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THE NEW GREEN BUSINESS MODEL FOR INVESTMENT

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Introduction

Emerging markets for environmental financial investment and trading continue to attract significant global investment interest but little investment capital as yet.[1] According to Cleantech Venture Network, $5.18 billion was deployed for clean-tech investment in global markets for 2007.[2] For research and development in the same year, U.S. energy companies committed only $4 billion and the U.S. federal government spent $7.5 billion. It is now estimated that underinvestment in U.S. energy and water infrastructure is over $2 trillion. This underinvestment has been held up by regulatory uncertainty of the United States on federal climate change legislation as well as the lack of attention by politicians. That will now change with the next U.S. administration.

Traditionally, private investment has come from the venture capital world, which typically has the requisite patience to invest in many projects for as long as the 10-year life of venture capital funds. More recently, this area of investment has

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attracted large hedge funds. Hedge funds do not have that much patience and usually look for more immediate arbitrage opportunities. However, they are now investing in many clean energy technology projects. Private equity funds, which number in the hundreds in the United States, have not yet deployed much capital into this emerging market sector as it is still under researched. Private equity investors feel they can achieve better investment returns in replatforming distressed asset plays rather than investing in unknown financial markets with more risky returns. They are monitoring the space but not deploying much capital yet.

As markets change, so do investment models. The new business model that has emerged for investment in alternative energy and clean technology is a hybrid business model of venture capital, hedge funds, and private equity. Investment is locked up for shorter periods of time, from one to four years, rather than with traditional venture capital time spans of up to 10 years. Coupled with the project orientation of the investment, there also is a dimension of credit trading for emissions, carbon, and renewable energy included in this investment strategy. The blurring of the lines among hedge funds, private equity funds, and venture capital is being exacerbated by significant private equity participation in environmental finance. This new hybrid financial green investment model will be discussed and analyzed in this paper.

The New Market Drivers

The three global market drivers—sustained higher energy prices, accelerated technology shift, and increased environmental concerns—form the perfect storm for clean technology investment deployment. Further, falling renewable energy costs are expanding investment opportunities in this sector as are government mandates for renewable energy deployment in 28 states (table 1 as of February 2009). To put this clean technology market in some perspective, we must look at its origin, what is driving it, and where it is headed in the foreseeable future.

In 2007 clean technology investment is the fifth largest share of venture capital in North America at 10 percent of market share and rising. U.S. $8.2 billion was invested by venture capitalists in this sector from 1999 through 2005, according to the Cleantech Venture Network. It is now very conservatively estimated that U.S. $8.5 billion more will be invested in this sector from 2007 through 2010.

In addition to venture capital, both private equity and hedge funds will supply additional billions more as new technology is rapidly commercialized and deployed globally. The need is that great. Demand pull of global financial markets is accelerating. We have entered the world of Kyoto Protocol implementation in 2008 in 174 countries, and that already has impacted environmental project finance. Some of that anticipated investment is estimated in table 2.

Global growing pains in this sector are seen in the shortage of wind turbines, polysilica for solar power, and even geothermal parts. The whole world is moving rapidly toward cleaner energy sources at the same time. Rising environmental

Table 1
RENEWABLES PORTFOLIO STANDARD (RPS) OF U.S. STATES, FEBRUARY 2009

State[a]	RPS: Percent By Year	Solar Water-Heating Eligible
Arizona[b]	15 by 2025	Yes
California	20 by 2010	
Colorado[b]	20 by 2020 (IOUs); (10% co-ops and large munis)	
Connecticut	23 by 2020	
Delaware[b,c]	20 by 2019	Yes
District of Columbia[b]	20 by 2020	Yes
Hawaii	20 by 2020	Yes
Illinois	25 by 2025	Yes
Iowa	105 megawatts (MW)	
Maine	30 by 2000 (10% new renewable energy by 2017)	
Maryland[b]	20 by 2022	
Massachusetts[b]	15 by 2020 + 1% annual increase (Class 1 Renewables)	
Michigan[c]	10 + 1,100 MW by 2015	
Minnesota	25 by 2025 (Excel Energy: 30% by 2020)	
Missouri[b]	15 by 2021	
Montana	15 by 2015	
Nevada[b]	20 by 2015	Yes
New Hampshire[b]	23.8 by 2025	Yes
New Jersey[b]	22.5 by 2021	
New Mexico[b]	20 by 2020 (IOUs); (10% co-ops by 2020)	
New York[b]	24 by 2013	
North Carolina[b]	12.5 by 2021 (IOUs); (10% co-ops and munis by 2018)	Yes
Ohio[b,d]	25 by 2025	Yes
Oregon	25 by 2025 (large utilities); (5-10% smaller utilities)	
Pennsylvania[b,d]	18 by 2020	Yes
Rhode Island	16 by 2020	
Texas	5,880 MW by 2015	Yes
Washington[c]	15 by 2020	
Wisconsin	Requirement varies by utility; 10% by 2015 goal	

[a]Five states have state goals not RPSs: North Dakota (10% by 2015), South Dakota (10% by 2015), Utah (20% by 2025, minimum solar or customer-sited RE requirement, solar water-heating eligible), Vermont (Renewable Energy meets any increase in retail sales by 2012, solar water-heating eligible), and Virginia (12% by 2022).

[b]Minimum solar or customer-sited renewable energy (RE) requirement.

[c]Increased credit for solar or customer-sited RE.

[d]Includes separate tier of non-renewable "alternative" energy resources.

Source: Database of State Incentives for Renewables & Energy Efficiency, available at www.dsireusa.org/documents/SummaryMaps/RPS_Map.ppt.

imperatives will accelerate much of this energy market transformation into a cleaner energy world.

Table 2
CLEAN ENERGY INVESTMENT, 2005 AND 2015
(in billion U.S. dollars)

Energy Type	2005	2015
Bio fuels	15.7	52.5
Wind	11.8	48.5
Solar photovoltaic	11.2	41.5
Fuel cells	1.2	15.1

Source: Clean Edge, available at www.cleanedge.com.

Clean Technology Investment Trajectory Is Accelerating

The investment opportunities are immense. World energy demand is rising. Renewable energy mandates are proliferating in the United States, the European Union (EU), China, and India. The "Kyoto Factor" arrived in 2008, and the need for carbon credits for the industrialized world is accelerating, as well as the need for less carbon-intensive technology. It is estimated that the carbon credit-trading market may reach $3 trillion by 2020. It has doubled in the past two years, reaching $60 billion for 2007, according to the carbon market analyst firm Point Carbon.[3] Most of that trade was dominated by the EU, but the United States has the largest carbon footprint at over 6 billion tons of carbon dioxide equivalent (CO_2e) and it is now moving on carbon trading and finance mostly in the voluntary markets. EcoSystem Marketplace reported the voluntary market may be 150 million to 200 million tons last year (2008) with a market valuation of $331 million. It is now estimated from informal discussions by Global Change Associates with large U.S. carbon market providers that the voluntary carbon market will at least quintuple in 2008 as U.S. firms prepare for a coming mandatory carbon reduction regime in 2010.

Moreover, this is much more market driven than regulatory driven as it was before. While there continues to be a focus on the regulatory regime, greater energy demand is pushing out clean-tech products faster. Biological and materials sciences are also contributing to this effort on a new level in the form of both biofuels and nanotechnology. There is a higher use of information technology than ever before. This tweaks many efficiency gains that makes projects fly, particularly in advanced metering and remote sensing. Higher sustained energy prices are setting up the price floor to push such gains even faster. Technology also is becoming more cost effective as deployment of the technology increases.

Energy, agriculture, manufacturing, transportation and water are all under the clean technology tent. This leads to many applications and cross-fertilization between different scientific disciplines. The list in table 3 includes bio-based fuels, micro-irrigation systems, distributed energy, renewables, energy storage,

advanced packaging, natural chemistry, hybrid vehicles, lighter materials, smart logistics software, water recycling, desalination, and newer applications of sensing equipment. The opportunities are almost endless and the technology cycles are shrinking as well. This age of technology delivers results.

As one can see from table 3, these technologies encompass engineering disciplines, information technology, and the physical sciences. The game is to deploy more capital, reduce costs, and utilize the technology globally. Since there is no one silver bullet, investors are betting on all the technologies in table 3. According to the Cleantech Venture Network, which tracks this sector, some 2,014 financial investment deals have been made since 2001. That investor interest is beginning to scale globally.

What the New Business Model Looks Like

It may be helpful to review recent developments in "clean technology," also called "clean tech." When mainstream press—*Business Week*, *The Financial Times*, *Forbes, The Wall Street Journal*, and *The Economist*—starts covering this sector, they herald the news that the time has arrived for greener and cleaner technology. But the space is very different than what many envision. Good venture projects for the clean technology space need three elements to be successful: (1) revenue stream, (2) a seasoned management team to grow the business, and (3) a defined exit strategy (usually by an initial public offering, trade sale, or roll up).

Table 3
CLASSIFICATION OF THE CLEAN ENERGY BUSINESS OPPORTUNITY

Type of Opportunity	Type of Opportunity
Alternative energy	*Energy recycling*
Solar	*Waste-to-energy*
Wind	*Battery technology / energy storage*
Hydro, tidal, and wave	*Medical and biological crossovers*
Geothermal	*Environmental technologies*
Bioenergy and biofuels	Water and wastewater treatment
Distributed energy	Clean coal gasification
Combined heat and power	Emissions mitigation
Microturbines	Desalination of water
Fuel cells	*Information technology*
Hydrogen generation	Net metering and real-time pricing
Flywheels	Demand response (energy efficiency)
Energy efficiency	Energy management systems
Lighting	Remote sensing
Buildings	
Transportation engines	

Source: Global Change Associates, available at www.global-change.com.

Building a business to scale and commercialization is very different than funding research and development efforts that are really science projects. In fact, some of the currently funded technologies are so debt-ridden that they will never be commercially viable. Moreover, their cost structure is so onerous that it will require an ability to reduce costs significantly in order to become commercialized. They cannot depend solely on the "environmental kicker" of emissions reductions (called "carbon offsets") as making a project economically viable. These are additional benefits for a business but are not the reason for that business to exist.

What may be more interesting are the second-stage investments in clean technology and alternative energy that do have revenue and can make money for investors. Several venture funds are focused on these later-stage investments, and the investment space is beginning to get crowded. There is a great need for viable later-stage companies. Angel investing, on the other hand, will fund start-ups in the green space and, consequently, take on more risk. This is currently less attractive to most investors, however, that dynamic is going to change when the U.S. carbon regime is implemented. In turn, that will provide the necessary uplift to the market, i.e., more capital deployed in earlier-stage investment for greater reductions of carbon in the future. Therefore, there is really a twofold market developing that is following regulatory developments in renewable energy and carbon reductions. The first is a deployment of "today's" technology because mandates for renewable energy are very tangible now, and climate change reductions really do not get serious until 2020 for tomorrow's technology. The second market developing, the so-called "next generation" technology, has more risk and is not yet commercially viable. It also may not come to market for five to 10 years from now.

While the outcome is still uncertain, the timing is right. Higher energy prices in 2007-2008 now are sustainable due to unprecedented global demand coupled with two decades of underinvestment in the global energy business. The real metric is that U.S. $40 oil makes a floor for all these new technologies to take off; $100 oil makes the investment costs even more attractive. Higher global energy demand growth will continue to drive return on investment (ROI) higher in the clean-tech space.

But what about the trading markets and the reduction of project costs? The new model that has emerged is a hybrid among venture capital, hedge funds, and private equity funds. A capital commitment from investors is required for one to four years (called a lock up) and a capability to trade the renewable energy credits (RECs) and emissions reductions [sulfur dioxide (SO_2), nitrous oxides (NO_X), and carbon dioxide (CO_2)]. Some funds also trade biofuels, and environmental credits for wetlands and site remediation. These green streams of revenue or "green finance" make the cost of capital cheaper but also bring much needed liquidity to emerging environmental financial markets. They cannot fund projects entirely unless they are a pure speculative play.

There is increasing interest by investors in how SO_2, NO_X, CO_2, and RECs are related to clean technology projects. It seems obvious to most clean-tech investors

we are entering a carbon-constrained world and that their venture capital investments in clean technology will have an environmental kicker at some juncture in the United States and from 2008 in the Kyoto world. In fact, the price for carbon may be the missing link in clean-tech investment since most of those investments are either focused on carbon reductions (i.e., energy efficiency) or are impacted by climate change (i.e., water). The question, then, becomes how this is related to carbon finance and carbon offsets and, more importantly, investment in the realm of clean energy and cleaner technology.

This hybrid business model of figuring out the best business structure to participate—not only in investment in equities and commodities but also in clean technology tied to carbon reductions—actually is becoming quite significant for new project development in the area of carbon offsets. The entire concept of "green trading" is focused on the interrelationship of emissions reductions, renewable energy credits, and energy efficiency.

Investment interest is now more focused on how to invest in new technologies and gain investment streams that encompass two or three of these environmental benefits and should benefit from multiple credit streams. Of course, there are those who believe that "double counting" of credits for renewable energy and carbon reductions is a bad thing; I think that in the beginning of a market shift these multiple environmental credit streams actually enhance project creditworthiness. They also get us beyond the myopia of subsidizing technologies and push cleaner technologies to more market-centric sustainability. Renewable energy subsidies in the United States have been politicized to such an extent that production tax credits for wind and solar power keep expiring as they are tied to election cycles. The new green business model appears better suited for the future since it seems inevitable that technology cycles are accelerating and the need to invest in better technologies, which are more energy efficient as well as cleaner will deliver better financial results.

Climate Change as the New Market Driver

The impending climate-change regime in the United States will add an extra dimension to the drive for greater energy efficiency and the reduction of the carbon emissions footprint. There is clear movement of capital into "carbon finance," but this is not very well tracked in the United States. This extra dimension of monetization of carbon credits for green project finance will increase ROI for many projects. More energy-efficiency and renewable projects will take root as technology continues to shift, and the regulatory scheme for a less carbon-intensive world takes hold.

Moreover, it seems reasonable that more rapid deployment of these clean-tech investments will be needed to scale to meet the rising environmental and energy needs both in the United States and around the world. It is no accident that there is a shortage of most renewable energy equipment today. A flattened world levels the

playing field for new technology and also creates more market opportunities. It should not be forgotten that throughout the world 2 billion people do not have access to electric power, and 3 billion people do not have potable water. The scale has been underestimated by all economic forecasts. Global demand is evident in the BRIC (Brazil, Russia, India, and China) economies with 800 million middle-class consumers who have money in their pockets and want consumer goods and products just like the developed world. Most economic projections have underestimated this need, just as no one estimated or anticipated how much electricity the Internet would use before it became increasingly deployed.

Everyone has underestimated the scale of the clean-tech revolution. The short-term focus on ethanol and solar companies, which receive most press and investment attention, is only the initial stage of this move to clean energy. It is a growing global phenomenon that will be rising in developing countries in coming years and cycle in much more innovation than can be imagined today. The market demand is there in both the developing and developed world. One is leapfrogging technology and one is replacing antiquated infrastructure. Green is the new gold, and now is the time to watch it accelerate.

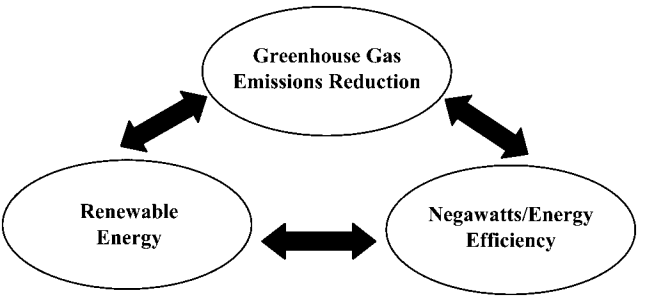
Several funds have invested and made money on the ethanol and solar price moves of the last two years within existing funds; they now are launching alternative energy-specific funds. There are carbon funds in Europe that are oversubscribed and many in the United States are growing their asset base. There are alternative energy/clean-tech funds in Europe with multi-hundred-million-dollar backing. There are clean-tech funds on both sides of the Atlantic Ocean. More recently, clean-tech funds are emerging in both India and China. There seems to be a realization that this market move is sustainable. What is really lacking is in-depth knowledge of the sector, which currently is not widely followed by Wall Street and City of London investment analysts or, for that matter, anyone.

It would take mainstream investors at least 12 to 24 months to get up to speed in the clean-tech/alternative energy sector. Some investors had allocated into several commodity-trading green hedge funds (those that trade RECs and greenhouse gases) but felt that the capacity was limited in those existing structures. This time lag of knowledge is significant as it focuses much of today's investment attention on the narrow band of biofuel and solar projects and gives short shrift to the broader dimensions of the opportunity.

The Green Revenue Stream

The ability to trade both emissions and renewable energy credits creates another revenue stream. "Green trading" is an encompassing term, which we define as the triple convergence of emissions reductions, renewable energy, and energy efficiency (figure 1). This triple convergence offers multiple risk arbitrage opportunities as well as many revenue streams. They obviously are interrelated as the use of more efficient

Figure 1
GREEN TRADING CONVERGENCE



Source: Global Change Associates, Inc.

technology reduces the emissions footprint. Similarly, using renewable energy can reduce the carbon footprint of power stations as an example. The low-hanging fruit of climate-change carbon reductions may be energy efficiency, but there are many opportunities to invest across a wide spectrum of technologies.

Green trading[4] is a term that captures the value of the convergence of the capital markets and the environment. It encompasses all forms of environmental financial trading, including carbon dioxide and other greenhouse gas (GHG) reductions, sulfur dioxide (acid rain), and nitrous oxide (ozone), renewable energy credits, and "negawatt" (value of energy efficiency). All of these emerging and established environmental financial markets have one thing in common: making the environment cleaner by either reducing emissions, or employing clean technology, or not consuming energy through the use of financial markets. Sometimes two goals can be accomplished, as in reducing emissions and slashing energy usage by moving to cleaner technology. Green trading is one mechanism to accelerate this change.

Sulfur Dioxide (SO_2) and Nitrous Oxide (NO_x) Markets in the United States

For example, in the well-established U.S. SO_2 and NO_x markets created in 1995 and 1999, respectively, we have seen a sea change since 2005 in U.S. environmental financial markets. As coal-burning increased at electric utilities, due to rising electricity demand and decreasing supply of natural gas, the U.S. emissions trading markets responded in kind. The price of emissions allowances in the United States rose to a peak of $1,630 per ton for SO_2 in December 2005 and $40,000 for NO_x in the summer of 2006. SO_2 credits in the 13-year-old markets never before had risen above $225 per ton. Prices have leveled off to the $500- to $600-range during 2007-2008.

The trading markets determine the financial value of environmental benefits. The quaint notion that we are "trading pollution" is an oversimplification of the need for markets to create financial incentives to reduce pollution and accelerate more efficient and environmentally benign technology transfer. This is not an academic exercise but an exercise of rational economic behavior.

The financial penalty for emitting more emissions hastened the emergence of new technology into the coal-burning power generation space that previously was uneconomic. In the past two years (since 2005), at least 25 newly planned coal-gasification facilities either have been announced or are on the permitting cycle for siting in the United States; in 2005 there were none. The benefits of gasification technology are that they not only reduce the previously mentioned SO_2 and NO_X emissions but also reduce those of CO_2. Another benefit is increased efficiency of coal burning from 30 percent to the 50- to 70-percent range, which means less coal will be burned to produce the same amount of electric power in the future. This additional efficiency boon often is overlooked by environmentalists, economists, and policy makers who tend to view the energy supply picture as static with ever-increasing energy demand. Basically, we shall be using less energy (British thermal units in any form) with the same energy benefit. It just will be cleaner forms of energy in the future due to market-based incentives coupled with financial penalties for noncompliance. These are not voluntary markets but *government- mandated* markets. They are proved to work and are cost effective. They are essentially the templates for the Kyoto Protocol, which ironically was proposed by the U.S. climate-change delegation at the 1992 Rio Climate Convention and opposed by the EU.

For CO_2 and GHG markets, 2005 was a watershed year. In February 2005, the Kyoto Protocol entered into force more than seven years after it was established. With Russia's ratification in November 2004, countries that represent over 60 percent of the total 1990 CO_2 emissions now have ratified the Protocol. They include the EU, Japan, New Zealand, Canada, Russia, and most of the countries known as the economies in transition (the countries that were "behind the Iron Curtain" in the decades leading up to 1990). The United States has not ratified the Protocol; nonetheless, it is pursuing programs to reduce GHG emissions on a voluntary basis and hence their prices for carbon credits are lower than in the European Union.

The Kyoto Protocol in the Global Arena

Under the Kyoto Protocol, countries can use emissions trading to lower the overall cost of reducing greenhouse gases to meet the Protocol targets. Kyoto provides three flexible mechanisms for trading among countries. (1) An international emissions trading regime, a cap-and-trade program, will allow industrialized countries to trade carbon permits in the international market. (2) Joint implementation (JI) allows trading among industrialized countries and the economies in transition. (3) The clean development mechanism (CDM) permits developing nations that are not parties to the Protocol to sell emission reductions to Annex I countries. By far, the CDM market has been the most developed with over 1,000 projects globally.

A distinct shift in the market began in 2004 as the EU countries prepared to implement their Emissions Trading Scheme (ETS), a program adopted to reduce the cost of Kyoto Protocol compliance that permits the trading of carbon dioxide. The ETS officially started on January 1, 2005, and is now trading hundreds of

millions of tons per annum. Trades on the European market have continued to increase on a year-to-year basis, reaching $60 billion in 2007. The European Commission estimated that adopting the EU-wide trading scheme would reduce the costs of attaining its emissions target by at least 20 percent if it covered the energy supply sector.

Emissions Trading Scheme in the European Union (EU)

Some 12,000 facilities in Europe fall under the purview of the EU Emissions Trading Scheme (ETS). In 2008 the Kyoto Protocol takes effect and the program globalizes for over 174 signatory countries. Carbon prices fluctuate: in the European Union ETS, the price is 22 euros (March 21, 2008); on the Chicago Climate Exchange, the price is U.S. $5.75 (March 21, 2008).

Another venue for green trading has been in renewable energy. Wind, solar, and biomass markets are accelerating commercially, due to the monetization of "renewable energy credits," as they are called in the United States. By 2008, 25 states have or are developing a renewable portfolio standard (RPS) that is jump-starting markets in Texas, California, and the northeastern states to take advantage of "green power" programs that are popular with consumers. In the United States there were over 600 green power programs in 2008 where consumers willingly pay more for green power. The renewable energy projects in these states are able to bank-finance their development and create a revenue stream of green credits that reduce the cost of capital, in effect creating "green finance." Wind power is now a mature financial market with large-scale wind farm deployment throughout the United States. Solar thermal currently is scaling to large-scale plants, particularly in the Southwest and California.

Green trading is the mechanism to create market-based incentives. Their application is global. Not only are the United States, the EU, and Japan moving forward, but so are developing economies such as China, India, and Russia, on both emissions-trading initiatives and clean technology applications. These global carbon programs are starting to link, and will accelerate market development in the post-Kyoto world of 2013 when the United States, EU, Japan, and all developing economies work under one protocol to reduce global carbon emissions.[3]

As fossil-fuel prices remain high throughout the 2000s and as demand continues to increase, clean technology will become a more attractive economic choice for deployment in global markets. The interconnection of energy and environment issues will expand. Rising demand is accelerating the need to move faster to clean technology solutions. Green trading is the financial mechanism that allows markets to meet that goal of global deployment of new, cleaner technology to satisfy rising demand for electricity, transportation, and heating and cooling applications. What used to be expensive and noncommercial is rapidly changing to economic solutions to global environmental problems.

Carbon: The Missing Link in Clean-Tech Investments

The need to scale projects and deepen capital actually rests on the need to reduce GHG emissions. Thus, discovering the carbon price is essential to scale less carbon-intensive technologies and investment. Price discovery for carbon has not been easy with so many conflicting regulatory regimes and mandates. The name of the game is to link all these carbon-trading regimes through some kind of harmonious process making. There cannot be an EU standard that does not work with the United States, no matter how hard the Europeans attempt to push it. Markets do not work that way; they work with simplicity and replication of trade. While the goal is the same—reducing the carbon footprint—the means may be very different. For example, the United States is the world's leading greenhouse gas emitter and also the repository of the most risk capital and venture funds. The United States therefore will deploy more technologies in more sectors than Europe and acquire those carbon credits. Afforestation is still contentious in the EU, but in the United States forest protocols were issued by the California Air Resources Board in late 2007, and trades commenced almost immediately. Geological sequestration, created in the United States, was not part of the Kyoto Protocol. Additionally, buildings are a large piece of the GHG puzzle, and the building retrofit market will be incentivized to deploy more energy-efficient technology. The point is that the United States, which has a 6-billion-ton carbon footprint, will deploy technologies economy-wide and in more carbon reduction strategies to accomplish the goal. The EU is going to have to create an attitudinal change that links to the U.S. carbon-trading regime, rather than pursing a perfection that does not create the proper market linkages. All have the same goals, but the problem is getting worse with a rise of 3.1 percent in GHG emissions since 2000. Flexibility is going to be required to make significant reductions in global greenhouse emissions. Clean tech is one venue, but proper market incentives are also key.

From Where Is the Money Going to Come?

This investment sector is getting started. There is pent up demand for renewable and clean technology. There is global demand due to the rising Asian economies. The green investment sector appears ready to really blossom. Wall Street and City of London analysts are gearing up to speed and starting to follow those companies that can scale. A new asset class has emerged, and it is called "green."

The implications of this new wall of money are hard to predict at the present time. The hype of markets for ethanol and solar power overshadow many other investment opportunities. Still, we are starting to see private equity funds, dedicated to infrastructure investment beyond clean technology, raise capital on the multi-billion scale.

The financial argument that the United States cannot afford this transition to a cleaner and more efficient energy economy is not true. The fact is that U.S. energy

infrastructure of transportation, buildings, and economic development was predicated on cheap and abundant energy resources. Those days are over. But the capital to deploy in this new market is readily available as private wealth has deep pools of capital, as can be seen in figure 2. So, the argument of capital shortage is bogus.

The rapidly evolving renewable energy and clean technology industries offer attractive investment opportunities. While some funds focus on early-stage investment, many funds are focused on mid-/later-stage development and desire to provide developmental capital to fund expansion and scale of operations. There are opportunities across the energy and environmental value chain.

Renewable opportunities include wind, biomass, geothermal, solar, landfill gas, waste-to-energy, hydro, ocean/wave, biodiesel, and ethanol. Some funds are offering the traditional private equity project finance component and are extremely well capitalized. For example, Carlyle's Riverstone fund and ARC Light fund are close to U.S. $6 billion. Others are just ramping up and are in the process of raising U.S. $100 million to $400 million in their first financing. Still others have become stand-alone investment vehicles as part of larger hedge funds where ethanol and solar projects over the 2005-2007 span have paid off handsomely. These fund managers now wish to take the deeper dive by building a wider renewable energy portfolio.

Some funds are seeking to secure a portfolio of projects with different locations so that they can get into the game faster. Others are either looking for co-investment opportunities or partnerships with developers. Law firms have become extremely entrepreneurial and take equity stakes in projects in lieu of fees similar to what the Boston Consulting Group and Bain and McKinsey have done.

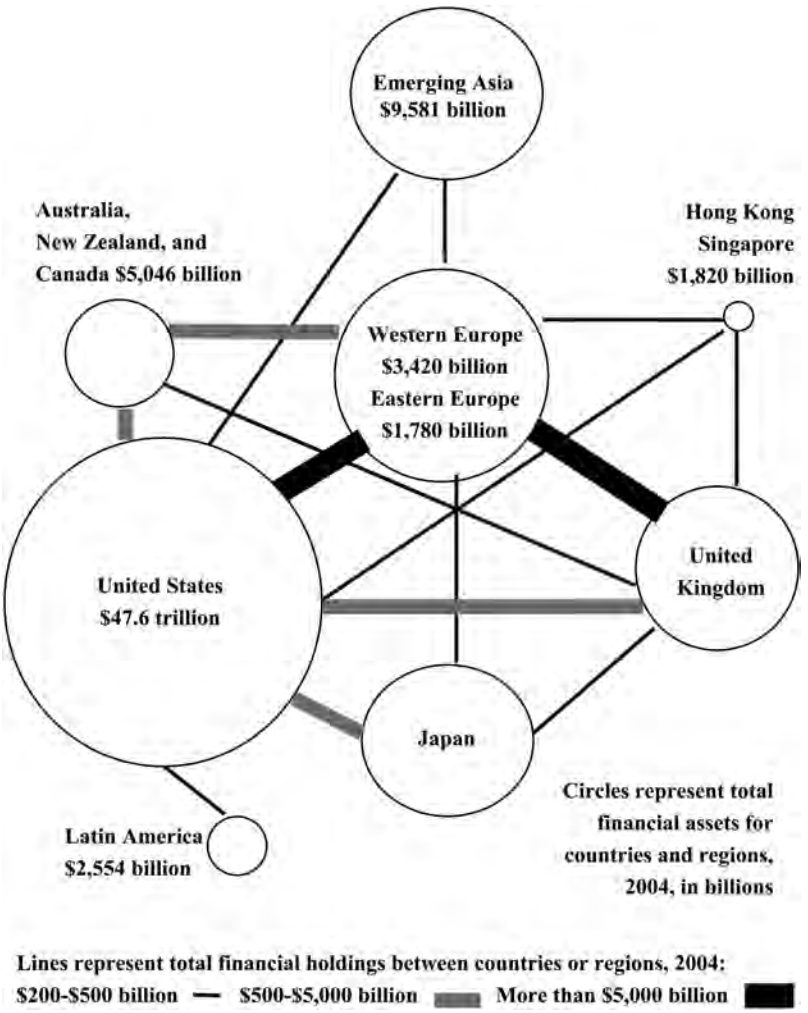
The sector is changing rapidly since the need has become global. It is not unusual to see the emergence of India's Suzlon and China's Suntech with rapid growth in 2006, including global projects. But what is underestimated is the second wave of new technology companies that also will come from those and other developing countries.

Finding the Good Green Projects Globally

The "Holy Grail" of clean energy investment is finding the outstanding technology projects that can be scaled into a robust enterprise. According to Clean Edge, Inc.'s "Clean Energy Trends 2006," market opportunities for wind, biofuels, photovoltaics, and fuel cells are expected to increase fourfold in the next 10 years, growing from U.S. $40 billion in global revenues in 2005 to U.S. $167 billion by 2012.

As in all boom times, there will be a short-term bust; this already occurred in the ethanol sector in 2007 and is now hitting the solar energy sector in 2008. But the need for global investment is so great and the technology is shifting so fast that the momentum will carry clean energy as well as clean water initiatives for the

Figure 2
GREEN TRADING CONVERGENCE



Source: Adapted from McKinsey & Co.

next two decades. Climate-change risk increasingly will be mitigated by the movement and rapid deployment of clean energy projects on a global scale, which has never before been anticipated or appreciated. Climate change will drive investment faster as carbon trading is a facilitator for deployment of more capital in the sector. The skills shortage of the oil and gas industry will spill over into the clean-tech sector. Building out infrastructure will take time. This presents many opportunities for smaller-scale technologies in distributed generation and

distributed water solutions to take root. Both small and big projects will be built out, licensed, and distributed on a global scale following a new manufacturing model of global outsourcing and distribution. It is possible this model may be crimped by supply chain management, too.

End of the Beginning

Higher energy prices, national security concerns over oil, global warming, implementation of the Kyoto Protocol, modernization of Asian economies (particularly China and India), and a growing movement of multinational corporations to go green and adopt clean technologies have pushed the energy and environmental dynamic faster than anyone imagined early in the 2000s. The needs to improve operational efficiency, reduce costs, and eliminate waste and pollution have coalesced to form a new market that is not hindered by misconceptions it is a bubble or dotcom boomlet. The energy value chain now is overlaid with an environmental value chain. The clean energy market is large, expanding, and global, with higher rates of market acceptance than anyone anticipated. In the United States alone, there are now over 600 green power programs where consumer preference is for green energy. This trend is growing.

The competitive landscape has shifted. Government initiatives are helpful but the global capital markets are driving this boom. There will high profile market failures during this transition to cleaner technology and cleaner use of energy. The era of coal and oil is plateauing, and not in the production sense. These dirtier carbon-intensive fuels are being replaced by renewables, cleaner technology, and higher efficiencies. By 2020 oil and coal will plateau in global usage. For example, as clean coal technology takes root with the gasification of coal, there is not only an emissions reduction but also a higher efficiency gain from 30 percent for conventional coal-fired plants to a higher range of 50 to 70 percent. The same is true of hybridization of the transportation fleet, featuring greater fuel economy and lower tailpipe emissions. If we apply this business model to how clean tech permeates the entire energy value chain, it stands to reason that all applications—to be financially viable—will have to reduce energy consumption and be cleaner. This dual benefit is lost by many observers in the mainstream media. Using renewables to replace fossil fuels brings with it a third layer of benefit by offsetting carbon.

The new green business model is blurring the lines among hedge funds, private equity and venture capital. The arbitrage opportunities combined with the building out of new projects will lead to more incentives to invest in clean energy and clean technology. However, this is a transition that defies a quick fix. It will take decades to remediate the environmental damage done and shift to the more environmentally benign technologies of tomorrow. But the good news is that global investors are now focused on this sector!

The Green Hedge Funds Have Arrived

Green hedge funds offer both investment opportunity and non-correlation to other investment sectors as well as asset diversification. Green hedge funds are active in equity trading for alternative energy and clean tech, commodity trading for carbon, and equity and commodity trading for water and forest products. Today, Global Change Associates is tracking 101 green hedge funds. This emerging investment sector is the next generation of investment in green. They meet the metrics of "socially responsible investing" as well since they have the "triple bottom-line benefits." The triple bottom line takes into account environmental and social performance as well as financial performance.

The universe of green hedge funds includes long/short alternative energy or clean-tech equities; that universe of investment now includes over 650 market caps globally. These are public companies on listed stock exchanges. This is the primary investment strategy of most of the green hedge funds, and many of these funds have some of the same stocks in their portfolios, so diversification is limited if everyone is investing in the same funds. In this universe, we now have five water funds with many more to come as that market becomes commoditized.

The second leading hedge fund strategy is carbon trading and finance. New Carbon Finance estimated the number of carbon funds at 67 during the fall of 2007 with assets under management of $12.5 billion. That number is continuing to grow as the Kyoto Protocol began on January 1, 2008, as well as Phase 2 of the EU's ETS. Many of these carbon funds are investing in Kyoto clean development mechanism (CDM) and joint implementation (JI) projects. The idea here is to lock up and monetize the carbon credit-generation asset stream. Many of the Kyoto projects are oriented toward energy efficiency and renewable energy. Because the market is so new, most carbon funds do not have a hedge fund strategy, although some do. That lock-up period is shorter, usually one year, but many carbon funds really resemble private equity investment with up to six year lock ups. The carbon hedge funds are also active traders of other environmental financial products such as SO_2 (acid rain) and NO_X (ozone) credits in the United States as well as trading the U.S. voluntary carbon markets. In fact, the United States has over 35 environmental financial markets; there also is trading in wetlands, nutrient credits, and site remediation (so-called brownfield sites). The next generation of the green hedge funds is to morph into environmental finance banks that stockpile multiple streams of environmental credits. A new emerging market is the MERC, which is the trading of Mobile Emissions reduction Credits for tailpipe emissions. Once again the United States is the leader is regulating tailpipe emissions, and will be pushing forward aggressively with GHG mitigation impacting this market exponentially.

The other active market for hedge funds is for biofuels trading. This is principally for ethanol but biodiesel is emerging. The preferred feedstock for biodiesel seems to be the weed "jatropha" that can be farmed on non-arable land. Jatropha

plantations currently are trying to scale in Africa, Asia, and Latin America. The funds in this sector are more like project financiers, but there is active credit trading both in the United States and internationally.

Because of the financial immaturity of the green financial markets, the lock-up periods are usually longer than traditional hedge fund investments. Some of which have no lock up or monthly or 45-day liquidity (investors have access to their cash). The tenor of the green hedge funds is different as funds have lock ups of at least one year and some up to six years. The quid pro quo is a reduction of hedge fund fees for longer lock-up periods. he key metric emerging as we enter year four of the green hedge funds is that returns are starting to become financially sustainable. Thus, a new asset class for hedge fund diversification is being created.

Impending U.S. Climate Change Legislation as Market Driver

The climate-change train finally has arrived at the station. In the next two years (2009-2010), the United States finally will pass federal climate legislation. This regulatory certainty will provide the financial certainty needed to deploy hundreds of billions of dollars in both U.S. infrastructure and globally. Although we presently have mandatory GHG reduction regimes in the Northeast and West Coast, only the U.S. Senate can ratify international climate-change treaties. This point of constitutional law is critical to address global climate-change remediation. That development is going to unleash the capital needed to scale new technologies to both profitability and for global deployment. And these technologies are not just home grown in the United States but will come from China, India, Israel, and South Africa as well as Europe. Investors are seeking green investment along with sustainable returns.

NOTES

[1]Much of this monograph was presented in the author's chapter in *Cut Carbon, Grow Profits* (London: Middlesex University Press, 2007). Other references for those interested in the topic include: Peter C. Fusaro, *Energy and Environmental Hedge Funds: The New Investment Paradigm* (Hoboken, New Jersey: Wiley, 2006), *The Professional Risk Managers Guide to Energy & Environmental Markets* (Professional Risk Management International Association, 2006), "Cleantech Is More Than a Buzzword"and "The New Business Model for the Green Space,"Utilipoint Issue Alert, April 26, 2006 and July 11, 2005 (www.utilipoint.com), "Turbulent Markets Ahead: Why the Energy and Environmental Crisis Will Continue for Many Years," September 20, 2005 (www.utilipoint.com), and "Green Hedge Funds Offer Opportunity and Non Correlation," Energy Hedge 65, March 1, 2008; Peter C. Fusaro and Tom James, *Energy and Emissions: Collision or Convergence* (Hoboken, New Jersey: Wiley, 2006); Peter C. Fusaro and Marion Yuen, *Green Trading Markets: Developing the Second Wave* (Burlington, Massachusetts: Elsevier, 2005); and other useful websites for environmental finance information such as www.pointcarbon.com, www.evomarkets.com,.www.cleantech.com, www.cleanedge.com, and www.environmental-finance.com.

[2]Available at www.cleantech.com.

[3]Available at www.pointcarbon.com.

[4]This terms was coined by the author in 2001.

[5]The U.S. delegation at the Bali climate meetings in December 2007 agreed to this policy framework.