economics from the Moscow State Institute of International Relations (MGIMO). She has authored and edited over thirty research publications, including four monographs, on the cross-links between the environment and economic development. Her research interests are global with a focus on emerging markets, and include environmental management of multinationals, responsible investment, energy and resource economics, and economics of climate change.

Interview with Dr. John Holdren

Conducted by Lia Abady, *JEI* Interview Editor
October 24, 2010

Dr. John Holdren, Assistant to the U.S President for Science and Technology and Director of the White House Office of Science and Technology Policy speaks to Lia Abady for the Journal of Environmental Investing. In the interview, Dr. Holdren talks about U.S energy policy and touches upon the President's FY2011 budget that proposes to eliminate a number of fossil fuel tax preferences projected to be worth about $40 billion over ten years.

Interview:

Ms. ABADY: *Well thanks for taking the time to be interviewed. I'd like to begin with asking where you see the energy balance of the U.S in 30 years, in terms of nuclear, solar, wind, bioenergy, coal, oil and gas?*

Dr. HOLDREN: Today, 85 percent of U.S. energy supply is provided by fossil fuels. The carbon dioxide released from the burning of fossil fuels accounts for over 90 percent of U.S. greenhouse gas emissions. In order to address the challenge of climate change, we must change the way we produce and use energy. I am not willing to hazard specific predictions about what the structure of this nation's energy portfolio will be decades from now. There are simply too many variables that are unknown and unknowable at this point, ranging from uncertainties about the likelihood of helpful disruptive technologies emerging to uncertainties about the evolution of political will in future Administrations.

But I can say without any hesitation that under President Obama the United States has done more to reduce greenhouse gas emissions than ever before, by supporting domestic policies that advance clean energy and by vigorously engaging in international climate negotiations. As these efforts bear fruit, I believe that the United States will increasingly shift its energy mix to renewable and other low-carbon technologies, including the use of fossil fuels with carbon capture and sequestration. As President Obama has said, "The nation that leads the world in creating new sources of clean energy will be the nation that leads the 21st century global economy. I want America to be that nation."

Ms. ABADY: *How do you see scholars working with market actors to create scalable market-based solutions to environmental challenges?*

Dr. HOLDREN: The current economic downturn notwithstanding, the American economy remains the most dynamic, innovative, and resilient in the world. We have world-class research universities, flexible labor markets, deep capital markets, and an energetic entrepreneurial culture. The potential synergy among these components of our economy has been proven repeatedly through the development of such innovations as the electric grid and the Internet and the countless social and economic institutions that have spun off of them. So while it will be important, of course, to maintain Federal R&D investment to build the human, physical, and technological capital that conducts breakthrough research and transfers those innovations to the market, it will also be crucial in the years ahead to nourish new ways of ensuring that academics, entrepreneurs and others interact and build on each others' skills and expertise to help meet America's challenges, including environmental challenges. Along these lines, it's worth noting the emphasis that this Administration has given to the potential of contests, challenges, and prizes as a means of engaging experts and ordinary citizen solvers across the Nation to take their best shots at solving national problems large and small. Just this week the Federal government launched challenge.gov, a novel digital platform where people can compete for prestige and prizes by providing novel solutions to tough problems. Challenge.gov makes it simple and free for Federal agencies to post rules and resources for challenges; allows anyone interested to submit a solution; and helps manage the selection process. It showcases virtually any kind of government challenge, regardless of that challenge's technology platform, providing "one stop shopping" for academics, entrepreneurs, and others with expertise to bring to the competition. One such challenge in the environmental arena—the winners of which were announce in September—is the Progressive Automotive X Prize, sponsored in part by the Department of Energy, which offered a $10 million prize for building vehicles with fuel-efficiencies exceeding 100 miles per gallon.

Ms. ABADY: *What do you consider the optimal role of government to be in the creation of solutions to the climate change problem?*

Dr. HOLDREN: Solutions to the climate change problem will come largely from the application of science and technology to innovations that will change the way we produce and use energy. Government has a critical role to play in ensuring that our economy has the necessary tools for successful innovation, from investments in energy research and development to the human, physical, and technological capital needed to perform that research and transfer those innovations to the marketplace. In addition to government investments in basic research, of course, it is government's role to promulgate policies that encourage the private sector—which today accounts for the majority of R&D

investments—to step up to the plate as aggressively as possible. That's one reason why the President recently re-articulated his commitment to making permanent the R&D tax credit for businesses, without which industries are likely to remain wary about making the steady investments that are most likely to lead to real, energy-saving and environment-preserving solutions. We also need policies that put a price on greenhouse gas emissions, to spur additional private investment, innovation, and entrepreneurship.

Ms. ABADY: *Many thought the BP oil leak would prove to be a catalytic event in U.S climate and energy policy but to date this has not proven to be the case. Do you think we need such a catalyst and if so what do you think it could be? In general, what do you think it will take for the U.S to put in place policies that are "loud, long, and legal" and ultimately signal to potential investors the certainty they seek to make substantial commitments of capital?*

Dr. HOLDREN: President Obama supports comprehensive energy and climate legislation that will put a price on greenhouse gas emissions to stimulate investments in energy efficiency and in low-carbon energy supply. I am disappointed that the Senate has not yet acted on such legislation, despite clear and growing evidence that greenhouse gas emissions pose a serious threat to the welfare of the nation and the world. Ultimately, it is up to the American people to make clear that they favor policies that will encourage the development of low-carbon energy sources. We need to do a better job of educating the public about climate change and the changes in energy use that are needed to avoid dangerous changes in climate.

Climate is changing all across the globe. The air and the oceans are warming, mountain glaciers are disappearing, sea ice is shrinking, the great ice sheets on Greenland and Antarctica are slipping, and sea level is rising. The consequences for human well-being are already being felt: more heat waves, floods, droughts, and wildfires; tropical diseases reaching into the temperate zones; and coastal property increasingly at risk from the surging seas. And all this is happening faster than was expected. It is the responsibility of the Federal government but also of academia, the business community, and others to help Americans and people all around the globe become more aware of these scientifically verified realities, until it becomes more politically dangerous to avoid the issue than to engage it.

Ms. ABADY: *Do you think the proponents of renewable energy, in the public and private sector, have thought seriously about the scalability of their technologies and risk associated with their assets in the event of a natural disaster? (i.e., a tornado storm in the Mojave desert destroying solar panels?)*

Dr. HOLDREN: Utility-scale solar power installations are vulnerable to damage by weather, and this can be a legitimate concern for investors. Weather is also a concern for traditional energy sources, as was demonstrated in 2005 by the effects of hurricanes on oil and gas supplies in the Gulf of Mexico and by the shutdown of nuclear reactors in France during the heat wave in 2003. In general, underwriters provide insurance to protect against potential damage or loss based on the associated risks, but the risks for renewables are more difficult to estimate because the technologies are newer and less common. But efforts are underway to accumulate the information needed to better inform investments and insurance decisions. A recent report by the National Renewable Energy Laboratory, for example, identified various ways that the government could help to increase the availability of such information relating to solar power generation, improve public comprehension of relevant risks, and ultimately make insurance products for this sector more available and affordable.

Ms. ABADY: *According to a new report released by the Congressional Budget Office (CBO), the U.S deficit would be cut by $19 billion over the first 10 years, and it would also not increase over the following 40 years if Senator John Kerry's energy and climate change bill is passed. What sort of signal would the Senate be giving the investment community if the potential to cut the deficit was ignored given it's a key political issue at the moment?*

Dr. HOLDREN: The CBO's analysis of Senator Kerry's climate and energy bill is consistent with the Administration's principle that climate and energy legislation should not increase the deficit. The President has consistently stated that we can limit greenhouse gas emissions, slow global warming, and jump-start the clean-energy industries of the future while being fiscally responsible. I'm disappointed, of course, that the Senate has declined to pass comprehensive energy and climate legislation until now. Most members of the business and investment communities—even fossil energy industry executives—would welcome such legislation because it would provide a long-term, predictable framework for making business and investment decisions and because it would provide stable incentives for making investments in clean energy technologies and industries. As a bonus, comprehensive legislation could make a contribution to addressing our long-term budget and deficit problems.

Ms. ABADY: *Regulatory uncertainty both in the U.S. and Europe is hampering investment flows into the cleantech sector. Spain, Italy and Germany are in the process of cutting solar and wind feed-in tariffs. And in the U.S., the 1603 cash grant is due to be phased out at the end of the year. The reduction in feed-in tariffs has already confused the market in Spain. What happens when the stimulus program is phased out in the U.S?*

Dr. HOLDREN: The President has called on the Congress to enact comprehensive energy legislation that would spur U.S. development of advanced, clean-energy technologies to reduce our dependence on imported oil, create new jobs, and restore America's position as a global leader in efforts to mitigate climate change. Legislation that places a price on carbon emissions would be the most effective way to encourage robust investment in clean energy technology.

In the meantime, Recovery Act projects have contributed to economic growth and will serve as the foundation for long-term U.S. leadership in growth industries like renewable energy and energy storage. Furthermore, the President's 2011 Budget promotes innovative energy efficiency and renewable-energy projects through $500 million in credit subsidies that will support $3 to $5 billion in lending; expands the Advanced Manufacturing Tax Credit by $5 billion to help build a robust domestic manufacturing capacity for clean-energy technologies; and proposes to make the Research and Experimentation Tax Credit permanent, eliminate capital gains taxation on small businesses, and invest in innovative programs to help commercialize promising technologies and transition them to the private sector. The Nation's long-term economic recovery will be sustained by continued investments such as these in the new energy economy.

Ms. ABADY: *At the Toronto Summit, G-20 Leaders reaffirmed their commitment to phasing out fossil fuel subsidies. The estimated cost of fossil fuel subsidies to the global economy was $557 billion in 2008. Which fuel source would be most impacted by the phasing out of the subsidy in the U.S? How likely is it that the savings would be re-directed towards government spending in the cleantech sector?*

Dr. HOLDREN: The President's FY2011 budget proposes to eliminate a number of fossil fuel tax preferences, which are projected to be worth about $40 billion over ten years. The largest beneficiaries of these subsidies are oil and gas producers. Removing fossil fuel subsidies increases incentives to invest in clean-energy technologies. Furthermore, eliminating fossil fuel subsidies provides flexibility to expand our investments in clean tech innovation, which in the proposed FY2011 budget includes $4.9 billion for climate technology R&D programs at the Department of Energy – an increase of 11 percent over the FY2010 enacted level. This climate technology funding includes $2.4 billion for Energy Efficiency and Renewable Energy programs and $300 million for the Advanced Research Projects Agency–Energy (ARPA-E).

Ms. ABADY: *Thank you for taking the time. I appreciate you taking time on your schedule to talk to us*.

Dr. HOLDREN: It was a pleasure. Thank you.

Contact: lia.abady@thejei.com

John P. Holdren is Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST). Prior to joining the Obama administration Dr. Holdren was Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as professor in Harvard's Department of Earth and Planetary Sciences and Director of the Woods Hole Research Center. A member of PCAST during the Clinton administration, he chaired studies requested by President Clinton on preventing theft of nuclear materials; the prospects of fusion energy; and a U.S energy R&D strategy for, and international cooperation on, energy technology innovation.

Holdren holds advanced degrees in aerospace engineering and theoretical plasma physics from MIT and Stanford and is highly regarded for his work on energy technology and policy, global climate change, and nuclear arms control and nonproliferation. He is a member of the National Academy of Sciences, the National Academy of Engineering, and the American Academy of Arts and Sciences. A former president of the American Association for the Advancement of Science, his awards include a MacArthur Foundation Prize Fellowship, the John Heinz Prize in Public Policy, the Tyler Prize for Environmental Achievement, and the Volvo Environment Prize. He served from 1991 until 2005 as a member of the MacArthur Foundation's board of trustees.

Interview with Ole Beier Sørensen

Conducted by Lia Abady, *JEI* Interview Editor
November 10, 2010

Danish pension fund giant ATP, which manages Dkr415bn (€55bn) in assets, has launched a climate change fund to invest in privately owned companies across emerging market economies. Ole Beier Sørensen, chief of strategy and research at ATP pension fund, speaks to Lia Abady from the Journal of Environmental Investing.

Interview:

Ms. ABADY: *ATP has taken a leading role in climate change investing. Last year the fund made a seed commitment of €1 billion to a new emerging markets climate change fund and a $400 million investment in a global clean technology renewable energy fund run by Hudson Clean Energy Partners. Can you talk a little bit about that process?*

Mr. SØRENSEN: ATP has been focusing on climate-related investments for quite some time and announced the €1 billion Climate Change Action Fund for Emerging Economies in the run-up to the COP15 summit that took place in Copenhagen at the end of 2009. The intention was to focus on climate-relevant investments in emerging economies. We made the announcement with the expectation that COP15 would be successful in providing a global agreement, and that this would result in climate change policies being implemented in many countries around the world. We believe that clear policy frameworks are necessary in order to make sound investment decisions in terms of scalability and priority. We did not have a global agreement in Copenhagen. In hindsight, we might have foreseen that, had we studied the signals more carefully. The consequence of the current uncertainty, we believe, is that national policies will develop but at a much slower pace.

Ms. ABADY: *Will ATP maintain its commitment to the €1 billion Climate Change Action Fund for Emerging Economies despite the disappointing outcome of COP15?*

Mr. SØRENSEN: ATP will maintain its €1 billion commitment, and we may very well go beyond that level at some point in the future if policies and terms are right. Right now, we believe that the lack of clarity is seriously holding back investor appetite from investing in this area. This is highly unfortunate because most of the investments – 85 percent according to a World Bank study – needed for financing for renewable energy and energy efficiency projects will have to come from the private sector. As it currently stands, the lack of clarity slows down the investment flow, and it means that fewer investors will consider investment in this area.

Ms. ABADY: *Can you give us an example of where public policy has helped to create investment in clean-tech?*

Mr. SØRENSEN: I can think of two examples: Japan's regulation of building energy efficiency and the automotive industry. The Japanese would not have been as energy efficient had it not been for building energy efficiency standards. The country has the world's second-largest economy, but it produces virtually no oil or gas, importing 96 percent of its energy needs. This dependence on imports has prodded the nation into tremendous achievements in improved efficiency. Denmark and its development of a high proportion of renewable energy in its energy mix can serve as another example.

Ms. ABADY: *Can you explain how ATP came to be an investor in the clean-tech sector?*

Mr. SØRENSEN: We are not a clean-tech investor as such, but we do believe that many companies in climate-relevant sectors and productions offer good business opportunities. In our view, climate change and the regulations that may be put in place in order to counter climate change pose companies and investors with significant risks. We believe that the ability to address climate-change-related issues will be an important competitive factor as we move forward. It is an essential part of our fiduciary to focus on and address such risks in order to serve our membership and protect our investments. The same view leads us to consider the opportunities offered by climate change. ATP has sizable investments in climate-related activities ranging from equities to infrastructure projects and substantial investments in forestry. However, it should be noted that we invest in such activities because business cases add up and not because it is popular or politically correct to do so. In order to attract the private investments needed in these fields at the scale and pace required, clear signals and targets are needed along with policy frameworks providing attractive risk-adjusted returns. Many of these activities and investments are policy driven and will remain so for quite some time.

Ms. ABADY: *As chairman of the Institutional Investors Group on Climate Change (IIGCC), a group of 58 investors with combined assets of around €5trillion, can you discuss the benefits of membership?*

Mr. SØRENSEN: Investors have a critical role to play in addressing climate change. In order to play that role effectively, we need coordination and collaboration. That is what the IIGCC is all about. It creates a joint platform for institutional investors and the ability to address policy developments and debates consistently. Climate change creates financial risks for investors; however it also creates investment opportunities. The IIGCC aims to ensure that these risks and opportunities are addressed and reflected in investment practices and decisions. The IIGCC brings investors together to use their significant collective influence to engage in dialogues with policymakers, investors, and companies to support the shift to a low-carbon economy. Strong stable policies and frameworks are essential. Governments should lead this response by creating a framework that provides incentives and investment certainty to companies and individuals.

Ms. ABADY: *What advice would you have for entrepreneurs looking to raise financing for renewable energy and clean-tech projects and for institutional investors looking to make investments in this area?*

Mr. SØRENSEN: Leading investors think about climate change first and foremost in risk terms, and taking stock of risks—and of opportunities—is a key responsibility of any pension fund. My main advice to entrepreneurs and institutional investors is to assess your climate risks thoroughly and account and report on your findings and be sure that the business case always adds up.

Ms. ABADY: *Thank you for taking the time to share your thoughts with the Journal of Environmental Investing. It was much appreciated.*

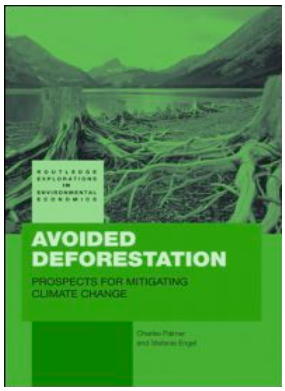
Mr. SØRENSEN: It was a pleasure. You're welcome.

Contact: lia.abady@thejei.com

Ole Beier Sørensen heads ATP's research activities on pension policy and other areas of public policy. He has a Ph.D. degree in Social Geography from the University of Copenhagen and his research covers a broad range of issues related to pension systems, pension reform and pension management.

In resent years he has focused particularly on pension reform issues and on non-financial investment risks – among them social responsibility and climate change – and on behalf of ATP he has been a key participant in discussions in the global investor community. Ole Beier Sørensen is chairing the European investor network Institutional Investors Group on Climate Change (IIGCC), he is a member of the Advisory Board of the Danish African Guarantee Fund, he is a Board member at the International Centre for Pension Management at the Rotman Business School in Toronto, Canada and he serves as a member of the Advisory Board of the Centre for Pension Law at the University of Copenhagen.

Book Review



Avoided Deforestation: Prospects for Mitigating Climate Change, edited by Charles Palmer and Stefanie Engels, Milton Park, Abingdon, Oxon and New York: Routledge, Taylor & Francis Group, 2009, 258 pp., $170.00 (hardback or eBook)

Reviewed by Dr. Richard Betts

Avoided deforestation, excluded from the Kyoto Protocol as a potential to help mitigate climate change, has now returned to the climate policy agenda once again. It is, however, fraught with complexity, particularly in the economics and politics surrounding its implementation and likely effectiveness. As a climate scientist specializing in the effects of ecosystem change on climate and vice versa, I have developed some awareness of the various issues and difficulties in the economic and policy areas, but have had little in-depth knowledge. *Avoided Deforestation*, edited by Charles Palmer and Stefanie Engels, has helped fill that gap in my knowledge.

The chapters, written by researchers and scientists with backgrounds in economics, environmental sciences, and climate policies, cover a wide range of issues and begin with the convincing reasons for financing avoided deforestation as part of the international community's attempts to slow climate change. Following extensive discussions of the difficulties in actually making avoided deforestation happen, the book then moves on to the potential solutions and case studies.

In several cases the same issue is covered from different angles by different authors, which I found particularly useful for someone from outside the field. (One never knows whether a particular result or opinion is representative of the mainstream or an outlier – either of which may be fine, but it is useful to be able to judge.) So it was valuable to read three chapters on the cost effectiveness of avoided deforestation as a mitigation policy. All three used different approaches, but all came to broadly the same conclusion: that avoided deforestation is cost-effective in comparison to other mitigation options, but that the cost-benefit analyses were contingent on successfully overcoming certain barriers, including actually sourcing the funding and dealing with the natural tendency of humans and institutions to cheat.

A major theme running through the book is that of the difficulty of setting baselines. Essentially the problem lies in establishing what would have happened in the absence of the incentives to avoid deforestation. While my own perspective would naturally lead me to focus on the scientific and technical aspects of this – such as how much deforestation is actually occurring and what this means for emissions – the authors focus on establishing effective incentives to avoid deforestation while trying to avoid introducing perverse incentives or penalizing those who already protect forests without outside incentives. The greater the baseline deforestation is, the larger the reward for avoiding it – a situation that is a huge political challenge. Part of the political challenge is the need for objective scientific evidence. Progress has been made in recent years, which is partly why avoided deforestation is now back on the political agenda, but to meet the more stringent requirements for evidence-based policy, more work is needed.

Another key theme is seeing the climate mitigation problem as part of the bigger picture. The editors build on the chapter contributions of various authors and offer their own perspectives on the role of avoided deforestation in relation to other mitigation measures. They make the point that while avoided deforestation is cost-effective, this effectiveness depends on the successful implementation of a wider range of mitigation measures, so they argue that avoided deforestation should be seen as a necessary part of a wider portfolio of measures and not just in isolation.

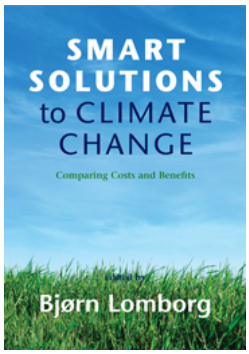
Links to conservation and poverty alleviation are also part of the bigger picture. Synergies between climate change mitigation and existing activities to protect forests for additional motives make intuitive sense for lots of reasons, and it is useful to see case studies presented here that clearly demonstrate this relationship.

One poignant aspect of this book is its posthumous publication of the contribution of Bernhard Schlamadinger. Although he and I knew each other by reputation, we only met once – however that coincided with an important moment in history. At the 2007 UN Climate Change Conference in Bali, we found ourselves seated together in the audience for the live video link to Oslo for the presentation of the Nobel Peace Prize to the IPCC and Al Gore. Since we were both lead authors on the IPCC 4th Assessment Report, and both wrote on land cover change issues, but from different perspectives and in different volumes, we were equally proud to watch the presentation of the award from within the policy conference where the implications of the IPCC's work were being addressed by the world's governments. Indeed it was at the Bali conference where REDD came firmly back on the UNFCCC agenda. Reading Bernhard's chapter reminded me of this globally significant moment for forests that I shared with one of the great scientific contributors to the debate.

Overall I found this a useful, interesting, and readable introduction to the political and economic complexities surrounding the practice of avoided deforestation as a means to reduce climate change. The content is accessible to non-specialists with a general interest in the topic and basic background knowledge, so it ought to appeal to students and policy stakeholders who want to rapidly get up to speed on this important topic. In addition, scientists working in related fields should find it a valuable aid in putting their work in context and for suggesting areas that require more robust evidence or technical advances.

Dr. Richard Betts leads the climate impacts research team and climate change consultancy team in the Met Office Hadley Centre. richard.betts@metoffice.gov.uk.

Book Review



Smart Solutions to Climate Change: Comparing Costs and Benefits, edited by Bjørn Lomborg, Cambridge, New York: Cambridge University Press, 2010, 436 pp., $90.00 (hardback), $24.00 (ebook)

Reviewed by Dimitri Zenghelis

In his latest edited book, *Smart Solutions to Climate Change*, the self-styled skeptical environmentalist Bjørn Lomborg might be mistaken for having made an abrupt volte-face in his views. "Climate 'sceptic' Bjørn Lomborg now believes global warming is one of world's greatest threats," blazed the Daily Telegraph; "The dissenting climate change voice who changed his tune," hailed the Guardian. And on first pass, this does appear to be the case: "The risks of unchecked global warming are now widely acknowledged," Lomborg writes. "We have long moved on from any mainstream disagreements about the science of climate change." He adds: "Climate change is undoubtedly one of the chief concerns facing the world today." He ends by asserting that

> *If we care about the environment and about leaving this planet and its inhabitants with the best possible future, we actually have only one option: we all need to start seriously focusing, right now, on the most effective ways to fix global warming.*

But behind the bombastic rhetoric, Lomborg has always agreed that man-made global warming is real. Yet he has always played down the need for emissions reductions, and he continues to do so here. He argues that there is no need to reduce CO_2 emissions to any significant extent in the near future. "It is unfortunate that so many policy makers and campaigners have become fixated on cutting carbon in the near term as the chief response to global warming," he claims. Referring to the judgment of his handpicked Expert Panel of five, he concludes that "drastic carbon cuts would be the poorest way to respond to global warming." Instead, he favors increased spending on green research and development (R&D): "R&D in green energy technologies is really the only viable long-term strategy for reducing fossil-fuel consumption without crippling the world economy."

Although the book contains a diversity of well-informed views from established practitioners (though none are climate scientists), its full value falls short of the sum of its parts. A lack of structure makes it a somewhat incoherent and rather misleading read. The

book has eight chapters, by different authors, each containing complex analysis and reviews of other studies purportedly aimed at establishing the costs and benefits of spending up to US$250 billion annually on 'solutions' to climate change such as climate engineering, carbon dioxide mitigation, carbon sequestration, adaptation, and technology transfers. Each chapter then contains an 'alternative perspective' section with contributions from other commentators. The options are then weighed up by a chosen Expert Panel of five. Lomborg introduces the book and summarizes in a sentence or two the authors' key findings. The chapter topics are far from exhaustive and—perhaps unsurprisingly given the editor's predisposition—only one chapter in eight is devoted to options for CO_2 mitigation.

Flawed Method

From the outset, Lomborg's basic method is flawed. He sets up an arbitrary challenge: "If the global community wants to spend up to, say, $250 billion per year over the next 10 years to diminish the adverse effects of climate change, and to do most good for the world, which solutions would yield the greatest net benefits?" In this way he assumes some notional budget constraint for the sum total of global spending on social and environmental ills, and then uses cost-benefit analysis to rank projects. By doing so, he appeals to the common sense doctrine of getting the "biggest bang for the buck."

But this doctrine constitutes bad economics. First, the projects and outcomes are almost all interrelated. Many of the development challenges Lomborg would prefer to spend money on (fighting AIDS, preventing malaria, and providing water and micronutrients) will be made worse, maybe much worse, by climate change, and the impacts of climate change are made much worse by delaying a response to these challenges. If the projects are interrelated in this way, rather than independent, then it is inappropriate to handle the analysis by assuming separate, mutually exclusive choices. This would be like arguing that it is preferable to build a roof than to build walls or foundations, because the roof is better at keeping out the rain.

Second, Lomborg fails to acknowledge that there are many market failures that can be addressed through action to reduce emissions. These relate to waste, inefficiency, congestion, biodiversity, and the under-supply of innovation that generates freely available knowledge spillovers, as well as the undersupply of infrastructure due to network economies. Such failures cannot be evaluated by means of an arbitrary budget constraint. Third, it is a mistake to use marginal cost benefit analysis to try and project the impact of large irreversible changes both to the climate and to technological innovation in the energy sector. Such large and non-marginal issues require a more sophisticated analytical approach taking full account of projected risks.

Finally, it is worth noting that for all his claims to favor spending on alternative development options, Lomborg spends very little energy actually championing these causes when compared with the time he spends decrying the value of emissions reductions. Readers can judge for themselves, but this might suggest that fairness and effectiveness are not his overwhelming concerns.

Lomborg Assumes Away Risk

Existing peer-reviewed climate science is clear about the risks from unchecked emissions growth. As summarized in the IPCC fourth assessment report, the business as usual and unabated emissions scenarios raise the risk of catastrophic, irreversible climate events like widespread floods, droughts, storms, heat waves, famine, disease, and devastating coastal inundation, which could render billions of people poorer than they are today. The physical and human geography of the planet likely would be radically transformed in little over 100 years. By contrast, Lomborg repeatedly argues that the risks from climate change are small. He argues that any warming we see, and additionally the damages associated with any warming we see, will likely be at the lower end of the model predictions.

In order to estimate the value of mitigation, Lomborg uses Richard Tol's model of climate impacts. It is worth noting that Richard Tol is an economist who, much like Lomborg, consistently downplays the case for urgent action on mitigation, preferring instead to champion the cause of climate adaptation. Tol's model systematically down-weighs future impacts and overstates the lack of affordable options to bring emissions levels down. It is also a deterministic model that does not deal with the central question of uncertainty. His model misses key elements of the story: where he tends to argue for greater action, for example, he does not include tipping points in the climate system, so that projected damages rise very slowly at high temperatures. Tol also calibrates his analyses on the basis of out-of-date scientific assumptions, in many cases using pre-2000 results.[1]

Lomborg uses Richard Tol's modeling assumption that unabated climate change can only ever have a marginal impact on GDP, affecting richer generations in the far future. Tol projects a mere 2% loss in GDP for a 5°C temperature increase—something that would rewrite the world and lead to mass migration and conflict. Indeed Tol's model projects net benefits to the world from warming until the world is almost 3°C warmer.[2] To reduce emissions, Tol declares that "the only scenario worth funding" is to apply a carbon tax of about \$2/tC (\$0.55/tCO_2). This would add only a small fraction of a percentage to energy bills, but alone would not prevent the level of CO_2 equivalent (CO_2e) concentrations in the

[1] A cursory glance at his bibliography will affirm that he rarely uses, or refers to, more recent studies that are based on the latest scientific assessment of the risks. Particular recent examples include model studies by Ackerman, Sokolov, Stern, Hepburn, Weyant, Watkiss and Hope.

[2] Temperature changes are all expressed relative to pre-industrial times.

atmosphere from rising to over 850 parts per millions (ppm) by the end of the century, compared with around 440ppm CO_2 e today. This would mean significant probabilities of warming by 5°C within a century or so compared with today, a temperature the world has not seen since the Eocene period some 30–50 million years ago.[3]

Just as unsettling is the implicit assumption that the impacts of climate change are known with certainty and can be used to design with precision the optimal policy mix. This is unrealistic and foolhardy. The scientific consensus agrees that there are low-probability risks of devastating and irreversible impacts associated with continued increases in GHG concentrations. Concentrations of 850ppm CO_2e could lead to far higher global temperature increases, maybe a one-in-a-hundred chance of 8°C or 9°C.[4] And scientists agree that the impact of any temperature increase on the global climate may be larger than the central expectation, perhaps triggering run-away thresholds like the release of methane from the tundra or the melting of the Greenland and West Antarctic ice sheets. Of course, the impacts may be smaller than the central expectation. But as with the risk of our homes being burgled or burned down, it is the downside uncertainty that motivates us to take out insurance even though we know the insurance company will make money off us. Assuming away climate uncertainty eliminates much of the case for action, which is about paying an acceptable premium to insure against dangerous consequences.

This strategy is irrational because such denial would require great confidence both that the scientific findings are wrong and that the corresponding risks are small. To understand this, assume that the scientific findings are wrong but we act as if they were right. This might lead us to excessive investment in developing low-carbon technologies and protecting forests; but these actions nevertheless have substantial other benefits in energy security, energy efficiency, biodiversity, and so on. Now assume that the scientific evidence is right but we act as if it were wrong. This would lead us to concentrations of carbon dioxide carrying immense and potentially irrevocable risks. And yet Lomborg insists that "alarmism on the part of environmentalists and climate scientists prevents a rational discussion." On the contrary, with the science driving the case for action, dealing rationally with climate change means adopting a comprehensive and robust risk-management approach.

Systematic Undervaluation of the Future

Lomborg argues that future generations will be so wealthy that very major impacts of climate change, such as global sea level rises of a few meters, would be more affordable than cutting greenhouse gas (GHG) emissions to stabilize levels in the atmosphere. There

[3] Based on the conclusions of IPCC (2007), a GHG level of 850ppm CO2e would mean a 50:50 chance of a 5C warming (at stabilization).

[4] Based on IPCC (2007), and across a number of climate sensitivity distributions.

is some truth to this. It makes no sense to burden poorer generations today with costs that can more easily be born by richer generations in the future. But by ignoring risk and taking global averages, this rules out the possibility that some sections of the population in vulnerable parts of the world may be poorer—perhaps much poorer—in the future because of climate change. And for these sections of the population, the loss of a few dollars in daily income will have a substantial welfare impact, often life-threatening. If climate change involves huge risks, then this changes the assumptions about future income levels and thus assumptions about the discount rate. Because outlier impacts are not adequately represented in Tol's deterministic cost benefit framework, the risk-adjusted costs of inaction on emissions are again unambiguously under-stated.[5]

Tol uses an average discount rate of 5% over the next century, without making it clear how he arrives at that figure. At 5% continuous discounting, a person's consumption in the middle of the next century would be valued at around 1/150 of a person's consumption today, thus favoring policies that benefit current generations today at the expense of those in the future. Indeed impacts beyond 2100, where the most threatening consequences of climate change are expected to arise, are dismissed altogether. According to Ackerman, by using a 5% discount rate, Tol makes it appropriate to *subsidize* those who emit carbon, because "they are accelerating the arrival of the gloriously hotter mid-century years."[6]

It seems hard to argue for discriminating against future generations purely on the basis of birthdates—a process known as pure time discounting. This is distinct from discounting because of income differences, or discounting because of the risk of future extinction, both of which can be expressed quantitatively as in The Stern Review. Pure time discounting is rooted in the economist's desire to reflect people's preferences, as people are impatient in many of the things that they do. But climate change is such a long-term social problem that it is inconsistent to use personal telescopic preferences, as reflected in market interest rates as the basis to determine policy. Why should we objectively treat the well-being of current generations on an equal basis, but apply a different treatment to the well-being of generations born next year, or the year after? Doing so guarantees that through time we will be shown to have made the 'wrong' decision. The fact is we don't, which is why so many of us think treating the atmosphere like an open sewer for future generations to cope with or suffer from is morally inadequate.

[5] See Dietz (2010) "High impact, low probability? An empirical analysis of risk in the economics of climate change," Climate Change; and Dietz et al (2007) "Right for the Right Reasons: A Final Rejoinder on the Stern Review," World Economics.

[6] See Ackerman and Stanton (2010) "The social cost of carbon," Real-World Economics Review, no. 53.

No Assessment of the Costs of Delay

Lomborg urges us not to be rash. We can't make proper decisions and prioritize our goals if we think we have a gun at our heads.[7] This is very true, but it is irrational to ignore the obvious fact that early emissions cuts would be far cheaper if we manage the transition by working with the investment cycle and prevent the lock-in of high carbon infrastructure, than if we rush to remove carbon-intensive infrastructure (or carbon from the air) later, calling forth expensive technologies that have not had time to mature. Early action does not mean rash action given the balance of risks. Every year of delay increases the costs of meeting a temperature target while opening up additional climate risks.

Lomborg uses Tol's findings to show that meeting a two-degree pathway would require a "staggering" 12.9% reduction in world gross domestic product.[8] That is indeed staggering, but thankfully it does not represent the economic community's main findings. A variety of economic assessments of the impact of a global effort to avoid dangerous climate change put the impact on global GDP at around 2% by mid-century over a period in which, by comparison, the world economy will have approximately tripled in size.[9,10] There are in fact a lot of options for reducing carbon emissions and making money in the process, both by increasing efficiency and reducing waste and by developing innovative processes and technologies that boost productivity.[11] Economic models are just now coping with market failure and waste, as well as with learning and experience associated with new innovation. A few even include knowledge spillovers. But all struggle to model the 'animal spirits' and innovative dynamism usually associated with non-marginal technological revolutions. Thankfully, entrepreneurs understand the transformative value of such processes even where economists don't.[12]

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[7] See http://news.bbc.co.uk/1/hi/sci/tech/3486894.stm

[8] It would require a tax of $100 per tonne of CO_2 worldwide, from 2010 rising rapidly with time.

[9] The reader is pointed in the direction of the ADAM project (http://www.adamproject.eu/) and the RECIPE report on The Economics of Decarbonization (each uses more than one model) as well as IEA, IPCC, McKinsey, OECD, and Stern Review findings.

[10] Unlike Tol, who imposes a strict limit on emissions staying below 450ppm CO_2e, more measured studies recognize that we will overshoot 450ppm CO_2e in concentrations, keeping them below 500ppm CO_2e and then gradually bringing them down to 450ppm CO_2e or less in order to have a good chance of keeping below 2°C. Tol also ignores the fact that the global cooling impact of atmospheric sulphate aerosols means that GHG concentrations can remain higher for longer, consistent with meeting a 2°C goal at lower cost.

[11] McKinsey estimate 15-20 Gt of CO_2 annually worldwide may be avoided at an average cost of less than zero by 2030: https://www.mckinseyquarterly.com/A_cost_curve_for_greenhouse_gas_reduction_1911

[12] Some models even give positive GDP gains because they assume that economies are not functioning optimally and that climate change mitigation policies can help to reduce imperfections in the economy. The presence of numerous market failures in energy technologies mean this is not as unrealistic as it sounds.

Tol also notes that "the analysis presented here also omits suboptimal policy design. Carbon price differentiation and direct regulation may well increase abatement costs by a substantial margin." This is surely correct. Uncoordinated delayed policy will only make things more costly, but that is precisely why interventions like Lomborg's, which impede coordinated action, are so dangerous.

Why Kyoto Was a Start

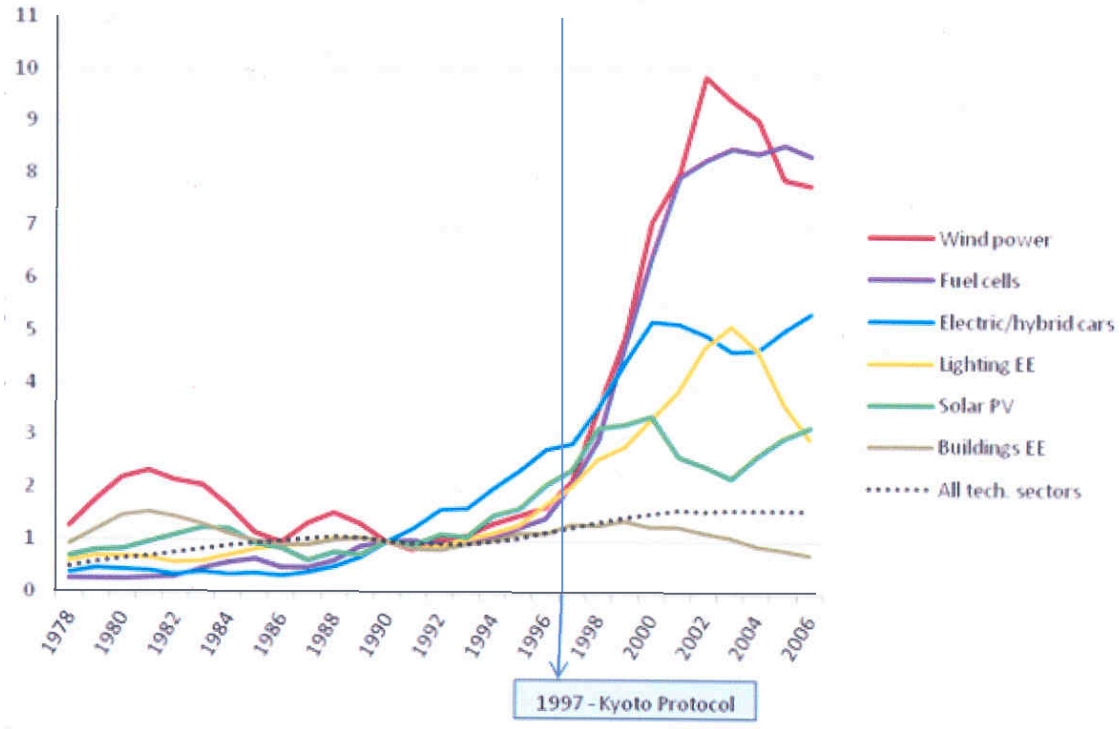
Lomborg argues that the 'Kyoto approach' to global warming has failed and recommends that we seek other ways of solving global warming:

> *Reading the research in this volume—written by some of the top climate economists working in this field today—it is easier to understand why a single-minded focus on drastic carbon emission reductions has failed to work.*

Kyoto was doubtless imperfect and insufficient. But by sending a clear policy signal to the private sector, the 1997 Kyoto protocol coincided with a marked up-turn in innovation in key green technologies such as wind, solar PV, fuel cells and electric vehicles (Figure 1).

Figure 1: Innovation in Climate Change Mitigation Technologies

Patenting activity in Annex-I countries
(3-year moving average, indexed on 1990=1.0)



Source: OECD 2010. OECD Project on Environmental Policy and Technological Innovation.

Focus on Technology Not Enough

On the positive side, Lomborg now calls for an investment of $100 billion per year on research and development for low-carbon technologies, instead of the $25 billion he was advocating 18 months ago. This is welcome, but it is only one element of the combination of policies needed to promote the development of a global low-carbon energy system. Without a clear price signal to stimulate investment and behavioral change, this is unlikely to make for ambitious cuts. He says that "trying to force carbon cuts instead of investing first in research puts the cart before the horse." In fact, the reverse is true. Funding R&D without using all the tools in the policy-maker's tool-box to address specific market failures and secure a long-term credible market could be a spectacular waste of resources, leading to policy recommendations that are inadequate, inefficient and surprisingly statist.[13]

A more robust approach to managing the risks of climate change would be not only to invest in R&D, but also to use a carbon tax (or cap-and-trade) to discourage greenhouse gas emissions in the short run. Pricing carbon creates a clear market signal to induce behavioral change and innovation and provide a valuable new asset for businesses and investors to accumulate. But to encourage enough emissions cuts in the next few years to keep greenhouse gases at low enough atmospheric concentrations, a carbon price considerably higher than Tol's $2/tC is required.

Lomborg remarks that "although carbon taxes and a 'cap-and-trade' scheme should, in theory, have very similar outcomes, the latter produces a much higher opportunity for 'pork-barrel politics' and waste." It is certainly true that the issuance of free emissions permits to hard-pressed industries opens up the scope for special pleading. The design of the EU emissions trading scheme has continued to improve in order to limit such incentives. Yet only the most naïve analyst would assume that just because a pure tax does not contain such mechanisms, no additional mechanisms would be created to compensate the losers. Such supplementary mechanisms are inevitable and would be equally susceptible to lobbying and waste.

An Exaggerated Role for Geoengineering

Lomborg makes much of the potential benefits of geoengineering: strategies such as space mirrors or aerosol injection to reflect sunlight and offset the effects of global warming. In an idea that emerged from the Copenhagen Consensus, he recommends that a fleet of 1900 robotic ships patrol the ocean, releasing particulates and ocean spray to reflect the sun's

[13] See Bowen "Fighting Climate Change: the Case for Using All the Tools in the Tool-box" Grantham Research Institute, LSE, forthcoming.

rays. With atmospheric concentrations certain to overshoot 450ppm CO_2e, low-intensity geoengineering is indeed an option that needs to be investigated as a means to manage the transition to decarbonization. However, it is not without risks and certainly does not provide a substitute to active mitigation.

As White House science advisor John Holdren asserted in 2009: "The 'geo-engineering' approaches considered so far appear to be afflicted with some combination of high costs, low leverage, and a high likelihood of serious side effects." With our incomplete knowledge of the workings of the non-linear climate system, many scientists argue that stratospheric geoengineering cannot be tested without full-scale implementation over decades. Once again Lomborg irrationally underplays risks and uncertainties. Moreover, most geoengineering 'solutions' do nothing to stop the underlying rise in GHGs or the consequences of ocean acidification, which some studies suggest will be a major problem in its own right.[14] Geoengineering is important, but relying on it alone is a bit like relying on methadone to cure the addiction of a heroin addict.

Conclusion

Whether or not Bjorn Lomborg has changed his mind is a moot point. The more important fact is that Lomborg continues to grab headlines, fill more newspaper column inches, and capture more TV airtime than almost any climate scientist. Until this changes, the chances of a successful, collaborative resolution to this urgent global issue, guided by a common understanding, remains slim. As Howard Friel recently wrote in The Guardian:

> *If Lomborg were really looking for smart solutions, he would push for an end to perpetual and brutal war (over climate action), which diverts scarce resources from nearly everything that Lomborg legitimately says needs more money.*

To offer smart solutions, Lomborg would need to commit to the following changes: stop contradicting the climate scientists by downplaying the risks from climate change; take a more balanced view of the findings of economists, engineers and technologists, who highlight significant opportunities for cost-effective emissions reductions; and focus on mitigation, in order to eliminate risks, rather than adaptation and geoengineering, which amount to the policy equivalent of mopping up water with the tap left running. Such changes would indeed mark a u-turn and bring Lomborg into line with the leading practitioners in the field. But they do not feature in this book. Instead, Lomborg stays true to his irrational course. He continues to advocate almost anything other than making carbon emissions more expensive—the one tool most economists feel is likely to lead to

[14] These policies would need to be supplemented by additional measures such as air-capture or liming the oceans.

cost-effective behavioral change and incentivize innovation in the development of new markets. Consequently, it remains wise to be wary of his pronouncements, no matter how much publicity they attract.

Acknowledgments

Mr. Zenghelis wishes to thank Dr. Alex Bowen, Dr. Simon Dietz, Professor Lord Nick Stern, Bob Ward, and Dr. Nicola Ranger for their contribution to this review.

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Dimitri Zenghelis is Senior Economist to Cisco Systems, Senior Research Fellow LSE Grantham Research Institute, and Associate Fellow Chatham House. dzenghel@cisco.com