Infrastructure Investments in Renewable Energy

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Table of Contents:

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Introduction

Infrastructure funds are increasingly targeting renewable energy investments. Such renewable assets cover a wide range of low carbon emitting sources of energy including wind, solar, biomass and hydropower. The investment rationale is compelling given the macroeconomic environment surrounding the energy market in general. This includes projections of a continued rise in demand for energy, increases in fossil fuel prices, heightened security concerns regarding existing sources of energy, and environmental concerns regarding the use of such fossil fuels. Renewable energy infrastructure assets also share many of the same characteristics of other regulated economic infrastructure investments, namely quasi-monopoly assets with steady income streams and high barriers to entry. A variety of funds are available to investors who want to access the renewable energy infrastructure market. Such funds are either private or public and may be in the form of debt, equity or project finance. A vast majority of the investments in renewables are part of a broader infrastructure portfolio and as such are actively managed.

In this paper, we review the renewable energy infrastructure market. The first section highlights the evidence surrounding climate change and the carbon footprint of fossil fuels. This is followed by an analysis of the current and projected demand for energy and the various sources of supply. The macroeconomic trends section focuses on the variables that should drive the growth and demand for renewable sources of energy in the future. The report also provides the latest data on the size of the existing renewables market disaggregated by sector and region. This is followed by an updated deal flow analysis where both closed and pipeline project finance deals are analyzed. Data on privately-held renewable energy infrastructure returns is not publicly available, therefore, in the following comparative return performance section, we use data on listed renewables to examine the performance characteristics of such energy investments. The historical returns and volatility of listed renewables are then compared to traditional asset classes such as bonds and equities. Correlation coefficients are also provided to assess the role of renewable energy investments in a broader multi-asset portfolio. We complete this section with a detailed look at the top three renewable energy sectors—wind, solar, and biomass—providing an analysis of their relative performance since 2006. Conclusions and implications for investors end the report.

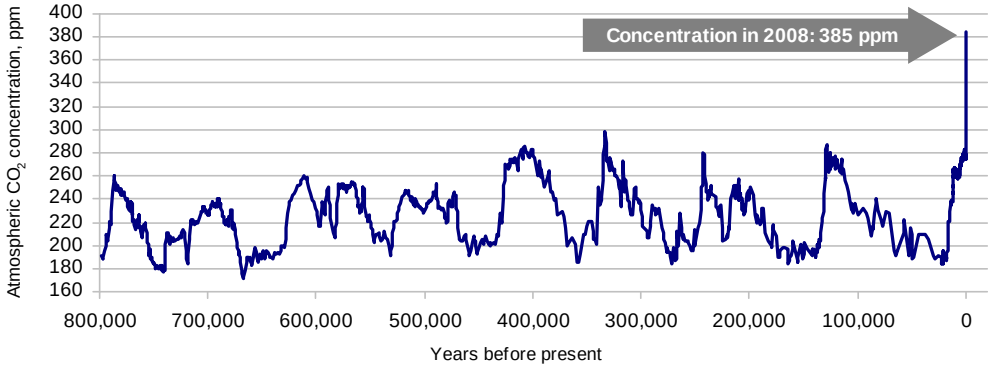
Why Renewables?

Human activity around the world, primarily from fossil fuel use and agricultural output, are contributing to increasing atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases. Research published in Nature in May of 2008 shows that atmospheric concentrations of CO_2 have reached an 800,000 year high (see Exhibit 1).[1] The current atmospheric concentration of CO_2 is approximately 385 parts per million (ppm), which represents an increase of nearly 40% over pre-industrial levels of 280ppm.

[1] D. Lüthi, "High-resolution carbon dioxide concentration record 650,000-800,000 years before present", Nature, May 15, 2008

Exhibit 1

CO_2 Concentration for the Last 800,000 Years



Source: DB Advisors, "Investing in Climate Change 2009 – Necessity and Opportunity in Turbulent Times", Deutsche Bank Group, October 2008

The rate of future rises in greenhouse gas concentrations will depend on economic, technological and social factors. If no changes are made, concentrations of CO_2 could increase to as much as 630ppm by 2050 and 1,200ppm by the end of the century[2].

According to many scientific studies, net concentrations of greenhouse gases should not permanently exceed 450ppm CO_2 equivalent because beyond that point it becomes increasingly likely that a series of macro-climatic shifts will set up a self-sustaining cycle of rapid global warming. Without significant and immediate action, increasing atmospheric concentrations of CO_2 could lead to extensive and costly damage to regional climates throughout the world. Projections of future climate change suggest a global temperature increase of between 1 to 6 degrees Celsius by 2100.[3] The magnitude of the potential warming varies according to different forecasts. The Stern Review on The Economics of Climate Change, a report released in October 2006 by economist Lord Stern of Brentford for the British government concludes that ecosystems, water supply, sea-levels, agriculture and health are all likely to suffer from continued climate change under business-as-usual conditions.

There is now almost total consensus among the scientific community that the warming of the climate observed over the past 50 years is primarily due to human-induced emissions of heat-trapping gases. Governments worldwide have determined that it is critical to act now to mitigate further climate change and find alternatives to coal, oil, gas and other fossil fuels that have been used since antiquity to meet growing energy demand. As a result, government regulations which include carbon pricing, traditional regulation and innovation policy have become major drivers of investment opportunities for renewable energy. The International Energy Agency (IEA) estimates in their BLUE scenario, which calls for a 50% reduction in CO_2 emissions from 2005 levels by 2050,[4] that about $45 trillion of incremental expenditure will be needed to develop and deploy new clean technologies between now and 2050. To many, this significant need represents nothing less than the potential to unleash a low-carbon Industrial Revolution.[5]

At the same time, governments are also interested in energy security, looking for clean and diverse sources of energy. Renewables provide a local source of energy which is clean, and diversifies the overall fuel mix. Growing concerns about the security of energy supplies,

[2] DB Climate Change Advisors, CO_2 measures is defined as the concentration of CO_2 that would cause the same amount of radiative forcing as the observed mixture of CO_2 and other forcing components in the atmosphere at any point in time - comparing them in terms of their instantaneous radiative effect.

[3] DB Advisors, "Investing in Climate Change 2009 – Necessity and Opportunity in Turbulent Times", Deutsche Bank Group, October 2008

[4] The BLUE scenario is consistent with long-term stabilization of atmospheric greenhouse gas concentrations at a level below that where there would be a more than 50% change of temperature increases above 2 degrees C, which is identified as a dangerous tipping point.

[5] OECD/IEA, World Energy Outlook 2008

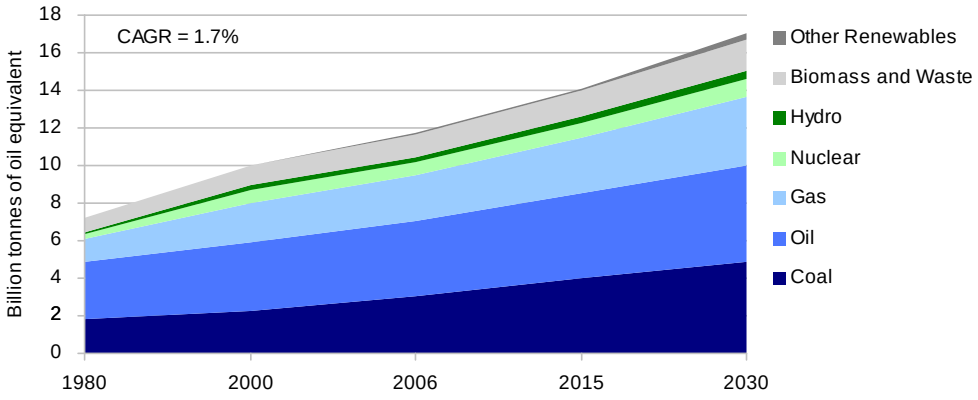
particularly in Europe, will lead to more focus on renewable investment. Over 70% of the world's oil reserves are held in regions with significant geopolitical risk, driving many countries to reduce their exposure to energy supply interruptions through the development of domestic renewable sources.[6] Accordingly, we expect to see a secular growth trend in renewable energy investment opportunities.

Energy Market Conditions

Business as Usual Projections

There is now overwhelming evidence that our climate is changing due to increasing atmospheric concentrations of greenhouse gases. The combustion of fossil fuels accounts for nearly 60% of anthropogenic greenhouse gas emissions and 88% of the world's primary energy.[7] According to IEA's reference scenarios and the US Department of Energy (DoE), world energy demand is expected to increase significantly over the next 20 years, increasing by 45% between 2006 and 2030, with an average annual rate of growth of 1.7% which is slower than the average growth of 1.9% per year from 1980 to 2006 (see Exhibit 2). Much of the demand in energy will likely be supplied by fossil fuels, unless clean energy sources can scale up production rapidly.

Exhibit 2
World Energy Demand



Source: OECD/IEA, World Energy Outlook 2008

- **Coal**: The demand for coal will increase by 2% per year on average, its share in global energy mix climbing from 26% in 2006 to 29% in 2030. Most of the increase in demand for coal can be attributed to the power-generation sector. China and India together contribute nearly 85% to the increase in world coal demand from 1980 to 2030.[8]
- **Oil**: Oil remains the dominant fuel in the primary energy mix, but its share drops to 30% in 2030, from 34% in 2006. Oil demand grows far more slowly than demand for other fossil fuels, mainly because of high final prices.
- **Gas**: Gas demand is expected to increases at 1.8% per year over the projected period and its share in world primary energy will grow to 22% by 2030. New power plants, using high-efficiency gas turbine technology, meet the bulk of incremental gas demand.
- **Nuclear**: Conversely, the share of nuclear power is expected to decrease over the period, from 6% today to 5% in 2030, assuming national policies towards nuclear power remain unchanged. Nuclear output nonetheless is anticipated to increases in absolute terms in most developing countries, with the largest growth taking place in developing Asia.

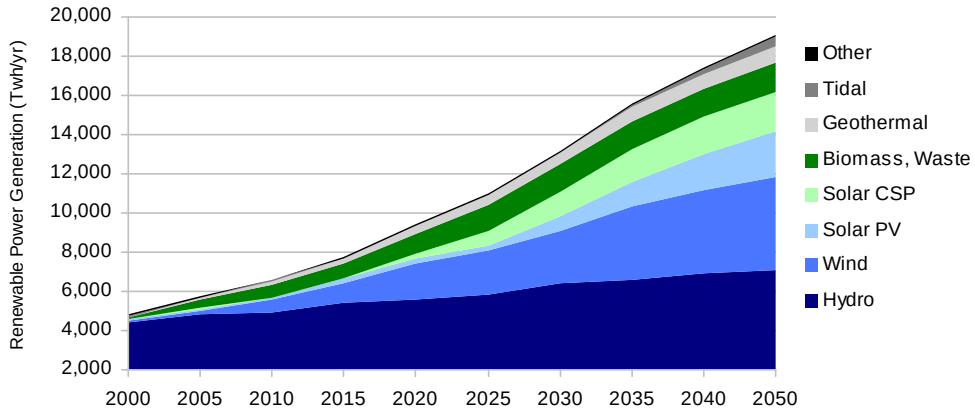
[6] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)
[7] DB Advisors, "Investing in Climate Change 2009 – Necessity and Opportunity in Turbulent Times", Deutsche Bank Group, October 2008
[8] OECD/IEA, World Energy Outlook 2008

- **Hydropower**: Hydropower is an important source of electricity production and its share of primary demand is expected to remain constant at 2%. Hydropower's share in global electricity generation, however, drops two percentage points to 14% in 2030.
- **Biomass**: The use of biomass and waste for energy is expected to increase by 1.4% per year. In OECD, the use of biomass for power generation is expected to grow at 5.4% annually.
- **Other Renewables**: Other renewables, a category which includes wind, solar, geothermal, tidal and wave energy, is expected to grow faster than any other energy source, at an average rate of 7.2% per year over the projection period. However, the share of other renewables in total power generation only grows from 1% in 2006 to 4% in 2030.[9]

Energy demand in non-OECD countries exceeded that in OECD countries in 2005 for the first time. Non-OECD countries are expected to account for nearly 87% of the increase in global demand between 2006 and 2030, driven mainly by brisk growth in China and India. As a result, the non-OECD share of world primary energy demand is projected to rise from 51% in 2006 to 62% by 2030. OECD countries will account for approximately 46% of the global increase in the use of renewables. Oil demand is expected to fall slightly for the region, while gas and non-hydro renewables are expected to make up most of the increase in energy demand. Currently, the 61% contribution of biomass and other non-hydro renewables to incremental energy demand in OECD countries is in the form of modern technologies, mostly wind.[10]

In the absence of major regulatory changes, the IEA forecasts a 130% increase in CO_2 emissions, compared to 2005 levels. This is partly because coal is considered to be plentiful in the long-run and low coal prices can have serious implications for greenhouse gas mitigation. In order to reduce greenhouse gas emissions 50% below 2005 levels by 2050, the IEA estimates that an incremental $45 trillion will need to be invested in renewable energy.[11] This will, in turn, lead to a meaningful scale-up of renewable power generation. Renewable energy sources have the potential to comprise 46% of total electricity supply by 2050 from 18% in 2006 (see Exhibit 3) according to the IEA's BLUE scenario.

Exhibit 3
Scenario Which Targets a 50% Reduction in Global CO_2 Emissions from 2005 Level by 2030



Source: OECD/IEA, 2008, Technology Perspectives

The need to control greenhouse gas emissions, improve energy security, and reduce energy price increases has led governments around the world to adopt regulatory mechanisms to

[9] OECD/IEA, World Energy Outlook 2008
[10] OECD/IEA, World Energy Outlook 2008
[11] Economic Stimulus: The Case for Green Infrastructure, Energy Security and Green Jobs, DB Advisors, November 2008

support the development of renewable-energy sources. Currently, governments use three main sets of regulatory tools to address climate change and the need for alternative sources of energy: 1) carbon pricing 2) traditional regulation (mandates and standards) and 3) innovation policy (incentives and subsidies).[12] Among the three broad categories, we believe that carbon pricing, used to internalize the external variable of climate change, is the most effective long-term policy. While traditional regulation corrects market failures and innovation policy can incentivize the development of new technologies, neither of those regulatory tools effectively prices the long-term externality associated with greenhouse gas emissions.[13]

Macroeconomic Trends

As scientific evidence becomes more conclusive, policy makers globally are increasingly focused on the hazards of climate change and the need to develop non-exhaustible, sustainable, sources of energy. Alternative sources of energy which are typically carbon free have gained prominence as a solution. As mentioned in the introduction, such alternatives are renewable sources of energy generated from natural resources, including hydro, solar (photovoltaic and thermal), wind, geothermal, tidal, biofuels, and waste-to-energy processes. This is in contrast to conventional sources of energy such as oil, gas, coal, and in some cases, nuclear. The majority of conventional sources of energy is "exhaustible" and will lead to greenhouse gases such as CO_2 and methane as depicted in Exhibit 2.

Analysts view today's renewable energy industry as almost a guaranteed-growth sector, supported by three underlying global mega-trends. These dynamic drivers include:

1. More stringent climate change agendas
2. Dwindling fossil fuel stocks
3. Heightened concerns over the security of energy supplies

Exhibit 4
Global Investment in Renewable Energy, 2004-2008*

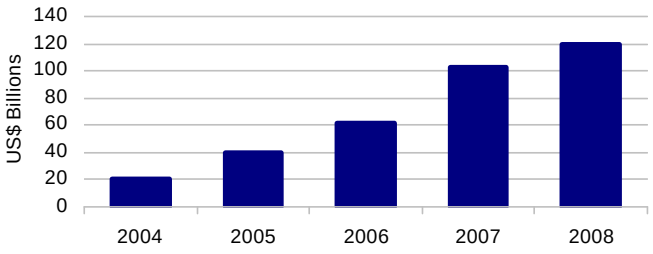


*Figure includes project finance and non-project finance deals

Source: REN 212009. Renewables Global Status Report: 2009 Update (Paris: REN 21Secretariat)

These drivers remain valid today and have been responsible for the growth of the renewables market to $120 billion in 2008, despite the unfolding of a major financial crisis (see Exhibit 4). High oil and natural gas prices in 2007 and 2008 were a secondary factor, driving up investments in renewables during this period. Security concerns about energy supplies continue to intensify. Over 70% of the world's oil reserves are held in regions with significant geopolitical risk. This should drive oil-importing countries to lower their dependence on oil by diversifying into domestic sources of renewable energy.

Major shifts in the global economy and financial landscape have impacted the renewables sector more recently, however. The decline in oil prices in the second half of 2008 and early 2009 has curtailed investment activity in the sector. Renewables have not been immune to the impact of the financial crisis either, as a variety of financing sources have dried up.

[12] DB Advisors, "Investing in Climate Change 2009 – Necessity and Opportunity in Turbulent Times", Deutsche Bank Group, October 2008
[13] DB Advisors, "Investing in Climate Change 2009 – Necessity and Opportunity in Turbulent Times", Deutsche Bank Group, October 2008

Economic Characteristics of Renewable Energy Assets

The economic characteristics of renewable energy differentiate them significantly from fossil fuel energy assets. Much of the difference stems from the operational cost structure of each source of energy. Renewable energy assets are characterized by three key stylized economic facts.

- **Large fixed costs and low/no variable costs**. These investments are characterized by very high upfront capital costs, similar to many types of infrastructure assets. Renewables are characterized by a downward-sloping average cost curve which implies that average costs are highly dependent on output level. With a declining cost structure, marginal costs will be lower than average costs. This is a key characteristic of "natural monopolies" where economies of scale dominate the cost structure. Such large initial fixed costs also act as a barrier to entry. In addition, in the case of wind and solar energy infrastructure, the barriers to entry are more a result of planning/permitting restrictions. Individual wind/solar projects can be relatively small as compared to conventional infrastructure assets.
- **Substantial upfront capital expenditures**. The costs of renewables are almost entirely capital costs which are front-loaded. The initial high capex is required prior to any generation of energy.
- **Low variable costs**. Renewable energy assets have no fuel costs. The only ongoing costs are maintenance and operations. This is in contrast to fossil fuel power stations which have significant fuel costs. These fuel costs are considered variable and rise significantly with output levels across traditional fossil fuel power stations.

The cost structure of renewables has significant implications for financing decisions. When a renewable power station is constructed, the front-loaded fixed costs means that the electricity is effectively pre-paid for the life of the asset. In this case, long-term debt financing is appropriate and optimal.

Economic Drivers of Renewables

There are four key factors that determine the attractiveness of investments in renewable energy infrastructure,[14] including:

1. The cost of oil and other fossil fuels
2. The cost of capital
3. The cost of carbon emissions (to the extent that carbon costs are internalized through a system of cap and trade or a carbon tax)
4. Government incentives/subsidies provided to producers of renewable energy

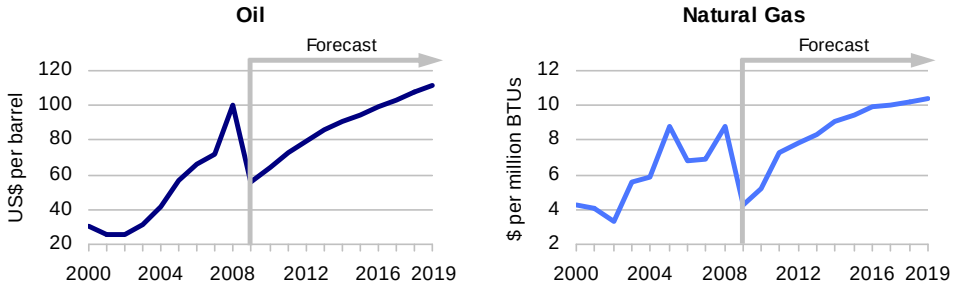
In the next four sections, we look at the current market conditions surrounding each economic factor. We then follow this with projections of the likely trends for each driver in Exhibit 6.

1. Oil and Fossil Fuel Prices

Renewables are an alternative or "substitute" source of energy to fossil fuels. The higher the price of fossil fuels, the more economically viable are renewable sources of energy. The price outlook for key fossil fuels such as oil and natural gas is critical to the long-term outlook for renewables. Exhibit 5 tracks the historic and projected movement in both oil and natural gas prices.

[14] This section is largely adapted from Geoffrey Heal, "The Economics of Renewable Energy," NBER, Working Paper 15081, June 2009

Exhibit 5
The Trajectory of Oil and Natural Gas Prices, 2000-2019



Source: Global Insight

Crude oil and natural gas prices are highly volatile. This volatility characterizes both markets since in each case supply and demand are highly inelastic with respect to price while demand is highly income-elastic. This implies that changes in income lead to changes in demand, where the new equilibrium requires a large movement in price.

High oil and natural gas prices were factors driving the robust pace of investment in renewables in 2007 and 2008. The fall in oil and natural gas prices in late 2008 and early 2009 was also widely viewed as a factor driving down investments in renewables more recently.

The projections for oil and natural gas prices are critical to the outlook for renewables. In the near term, the collapse in the global economy has led to weak demand for energy. Weak demand combined with relatively high inventories should weigh on oil and natural gas prices through 2010. As economic recovery gains traction by late 2010 and firms up even more by 2011, especially among energy-importers, we expect a significant rebound in oil and natural gas prices. Following a period of intense concern around supply, the potential strength of the demand recovery should support much higher fuel prices in 2011 and beyond. We also expect a structural increase in demand for energy, primarily from Asian emerging markets. This implies that oil and gas prices are likely to remain at relatively high levels. This is also supported by our demand and supply analysis of the broader energy markets in the preceding section.

2. Capital Costs

Given the large fixed-cost nature of renewable infrastructure assets, the cost of capital is critical to the economic feasibility of these projects. Effectively, the cost of renewables is almost entirely capital costs. The capital cost per megawatt of renewables capacity is often higher than that of power generated by fossil fuels. The higher cost of capital in the current environment has made renewables less economically viable. As a result of the current financial crisis, it has become very difficult to finance large-scale, capital-intensive renewable energy infrastructure projects. Many of the banks specializing in the underwriting of such projects have been hit hard by this crisis. In the current environment, it is hard to finance any project. Arguably, smaller ones are more difficult to obtain financing than larger ones. Our expectation, however, is that as the financial crisis ends, as banks repair their impaired balance sheets and as banks become profitable, financing will become more readily available for such large-scale infrastructure assets.

3. Carbon Pricing

At the center of climate policy is carbon pricing. Pricing greenhouse gas emissions internalizes the externality that is the cause of global warming. This pricing can be accomplished either through a carbon tax or cap-and-trade.

A number of geographies have announced carbon taxes. A carbon tax establishes a price for carbon, aiming to encourage a set amount of mitigation, or reduction in emissions when compared to business-as-usual levels. While "guessing" the price of carbon to get to mitigation may be suboptimal, proponents of a carbon tax argue that its greater price stability reduces carbon price risk and encourages greater investment in alternative energy.

Cap-and-trade sets a limit on emissions which is achieved when a central authority creates a limited number of tradable emissions credits, which emitters must hold in sufficient quantity to cover their emissions. Proponents of cap-and-trade, which is the system used in the EU-ETS, proposed under the American Clean Energy and Security Act of 2009 (Waxman-Markey), and proposed in Australia and New Zealand, argue it allows mitigation to be achieved in the most efficient way possible. This is because cap-and-trade sets a policy-driven cap, motivated by scientific evidence, and market mechanisms that allow those with the lowest cost of mitigation to reduce emissions, and to sell excess certificates to emitters with higher marginal costs of mitigation. The argument against cap-and-trade is that the variability of carbon prices inherent in such a system reduces investor certainty.

4. Government Policy: Innovation, Incentives & Enabling policies

Climate change is the result of a market failure because those who degrade the environment by emitting greenhouse gases generally do not bear the cost for the negative externalities related to their actions. There is no inherent price signal in markets about those costs.

Government policy is therefore essential to tackle the recognition of externalities in markets in order to combat climate change. However, this carries a short-term cost, to avoid risks of much greater costs in the long term. Some constituencies in society may question whether they wish to bear this cost. This is the key challenge to government policy in the long term baring a change in the scientific consensus.

Many of the clean technologies required to combat climate change are not yet cost competitive with conventional technologies. Economic theory suggests that subsidizing new technologies directly, particularly during their early stages, helps reduce their costs and brings them down their learning curve. Relying on carbon pricing alone to encourage their development might well necessitate an extraordinarily high price in the short-term for emitting greenhouse gases.

To avoid undesirable consequences, a number of targeted policy measures have been developed to spur innovation. These include a wide range of tools across geographies:

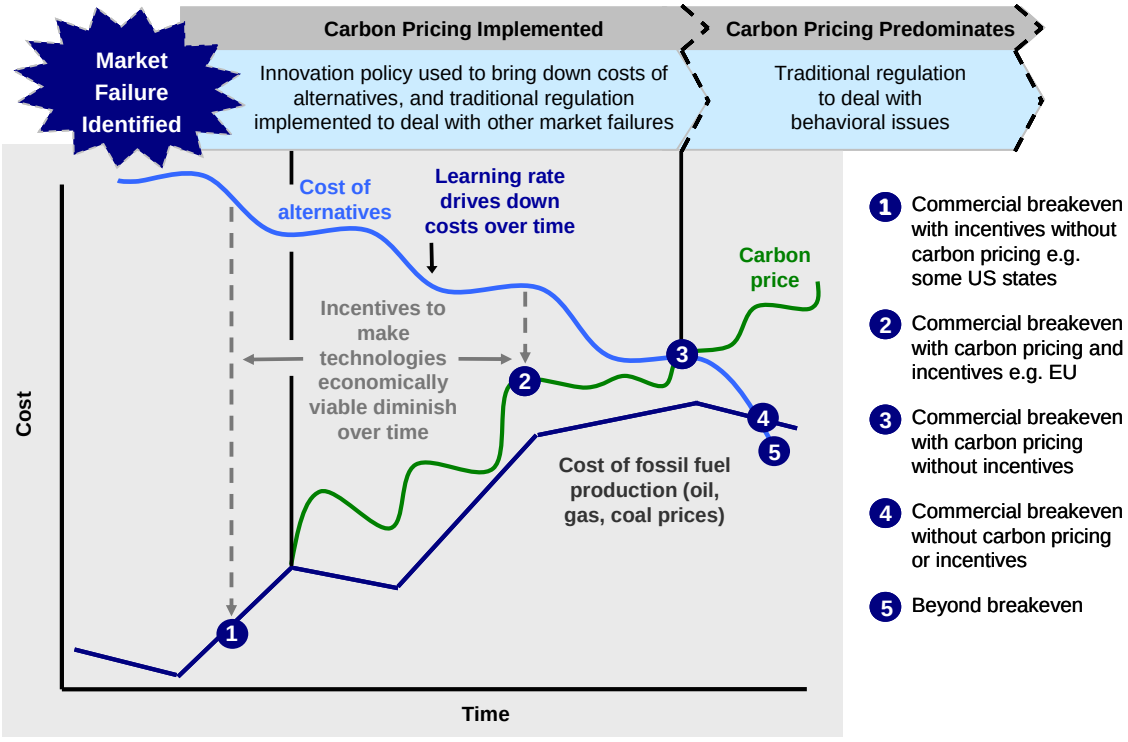
- Feed-in tariffs set a premium price for the production of renewable electricity. Generators are paid a premium rate for each kWh of power fed onto the grid. There are two general ways in which feed-in tariffs can be structured: Either by setting a fixed price for power generated by eligible sources and fed onto the grid, or by setting a fixed premium rate, which is paid on top of the market price, for power generated by eligible sources and fed onto the grid. At a particular starting year, payments are locked in, often for 20 years, improving the chances that renewable power generators can secure financing. Generally, the payments are reduced in successive starting years to encourage innovation that brings the cost of technologies down. Spain and Germany have both used feed-in tariffs to encourage wide-scale deployment of solar power. While Germany follows the fixed-price system, Spain allows generators to choose between the fixed-price or the premium model.
- Renewable tax incentives have been used to improve project economics for a number of renewable technologies. In the US, a multitude of these exist at federal, state and local levels. Around $21.6 billion of tax incentives for renewable energy were approved in the country's recent economic stimulus package. Solar, wind and geothermal will be the key beneficiaries of the extended tax credits, which include a three-year extension of the Production Tax Credit, which provides a $0.021/kWh benefit for the first ten years of a renewable energy facility's operation. Various other tax incentives have been developed, including the repeal of subsidized energy financing limitations on the Investment Tax

Credit (making it a 30% cash grant on capital invested in renewable energy projects); and temporary election to claim the Investment Tax Credit in lieu of the Production Tax Credit. Additionally, the Obama administration's brand new federal program, which is paying substantial cash grants to help cover the cost of renewable energy investments, has recently led many banks to become actively involved in financing new wind farms. Wall Street bankers have been receptive to government policies and many believe that this may be the beginning of an active pipeline of new wind farm financing, as well as investment in large solar installations and geothermal facilities.[15]

- Renewable standards and tradable certificates set a required proportion of energy that must be generated from eligible resources, and require utilities to produce a sufficient number of certificates at the end of each legal period to prove compliance. In the UK, the Renewables Obligation places an obligation on licensed electricity suppliers to source an increasing proportion of electricity from renewable sources. Suppliers meet their obligation by presenting Renewable Obligation Certificates (ROCs). Where suppliers fail to supply enough ROCs to cover their obligation, a payment is made into a buy-out fund. The buy-out price is a fixed price per MWh shortfall adjusted annually. In the US, Renewable Portfolio Standards at the state level are mostly used, but only a few states strictly enforce compliance through a penalty.

Government loan guarantees are also proving important in the current economic environment, where debt markets are constrained. In the US, the DoE programs such as Section 1705 of American Recovery and Reinvestment Act are close to implementation. Looking at how these policies might then interact with a clean technology on its path to commercial breakeven, we can illustrate this graphically. See exhibit 6.

Exhibit 6
Dynamics of Commercial Breakeven



Source: DeAm analysis, 2008

[15] Gold, Russell, "Wind Farms Set Wall Street Aflutter," Wall Street Journal, September 1, 2009

Note that carbon pricing acts as a "backstop" if the cost of conventional fuels fall unexpectedly on the right side of the diagram, maintaining the externality pricing signal when it is needed.

When allocating capital, investors seek a regime that is certain, transparent, and favorable. While some of these government interventions, such as carbon pricing, have simply improved the economics of low-carbon industries, others, including loan guarantees and feed-in tariffs, have de-risked low-carbon investments. We believe that governments will continue to renew their commitment to climate change. So long as this is the case, investing in climate change will remain fundamentally attractive as technologies reach commercial break-even and grow to scale. We have summarized the current conditions and outlook for the economic factors driving the viability of renewable investments in Exhibit 7.

Exhibit 7
Economic Drivers of Renewables

Variable	Current Conditions	Outlook	Trend
Price of Fuel	Unfavorable	Favorable	Longer term, we expect higher fossil fuel prices.
Price of Carbon	Unfavorable	Favorable	Governments worldwide are expected to enact policies to internalize carbon prices.
Cost of Capital	Unfavorable	Favorable	Financial conditions should improve and banks will provide financing to such long-lived assets.
Regulatory Regime	Favorable	Favorable	Growing awareness of the harmful effects of climate change and energy security concerns should lead governments to subsidize renewable sources of energy.

Source: Largely adapted from Geoffrey Heal and the outlook of RREEF Research

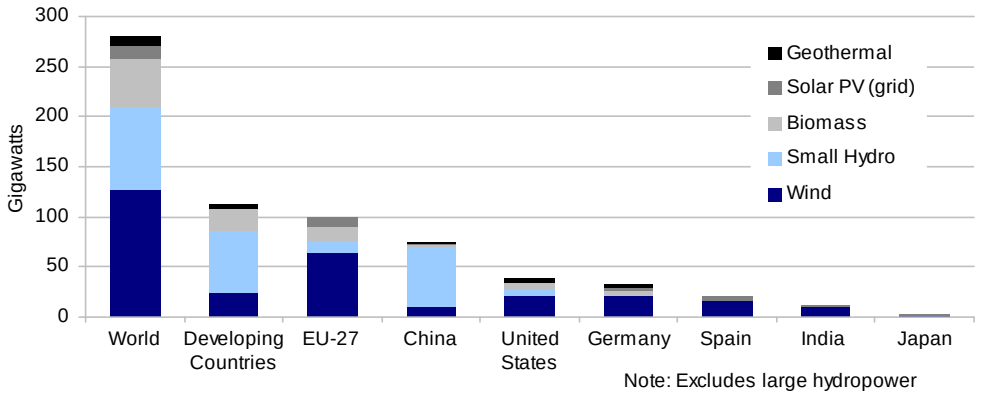
Based on our assessment of the longer-run future trends, we conclude that investments in renewables will become increasingly attractive as the current financial crisis ends. Additionally, the dynamic technological breakthroughs and innovations that will dominate the renewable space should render renewables increasingly affordable over time.

Size of Renewables by Region

Many significant milestones were reached for the renewables sector in 2008. Last year, added power capacity from renewables in both the US and the European Union exceeded added power capacity from conventional power (including gas, coal, oil, and nuclear). Total renewable power capacity expanded to 280 GW in 2008, representing a 75% increase from 160 GW in 2004, excluding large hydropower. Including large hydropower, global renewable power capacity reached an estimated 1,140 GW in 2008. The top six countries with the most renewable power capacity are China (76 GW), the US (40 GW), Germany (34 GW), Spain (22 GW), India (13 GW), and Japan (8 GW) (see Exhibit 8). The total capacity for developing countries grew to 119 GW, or 43% of the total, with China and India leading the increase primarily through wind and hydro development.[16]

[16] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

Exhibit 8
Renewable Power Capacities, Developing World
European Union and Top Six Countries, 2008



Source: REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

The renewable energy market boomed for most of 2008 despite the economic downturn. The US became the leader in new capacity investment with $24 billion invested, or 20% of global total investment. The US surpassed Germany as the leader in total wind power capacity. Last year Spain saw a fivefold increase over its' 2007 additions by adding 2.6 GW of solar photovoltaic (PV), representing half of global grid-tied installations. Over the last 5 years, subsides in Germany, Spain and the UK have almost tripled.[17] China moved to fourth place worldwide for renewable power capacity after doubling its wind power capacity for the fifth year in a row. China also usurped Japan to become the new world leader in PV cell production. The ethanol and biodiesel industries expanded rapidly in North America and Latin America, and the cellulosic ethanol industry is growing, with 300 million liters per year of capacity under construction.[18]

In response to the financial crisis, governments worldwide have announced plans to significantly increase public support for renewable energy and other low-carbon technologies as part of their economic stimulus packages. In the Americas region, the US administration stated a goal of $150 billion for renewables over 10 years (the American Clean Energy and Security Act earmarks up to $190 billion of potential auction credits to renewbles by 2025). Mexico's new 2008 renewable energy law established an $800 million fund, partly to finance renewable energy projects. In Europe, the Netherlands announced €160 million ($200 million) per year for 15 years to support offshore wind power. Ireland included renewable energy lending provisions when it provided share capital to two of its biggest banks, while Hungary is providing €250 million ($330 million) over seven years.

In Asia, Japan announced 1 trillion yen ($12.2 billion) over five years, while South Korea launched a $36 billion package over four years, and Australia aimed to accelerate an existing AUD$500 million ($370 million) renewable energy fund from the original six years to just 18 months. China has been providing growing amounts of public support to renewables in recent years—about $300 million equivalent for one period in 2007/2008, and at the end of 2008 it pledged $15 billion for renewable energy, much of it for wind power.[19]

In the MENA region, Morocco announced a $1 billion fund for renewables and energy efficiency. By early 2009, policy targets existed in at least 73 countries globally, and at least 64 countries had policies to promote renewable power generation, including 45 countries and 18 states/provinces/territories with feed-in tariffs (many of these recently updated). The number of

[17] McKinsey on Electric Power and Natural Gas, Winter 2008
[18] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)
[19] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

countries/states/ provinces with renewable portfolio standards increased to 49.[20] Policy targets for renewable energy were added, supplemented, revised, or clarified in a large number of countries in 2008. New solar PV subsidy programs were adopted in Australia, China, Japan and the US; laws and policy provisions for renewables appeared in developing countries including Brazil, Chile, Egypt, South Africa and the Philippines.

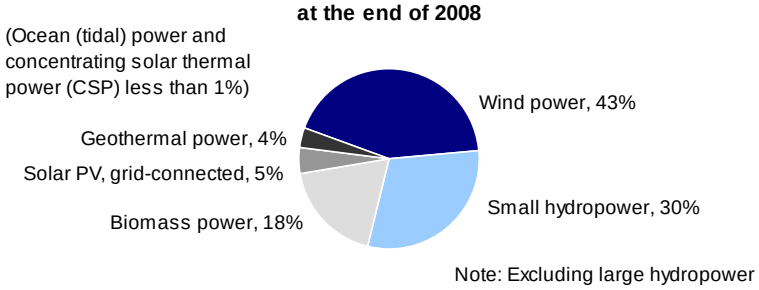
Size of Renewables by Sector

Renewable energy markets grew robustly in recent years and the trend is set to continue. Despite the growing trend, barriers to growth such as the relatively high costs of some technologies in the absence of subsidies, limited research and development until recently, growing concerns about the impact on food available for the use of crops for energy, and a lack of skilled labor remain.[21]

According to McKinsey, however, within three to seven years, unsubsidized solar power could cost no more to end customers in markets such as California and Italy than electricity generated by burning fossil fuels. In the case of biomass and onshore wind in Europe for example, they are in many instances already cost competitive with conventional power generation.[22] Going forward, the growth of the renewables sector will largely depend on the level of regulatory support and the price of fossil fuels.

In the four years from the end of 2004 to the end of 2008, solar PV capacity increased sixfold to more than 16 gigawatts (GW), wind power capacity increased 250% to 121 GW. Total power capacity from new renewables increased 75% to 280 GW, including significant gains in small hydro, geothermal, and biomass power generation. As of the end of 2008, wind power dominates power generation capacity by all renewables at 43%. This is followed by small hydropower at 30% (see Exhibit 9).

Exhibit 9
Power Generation Capacity (GW) by Renewables Sector Existing at the end of 2008



Source: REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

During the same period, solar heating capacity doubled to 145 gigawatts-thermal (GWth), while biodiesel production increased sixfold to 12 billion liters per year and ethanol production doubled to 67 billion liters per year. Annual percentage gains for 2008 were even more dramatic. Wind power grew by 29% and grid-tied solar PV by 70%. The capacity of utility-scale solar PV plants that are larger than 200 kilowatts tripled during 2008, to 3 GW. Solar hot water grew by 15%, and annual ethanol and biodiesel production both grew by 34%. Heat and power from biomass and geothermal sources continued to grow, and small hydro increased by about 8% (see Exhibit 10).[23]

[20] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)
[21] OECD/IEA, World Energy Outlook 2008
[22] McKinsey on Electric Power and Natural Gas, Winter 2008
[23] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

Exhibit 10
Renewable Energy Added and Existing Capabilities, 2008 (estimated)

	Added During 2008	Existing at End of 2008
Power generation (GW)		
Large hydropower	25-30	860
Wind power	27	121
Small hydropower	6-8	85
Biomass power	2	52
Solar PV, grid-connected	5.4	13
Geothermal power	0.4	10
Concentrating solar thermal power (CSP)	0.06	0.5
Ocean (tidal) power	0	0.3
Hot water/heating (GWth)		
Biomass heating	N/A	(250)
Solar collectors for hot water/space heating	19	145
Geothermal heating	N/A	(50)
Transport Fuels (billion liters/year)		
Ethanol production	17	67
Biodiesel production	3	12

Source: REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

- **Wind**: Among renewables (excluding large hydropower), wind power made the largest contribution to renewable energy capacity. Existing wind power capacity grew by 29% in 2008 to reach 121 GW, more than double the 48 GW that existed in 2004. The US overtook long-time wind power leader Germany, ending the year with 25 GW compared to Germany's 24 GW. China's total wind power doubled for the fifth year in a row, ending the year above 12 GW. More than 80 countries around the world had commercial wind power installations by the end of 2008. Existing offshore wind capacity reached nearly 1.5 GW in 2008, virtually all of it in Europe, with 200 MW added in 2007 and 360 MW added in 2008. The UK became the offshore wind power leader in 2008.[24]
- **Hydropower**: Small hydropower increased to an estimated 85 GW worldwide. Most of the small hydro is in China, where the small hydro sector has grown from 4 to 6 GW added annually from 2004 to 2008. Large hydropower increased by an estimated 25 to 30 GW in 2008 reaching approximately 860 GW, significantly more than in previous years. This sector was also led by China, which added 12 to 15 GW, and India, which added more than 5 GW.
- **Biomass**: Biomass power generation (and cogeneration) continued to increase, with an estimated 2 GW of power capacity added in 2008, bringing existing biomass power capacity to about 52 GW. Biomass power generation continued to grow in several European Union countries over the past two years, specifically Finland, France, Germany, Italy, Poland, Sweden, and the UK. China continued to increase power generation from industrial- scale biogas (i.e. livestock farms) and from agricultural residues, mainly straw. The sugar industries in many developing countries continued to bring new bagasse power plants online, including leaders Brazil and the Philippines, and others such as Argentina, Columbia, India, Mexico, Nicaragua, Thailand, and Uruguay.[25]
- **Solar PV**: Grid-connected solar PV continued to be the fastest growing power generation technology, with a 70% increase in existing capacity to 13 GW in 2008. This represents a sixfold increase in global capacity since 2004. Spain became the clear market leader in 2008 with 2.6 GW of new capacity installed, representing half of global installations and a fivefold increase over the 550 MW added in 2007. The Spanish 60-MW Olmedilla de

[24] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)
[25] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)

Alarcon plant, completed in 2008, became the largest solar PV plant in the world. Other leading markets in 2008 were the US (310 MW added), South Korea (200 to 270 MW), Japan (240 MW), and Italy (200 to 300 MW). Including off-grid applications, total PV existing worldwide in 2008 increased to more than 16 GW. According to the Renewable Energy Policy Network, Solar PV markets showed three clear trends in 2008. The first was the growing attention to building-integrated PV (BIPV), which is a small but fast-growing segment of some markets, with more than 25 MW installed in Europe. Second, thin-film solar PV technologies became a larger share of total installations. And third, utility-scale solar PV power plants (defined as larger than 200 kilowatts, kW) emerged in large numbers in 2008.

- **Geothermal**: Geothermal power capacity reached over 10 GW in 2008. The US remains the world development leader representing at least 5 GW per year. Other countries with significant recent growth in geothermal include Australia, Guatemala, Iceland, Indonesia, Mexico, Nicaragua, and Turkey. Geothermal development is under way in over 40 countries, with at least 3 GW in the pipeline beyond the US.[26]

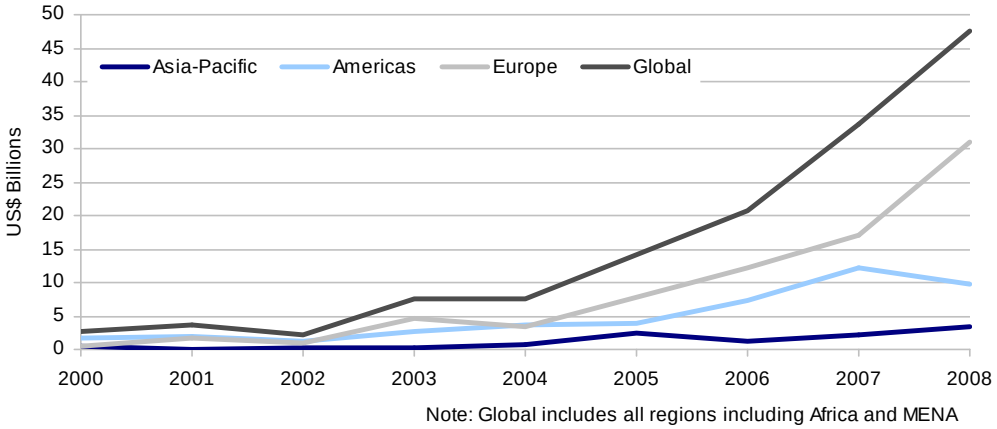
Deal Flow – Closed Transactions

According to Dealogic, global renewable energy project finance deals grew tremendously over the past few years with closed project finance deals for the renewables sector increasing by 238% from 2005-2008 (see Exhibit 11). Outside of the US, renewables project finance has proven to be relatively resilient to the recent financial crisis when compared to other sectors within the infrastructure asset class. Globally, the sector bucked the general downturn in 2008 and finished the year with a total project finance value of $47.6 billion, representing a 41% increase from 2007 despite a severe shortage of debt finance. The average wind project finance wind deal increased by 20% from 2007 to 2008. The renewables sector saw an increase in volume of 15% to $16.4 billion from the first half of 2008 to the first half of 2009.

- **Europe**: Historically, Western Europe has been the key region for renewables project finance deals. The brisk pace of renewables development in the Iberian Peninsula has helped the Western European market grow by roughly 284% from 2005 to 2008. Among deals in Western Europe, the wind sector dominated the renewables deal tables, accounting for 52% of total Western Europe deal volume in 2008. Babcock and Brown, a casualty of the financial crisis, recently embarked on a series of European wind farm disposals as the parent investment group sought to reduce debt. While the 2005 to 2008 growth rate is not available for Eastern Europe, the market has increased by roughly 181% from 2007 to 2008. According to Dealogic, only wind sector deals were project financed in Eastern Europe in 2008. The Eastern Europe region continues to show promise, as witnessed in 2008 by the closing of the 156MW Kavarna wind farm in Bulgaria for $341.9 million. Further projects in Bulgaria and Romania are expected to close in the coming two years.[27]

[26] REN 21.2009. Renewables Global Status Report: 2009 Update (Paris: REN 21 Secretariat)
[27] Kjorstad, John and Rey, Yoann, “Renewables Outlook 2009”, Infrastructure Journal, February 23, 2009

Exhibit 11
Closed Renewables Project Finance Transactions from 2000-2008 by Region



Note: Global includes all regions including Africa and MENA

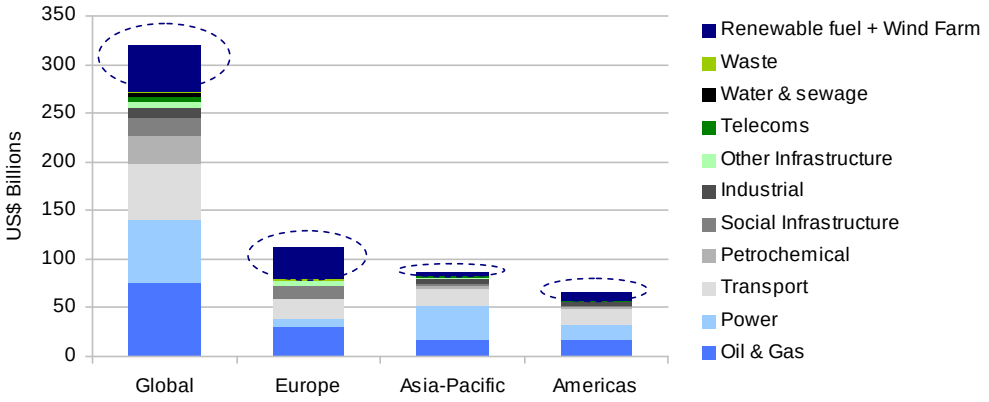
Source: Dealogic Projectware June 2009 and RREEF Research

- **Americas**: In the Americas, the market increased by roughly 151% from 2005 to 2008. Among completed project finance deals in the region, the wind sector by far exceeded all other renewables projects, accounting for 81% of the total 2008 renewables project finance deal volume in the region. The Americas region however, did not prove to be resilient to the global finance crisis as the total value of project finance renewables transactions declined from an average of $303 million in 2007 to $243 million in 2008, by roughly 20%. This is partially due to liquidity problems in the US tax equity market as financial service companies investing in projects have been hit hard by the financial crisis. Within the US, the state of California is a key area for renewable energy development, having set a 20% requirement for renewable energy by 2010 and a recommended target of 33% by 2020.
- **Asia-Pacific**: The Asia-Pacific market experienced a more mild growth of 46% from 2005 to 2008. In contrast to Europe and Americas, Asia-Pacific renewable deals were spread more evenly across all segments of the renewables sector. Deals within the wind sector only accounted for 16% of total 2008 renewables project finance transactions. Average renewables deal value in the Asia-Pacific increased by 13% from $160 million in 2007 to $180 million in 2008. The apparent hiatus in Asia-Pacific renewables deal value can be attributed to the financial climate and the wait and see attitude as companies and investors paused to await the next moves in climate change regulation. 2008 renewables project financing deal volume shrunk in Australia as the industry sought greater clarity on the development of national incentive renewables scheme to replace state-level schemes and awaited the content of the Australian government's proposed emissions trading scheme.[28] As the long-term regulatory outlook becomes clearer, the climate for renewables project finance market should improve. Generally speaking, outside of Western Europe and North America, project finance in the renewables sector remains limited for now.

Among project finance infrastructure deals completed in 2008, 15% were renewables projects (see Exhibit 12). Renewables deals in Europe, Asia and the Americas constituted 28%, 4%, 15% of total 2008 project finance infrastructure transactions in the regions respectively.

[28] PricewaterhouseCoopers, Renewables Deals 2008 Annual Review

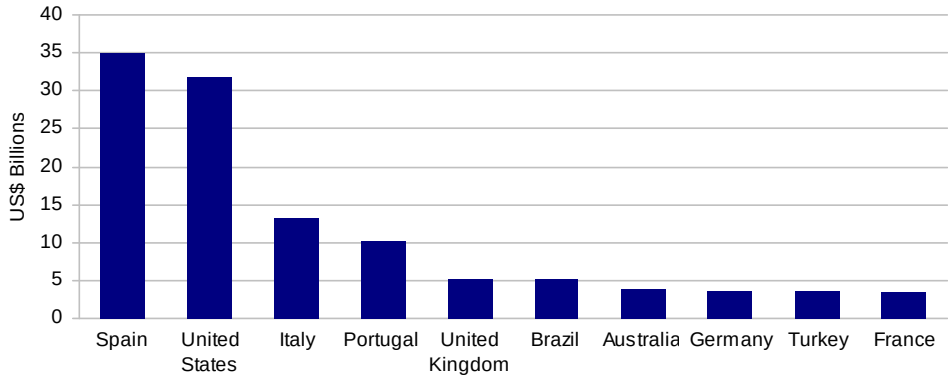
Exhibit 12
Closed 2008 Infrastructure Project Finance Transactions by Sector



Note: Global includes all regions including Africa and MENA
Source: Dealogic Projectw are June 2009 and RREEF Research

From 2000 to 2008, the top ten countries with closed project financed renewables transactions by volume were primarily from Europe (see Exhibit 13). Of those, Spain, Italy, Portugal and the UK led the pack. Over the past four years, Spain witnessed an average annual growth of 81%. Much of the growth can be attributed to a lucrative tariff placed on thermal and PV solar installations. While the Spanish solar market is not expected to be as active in 2009 as it was in 2008, financial activity in the sector should remain strong and many of the deals that reached financial close last year may seek to refinance once construction is completed in the next few years.[29] Spain's project finance wind deal volume increased 4% last year from $3.4 billion in 2007 to $3.5 billion in 2008.

Exhibit 13
Top 10 Countries for Closed Renewables Project FinanceTransactions by Volume, 2000-2008



Note: Data does not include renewable project finance deals that span multiple countries or regions

Source: Dealogic Projectw are June 2009 and RREEF Research

The US averaged a 50% growth in project finance annually over the past four years as it remains one of the world's most attractive countries to develop renewable power projects. Although the Americas renewables market slipped in 2008, it is expected to rebound over the next three years boosted by political support and the country's abundant resource for wind. A three year Production Tax Credit (PTC) extension through the end of 2012 was included in the US's economic stimulus package that was released earlier this year. This tax credit has been the primary driver supporting development in the wind sector since the early 1900s. The new legislation also gives the wind, geothermal and biomass industry an option to elect an

[29] Kjorstad, John and Rey, Yoann, "Renewables Outlook 2009", Infrastructure Journal, February 23, 2009

Investment Tax Credit (ITC) in place of the PTC.[30] This could be significant encouragement for the renewables market in the US going forward. US DoE loan guarantee programs should also be helpful.

Italy saw an astounding average annual growth of 319% over the past four years. This is primarily a reflection of a boom in transactions from 2004-2005. The outlook for Italy in 2009 remains positive as the country has recently amended its incentive structure and a strong pipeline of deals. A decree issued in December of 2008 replaced the old structure of renewable energy incentives with the exception for photovoltaic grants which are still regulated under an old 2007 decree.[31] Portugal witnessed an average annual growth of 125% over the past four years and the UK saw an average annual growth of 24% for the same time period, reflecting a -39% decline in renewables project finance transactions from 2006 to 2007. Brazil ranks sixth on the list although it observed an average annual growth rate of 42% over the past four years as a result of a sharp decline in project finance transactions in 2002 and 2003. Brazil is a strong market for biofuels, the scale of which has increased significantly over the time period.

A number of significant renewables project finance deals were completed in 2008 (see Exhibit 14). Wind deals by far dominated the top 10 transactions list by volume. The average deal value was $1.1 billion for the top 10 renewables deals in 2008.

Exhibit 14
Top 10 Renewables Project Finance Transactions in 2008

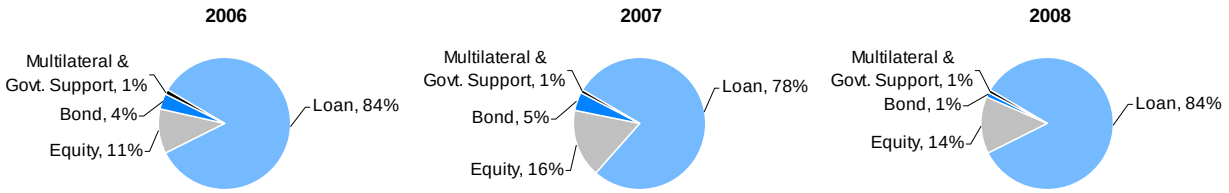
Name	Value (US$m)	Financial Close	Description	Location
IP Maestrale Refinance	3,054	3/10/08	648MW Wind Portfolio	Italy, Germany
Tuin Zonne	1,500	1/29/08	120MW Solar PV Portfolio	Spain
Noble Wind New York 2008	1,181	6/30/08	4 Wind Farms for a total of 351MW	USA
Martel II Refinancing	998	11/14/08	Wind Portfolio	Portugal
SER API	887	11/17/08	342.4MW Wind Farm Portfolio	Italy
Generg Refinancing	766	11/26/08	436.4MW Wind and 33.2MW Hydro	Portugal
EUFER	714	12/17/08	Wind Portfolio - 295.6MW through 12 projects	Spain
Kenedy Wind Farm	674	2/15/08	282.3MW Wind Farm in Texas	USA
Renovalia II	577	3/5/08	47.6MW Solar PV Portfolio	Spain
Manchasol I Termal Solar	547	10/24/08	50MW Parabolic Trough Plant in Ciudad Real	Spain

Source: Infrastructure Journal

While renewables have not been immune to the downturn, it is seen as a relatively resilient sector within infrastructure portfolios due to the clear long-term rationale of the sector and increasing government support. Resilience of operating renewable assets comes from the reality that long-term returns are generally fixed at financial close through locked-in construction costs and feed-in tariffs or power purchase agreements to fix unit MWh revenues. Wind volumes and sunlight hours have no correlation to underlying economic conditions. Project finance activity in the renewables sector remains relatively strong in the current market despite liquidity constraints in the debt market. Limited resources have forced banks to depend more on multilaterals such as the European Investment Bank and the Inter-American Development Bank in the near-term. Additionally, renewables projects are able to attract debt while financing for expensive traditional power plants may struggle because many renewables projects can be built in phases, with financing completed for each phase. The average debt to equity ratio for closed renewables deals was approximately 80:20 in 2008 (see Exhibit 15).[32] The bond market for renewables project finance has never quite taken off. Since the financial crisis, there has been more emphasis on the equity market, however, the actual amount of

[30] Kjorstad, John and Rey, Yoann, "Renewables Outlook 2009", Infrastructure Journal, February 23, 2009
[31] Kjorstad, John and Rey, Yoann, "Renewables Outlook 2009", Infrastructure Journal, February 23, 2009
[32] Kjorstad, John and Rey, Yoann, "Renewables Outlook 2009", Infrastructure Journal, February 23, 2009

Exhibit 15
Renewables - Source of Funding
(Percentage of Total per Year)



Source: Infrastructure Journal

equity invested in renewables project finance deals in 2008 remained the same. Our outlook for equity investments for renewables transactions remains positive for 2009.

Deal Flow – Pipeline Transactions

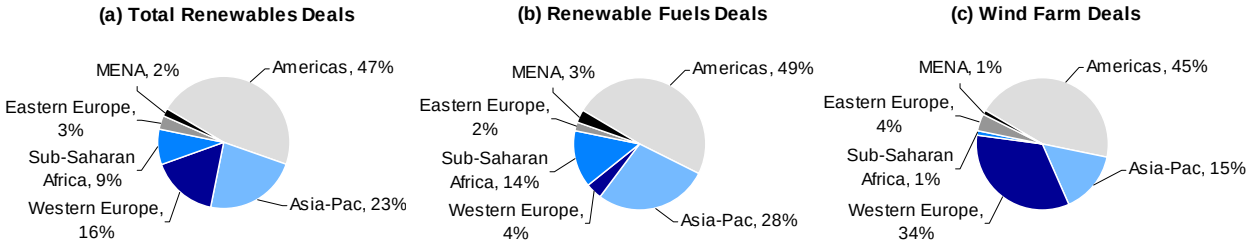
Following a strong performance in 2008, we remain bullish on our global outlook for the renewables project finance sector despite the challenging year ahead. The IEA declared that total investment in renewables is a long way behind the average annual need that would be required by 2030 to prevent atmospheric concentrations of CO_2 reaching 450ppm and avoid the worst effects of climate change.[33] The renewables sector is well-positioned to handle the challenges currently facing developers and financial markets as a result of strong government support, a need for energy security and growing consumer appetite for clean power. New developers seeking seed money for development assets however, may have a hard time accessing credit than experienced developers with a proven track record and operating assets. In North America and Europe, tariffs, tax credit and green certificates will continue to provide healthy incentives for new developments. In many countries, feed-in tariffs provide a strong incentive for the development of the sector as they provide more certainty and stability to project cash flows. In countries such as the US, Germany and Spain, there has also been significant tax-driven impetus which has effectively encouraged the development of the sector.[34]

Governments in Europe continue to show strong support for the development of domestic resources in their effort to increase the share of renewables in the power mix and to improve energy security. The European Commission has recently set a target of 20% of final energy consumption to come from renewables by 2020. Meeting these targets will require an even higher percentage of renewable generation in electricity. Earlier this year, President Obama pledged to double the production of alternative energy over the next three years to spark the creation of a clean energy economy. The American Recovery and Reinvestment Act of 2009 includes several provisions aimed at encouraging investment in the US renewables market. The bill underlines changes to tax incentives, cash grants, federal loan guarantees and direct spending. These measures have been welcomed by US developers which have suffered in recent months as a result of uncertainty regarding the extension of production tax credits, a tight credit market and troubled tax equity players.[35]

According to Dealogic, the majority (47%) of the project finance renewables deals in the pipeline are in the Americas region (see Exhibit 16). Approximately a quarter (23%) of the project finance renewables deals in the pipeline are based in the Asia-Pacific region. Western Europe constitutes 15% of the pipeline and Eastern Europe only comprises 3% of all project finance pipeline deals. In the near-term, we believe that Western Europe will continue to be the key region for wind and solar renewables project finance, led by Spain and Italy. A few projects in Turkey, Jordan and Poland may also grab headlines this year.[36]

[33] IEA confirms renewables recession woes, Environmental Finance, May 28, 2009
[34] PricewaterhouseCoopers, Renewables Deals 2008 Annual Review
[35] Stimulating the US renewables market, Infrastructure Journal, March 4, 2009
[36] Kjorstad, John and Rey, Yoann, "Renewables Outlook 2009", Infrastructure Journal, February 23, 2009

Exhibit 16
Project Finance Pipeline by Region

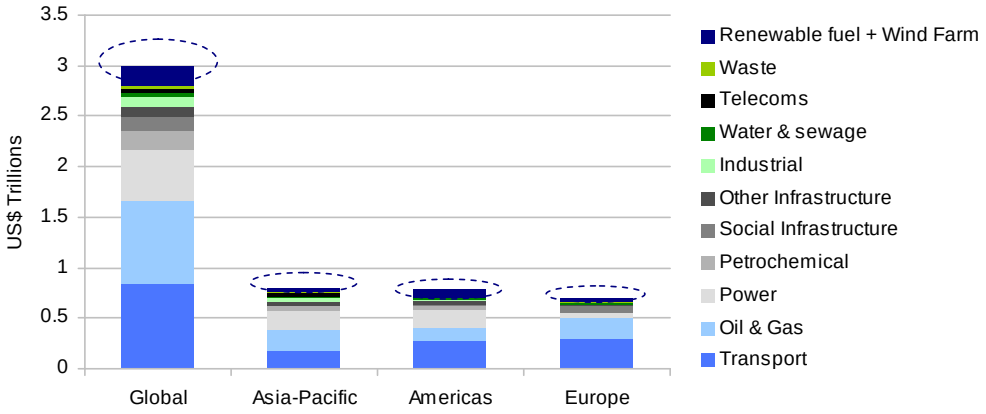


Source: Dealogic Projectw are June 2009 and RREEF Research

Specifically, the renewable fuels project finance deals in the pipeline total $119 billion, which includes Africa and MENA regions. For these projects, 49% of deals will originate from the Americas and 28% from Asia-Pacific. Western Europe and Eastern Europe combined only comprise 6% of the renewable fuels project finance pipeline. The wind farm project finance deals in the pipeline total $77 billion, including Africa and MENA regions. The majority (45%) of the global wind farm project finance pipeline also stems from the Americas region followed closely by 34% from Western Europe and 15% from Asia-Pacific.

The global infrastructure project finance pipeline offers a strong deal flow with over $2.9 trillion in deal volume. The renewables sector currently comprises 7% of total infrastructure deal volume which is $196 million (see Exhibit 17). In Asia-Pacific, the renewables sector constitutes 6% of the regional pipeline infrastructure deal volume which is equivalent to approximately $45 billion. India, Myanmar, Australia, Laos and New Zealand are the largest renewable markets in the region, totaling 65% of the regional renewables project finance pipeline.

Exhibit 17
Pipeline Infrastructure Project Finance Deals by Sector



Note: Global includes all regions including Africa and MENA
Source: Dealogic Projectw are June 2009 and RREEF Research

In the Americas, the renewables sector comprises 12% of the regional project finance pipeline at $94 billion. The US, Canada, Chile, Brazil and Argentina are the largest infrastructure investment markets in the Americas region (totaling 79%). We believe that the first year of the Obama presidency and the December 2009 UN Climate Change Conference in Copenhagen will set the context for the sector's development for the next few years.

In Europe, the renewables sector accounts for approximately 5% of the total infrastructure project finance regional deal volume which is equivalent to $35 billion. The UK, Germany, Belgium, Spain and the Kyrgyz Republic are the largest renewables project finance markets in the region, totaling 79% of the renewables project finance pipeline. The collapse of Babcock & Brown earlier this year could generate a few large wind and solar transactions in the near-term. Looking forward, the renewables energy sector has tremendous potential for growth globally as we expect investments to flow in from both the public and private sector.

Comparative Performance: Renewable Energy Investments and Traditional Asset Classes

Investments in renewable energy are becoming increasingly prominent in private infrastructure portfolios. Infrastructure investment managers, capitalizing on the inevitable transition to low-carbon sources of electricity, have targeted renewable energy assets as a key sector across the various funds. But how do such assets fit in a private equity infrastructure portfolio and are their features comparable to the broader infrastructure class universe?

The performance characteristics of infrastructure investments have been well-documented in past RREEF Research reports.[37] Renewable assets share many of the unique features characterizing infrastructure assets in general, including "quasi-monopoly" cost structures, high barriers to entry, an essential service, steady cash stream profile and high initial capital expenditures. The more specific characteristics of energy assets have also been documented in a follow up RREEF report as well.[38] Renewable energy also has the distinction of being part of the "regulated" infrastructure assets with a large degree of public oversight determining rates and concession terms.

In this report, we focus on the performance of renewable energy investments in the context of the broader infrastructure asset class and as compared to other traditional asset classes. For this purpose, we are using the Wilder Hill Clean Energy Global Index (ticker: NEX) as a proxy for the renewable energy sector. The NEX represents a global index of all publicly-traded renewable energy companies. Data on privately-held renewable energy infrastructure investments is not publicly available. For this purpose, we use the NEX as a proxy. Exhibit 18 provides 1, 3, and 5 year returns for the NEX and other broad infrastructure, equity, bond and fossil fuel indices.

Exhibit 18
Comparative Asset Class Performance*
(Percentage Returns)

		1 Year	3 Year	5 Year	5 Year Volatility
Renewables	Wilder Hill Clean Energy (NEX)	(44.5)	(5.2)	6.7	35.8
Infrastructure	UBS Infrastructure & Utilities	(30.1)	(0.6)	9.1	23.6
	Dow Jones Brookfield Global Infrastructure	(25.1)	(1.6)	8.3	24.3
Equity	MSCI World	(31.2)	(9.9)	(1.9)	21.1
Bonds	Lehman (Barclays) Global Aggregate Bond Index	2.8	6.7	5.5	5.2
Fossil Fuels	Oil	(50.1)	(1.9)	13.5	40.9
	Natural Gas	(71.9)	(14.1)	(9.3)	53.6

*Data through June 30, 2009

Source: Bloomberg and RREEF Research

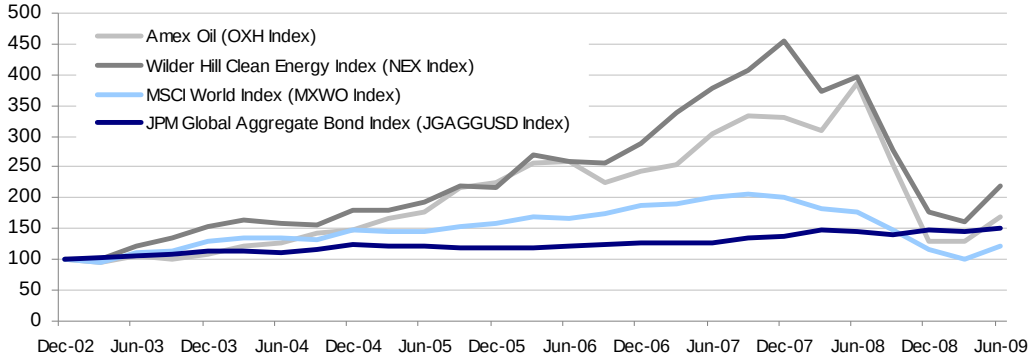
[37] Please see "The Performance Characteristics of Infrastructure Investments", August 2007

Volatility measures are proxied by the first-order standard deviation. In each case, a five-year standard deviation is calculated since the NEX does not go back further than five years.

As is reflected in the first and third-year returns, all asset classes with the exception of bonds have been hit hard in this downturn. The highly volatile oil and natural gas markets were the worst hit on a one-year basis followed by the listed renewables NEX index. The NEX is a publicly-traded benchmark and is likely much more volatile than privately-held energy infrastructure assets. Listed infrastructure vehicles have also been hurt, in line with the broader equity market averages. A large number of infrastructure vehicles tend to now be traded at a discount to the values of the underlying assets. In many instances, renewables, such as solar and wind, are suffering the same fate as the broader infrastructure asset class, trading at less than replacement cost of assets currently in production. Given the highly capital-intensive nature of renewables, a lack of available financing and a pullback in government subsidies, especially in Europe (Spain and Germany) have hurt performance. Based on the economic drivers of renewables, we expect that demand should rebound during the latter part of 2009 and early 2010 with improved financing conditions and the surge in the various government stimulus programs targeting alternative energy sources.

Exhibit 19 shows the performance of renewables in comparison to equities, bonds, and oil since 2003. The NEX index outperformed the broader market indices and oil through year-end 2007. Between 2003 to the end of 2007, the NEX index grew over 40% per year. By the second half of 2008, the NEX succumbed to the unfolding credit crisis. Indeed, publicly listed renewable energy firms were not immune to the financial crisis and NEX returns fell in line with the broader market through March 2009. Given the deterioration in financial conditions and lower oil and natural gas prices, investments in publicly-listed renewable energy firms declined significantly. During 2008 and early 2009, fewer renewable firms went public, adding to the decline in market performance. The risk aversion that had gripped the market through the first quarter of 2009 also saw a rotation of capital away from any new high-technology sector, including renewable energy. Indeed, back testing suggests a fairly high correlation between the NEX and NASDAQ between 2000 and 2003, when many renewable energy stocks were seen as technology plays. This clearly changed, however, as renewable energy infrastructure matured into its own investment sector. More recently, the correlation of NEX is highest with oil prices and broader infrastructure assets.

Exhibit 19
NEX vs. Broader Equity Markets*



Source: Bloomberg and RREEF Research

*All indices indexed at 100 as of year end 2002

Over the past quarter, however, the NEX index has rebounded at a stronger pace than the broader market. Our expectation is that the structural and cyclical drivers of the renewables sector will be positive for the long-term outlook for investment returns garnered from such

[38] Please see "Infrastructure Funds: The Role of Energy Assets", October 2008

assets. Although historically, the renewable energy stocks have been more volatile than other sectors, their returns have been higher, rendering them an attractive investment on a risk-adjusted basis.

Exhibit 20 presents the correlation coefficient matrix for the NEX, equities, bonds, infrastructure (both UBS and Brookfield indices), inflation, oil and natural gas. We could only go back to October 2003 since that is the inception date for the NEX. The NEX is highly correlated to the broader equity and infrastructure indices.

Exhibit 20
Correlations: October 1, 2003 to June 30, 2009
(Rolling 4-Quarter Basis)

	Wilder Hill Clean Energy Index (Global)	UBS Developed Infrastructure & Utilities Index	Dow Jones Brookfield Global Infrastructure Index	MSCI World Index	JPM Global Aggregate Bond Index	World CPI	Amex Oil	Henry Hub Natural Gas Spot Price
Wilder Hill Clean Energy Index (Global)	1							
UBS Developed Infrastructure & Utilities Index	0.90	1						
Dow Jones Brookfield Global Infrastructure Index	0.86	0.99	1					
MSCI World Index	0.93	0.95	0.94	1				
JPM Global Aggregate Bond Index	0.22	0.27	0.22	0.19	1			
World CPI	(0.84)	(0.90)	(0.91)	(0.92)	(0.06)	1		
Amex Oil	0.81	0.79	0.76	0.76	0.06	(0.77)	1	
Henry Hub Natural Gas Spot Price	0.41	0.39	0.31	0.30	0.30	(0.28)	0.61	1

Strong Correlation
Negative Correlation

Source: Bloomberg and RREEF Research

It is also highly correlated to oil given that they are substitutes, the higher the price of oil, the greater the demand for oil substitutes such as renewable energy which drives up the NEX. It has a low correlation to inflation but this can be misleading. Inflation rates globally were very low during the 2003 to 2009 period. Deflation was more of a concern, especially during the unfolding of the financial crisis since August of 2007. We do not have a long enough time series on the NEX to track its correlation to inflation during high inflationary periods which would have been more conclusive. The NEX is least correlated to bonds and would thus provide an efficient diversifier to a bond portfolio.

The investment horizons of renewable energy funds, similar to most economic infrastructure funds, are medium to long-term. We have also used standard deviations to measure volatility, but these measure the riskiness of listed renewable energy companies and activities. The risk profile of privately-held renewable energy infrastructure assets is hard to determine at this stage due to the relative immaturity of this sector.

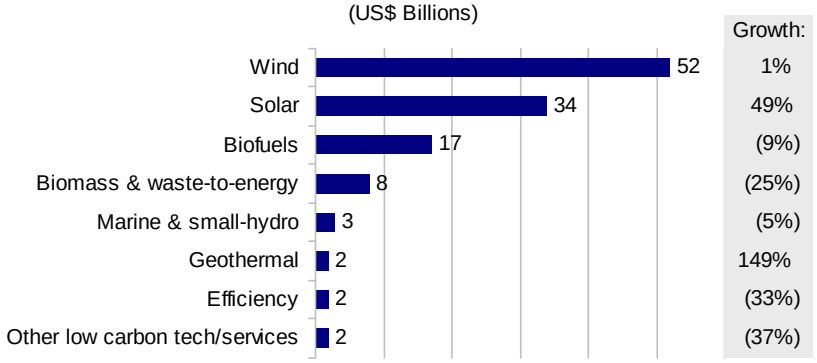
Renewable Energy Infrastructure Sectors

In this section, we focus on a subset of the full range of renewable energy opportunities. Infrastructure funds have predominantly targeted three renewable subsectors including:

- Wind
  - Onshore
  - Offshore
- Solar
  - Photovoltaic (PV)
  - Solar Thermal Electricity Generation (STEG)
- Biofuels
  - Ethanol
  - Cellulosic and Next Generation Biofuels

Mature infrastructure funds primarily target onshore wind, solar (PV and STEG), waste to energy and mini hydro. Biofuels and offshore wind haven not yet been targeted by such mature funds. Despite the unfolding of a major financial crisis, global investments in renewable energy continued strongly through 2008. Yet the pace of growth has slowed more recently due to the dearth of financing in capital markets worldwide. Exhibit 21 illustrates the major sustainable energy sectors, including the top three which is the focus of our analysis in this section.

Exhibit 21
Financial New Investment by Technology, 2008 and Growth on 2007
(US$ Billions)



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.

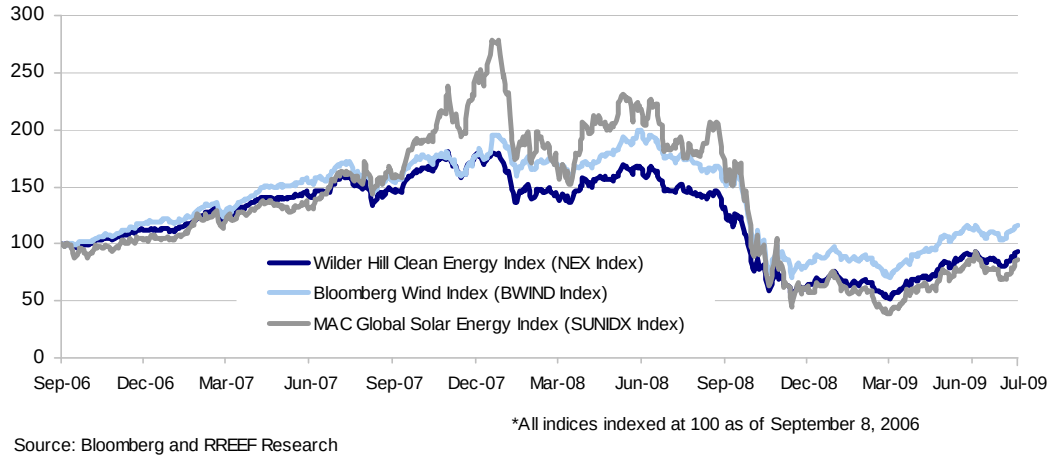
Source: New Energy Finance, UNEP, SEFI

Among the major renewable energy sectors, wind energy is being developed at the fastest pace, especially in the US and China. Over the past decade alone, globally installed capacity of wind power (both onshore and offshore) has increased to roughly 120 GW in 2008. Wind has also attracted the greatest amount in new investments, underscoring its status as the most mature renewable energy generating technology. As investors have become increasingly risk averse, however, there is a clear shift from early to later stage development of wind power, a reflection of where the market sees better value. Onshore wind continues to attract the highest volume of all financing as well since it is perceived as less risky than offshore wind.

Most recently, solar, especially solar PV, has widened its lead over biofuels, especially as a share of public market investments. Solar has also become the fastest-growing sector among renewables, advancing 49% in 2008. Biofuels remain a well-established source of renewable energy but have been hurt recently by rising food prices and the relatively low oil and natural gas prices. The reputation of biofuels has also been increasingly tarnished in the food versus fuel controversy.

Exhibit 22 depicts the performance of the renewable energy sectors between September 2006 and July 2009. In addition to the NEX index, we have charted the Bloomberg Wind Index (BWIND) and the MAC Global Solar Energy Index (SUNIDX).

Exhibit 22
Performance of Renewable Energy Sectors*



*All indices indexed at 100 as of September 8, 2006

Source: Bloomberg and RREEF Research

The BWIND Index is a multiple weighted index of the leading wind power stocks in the world, including both manufacturers of wind turbines, operators and their suppliers. The SUNIDX index tracks listed public companies globally that specialize in providing solar energy products and services. We do not have a comparable index for biofuels as it remains a less mature and less transparent sector as compared to wind and solar.

All three indices seem to have peaked around January 2008 before trending down with the broader markets. The returns for the solar sector have been more volatile than the more mature wind sector. By July 2009, wind had outperformed both the benchmark NEX index and the solar category. Indeed wind is up roughly 15% over this time period whereas both the NEX and the solar category are down relative to the September 2006 normalized period.

The performance characteristics of the renewable energy infrastructure sectors vary and each has a different risk/return profile. The risk/return profile is a function of project life cycle. Renewable projects typically go through various phases including planning, permitting, procurement, financing, construction and, finally, operation. At each phase, the risk/return profile is very different and attracts different sorts of capital. The very early stages are analogues to venture capital, multiples of invested capital over a 2 to 3 year period. This is similar to private equity style risk with an expected 25% to 30% IRR over a 2 to 3 year period. Mature infrastructure funds, however, target the less risky/lower return construction/operation stage with an expected average IRR of 10%+ over a 20-year period.

Any renewable company or infrastructure fund will target different proportions of assets at different stages of development. In general, the listed renewable companies have a large exposure to assets in the planning and permitting stages.[39]

[39] Historically, the listed market had valued these projects in line with their operating counterparts, applying the 10%+ discount rate less a probability discount for the chance of the project being developed. In common with their NASDAQ listing, these listed renewable shares were valued as growth stocks. As financing has dried up, the growth potential has diminished. The underlying value of the operating assets, by contrast, has remained roughly the same, generally in line with the resilient characteristics of infrastructure assets.

Mature infrastructure funds, by contrast, do not invest in the "pipeline" assets, as the development, permitting, financing, and construction risks do not meet the profile of such funds. Mature funds only target those assets which are operating or where the financing is in place. Such mature funds also pass off the construction risk through an Engineering, Procurement and Construction (EPC) contract.[40]

Exhibit 23 summarizes some of the key takeaways for infrastructure investors focusing on the various renewable energy infrastructure assets and presents indicative returns.

Exhibit 23
Target Renewable Energy Infrastructure Sectors*

Sector		Characteristics	Top Markets	Project Return
Wind	Onshore	Most mature. Most technologically advanced.	Germany, US, Denmark, Spain, India, China	10% - 14%**
	Offshore	As onshore sites become scarce, offshore has become best sites for wind energy. Advantages include predictable wind patterns and almost unlimited space for turbines. Need to develop storage/transmission facilities. More expensive than onshore.	Germany, UK	14% - 16%**
Solar	Photovoltaic (PV)	Fastest growing sector. Becoming more cost-effective as the cost of crystalline silicon (its main component) declines. Best use in smaller projects and integrated into residential/commercial buildings.	Germany, Spain, US, China, Japan	10% - 12% Heavily dependent on incentive regime
	Solar Thermal Electricity Generation (STEG)	Very large solar plants best in desert locations. Concentrates heat of sun to generate steam that can be used efficiently in turbines. Remains a less mature segment of solar energy infrastructure.	US, Spain, Israel, Italy, Egypt, Morocco, Mexico	12% - 15%
Biofuels	Ethanol	Increasingly controversial since its feedstock, input into energy production, is a food staple (corn and wheat) around the world. Has seen growth but viewed as jeopardizing food production.	Brazil, US	Not considered in mature infrastructure funds
	Cellulosic and Next Generation Biofuels	Bypasses the debate of food versus fuel. Newer technology that uses non-food sources to generate fuel including agriculture waste and algae. Less mature.	Brazil, US	Not considered in mature infrastructure funds

* Mature infrastructure funds also target waste to energy (13% - 15%) and mini hydro (12% - 14%)
** Depending upon nature of government support, feed-in tariff, ROC, etc.

Source: RREEF Research based on analysis of The World Economic Forum on Green Investing, January 2009.

In the current market, the distinction between development and operational renewable assets, especially for wind farm projects, has become more pronounced. Many developers are looking to monetize existing assets to fund new developments. Due to a distinct shortage of capital in the market, they are increasingly looking for partners to acquire developed wind farms. As such, some investment returns for operational wind farms have increased from high single digits as observed in 2006-2007 to 12-14% in markets which now have greater regulatory support.

[40] Under an EPC contract, the contractor will design the installation, procure the necessary materials and construct it either through own labor or by subcontracting part of the work. The contractor carries the project risk for schedule as well as budget in return for a fixed price, called Lump Sum or LSTK depending on the agreed scope of work.

Onshore wind remains the most mature renewable sector and has been targeted by mature infrastructure funds. As a result, the case study we have chosen is an onshore wind farm portfolio (see Exhibit 24).

Case Study

Exhibit 24
Italian Wind: Società Energie Rinnovabili Case Study

- **Project name**: Società Energie Rinnovabili wind portfolio
- **Location**: Italy
- **Description**: 16 wind farms with a total capacity of 350MW located in southern Italy (280MW in Sicily and 70MW in Puglia)
- **Significance**: Despite tight market conditions in the second half of 2008, a total of 11 banks came onboard for Italy's largest greenfield wind farm portfolio to date
- **Comments**: Italy is increasingly drawing attention from renewables developers and financiers attracted by good wind conditions and strong government support

Sponsors	50.1per cent - api nòva energia 49.9 per cent - Iberdrola Renovables
Total senior debt	€603.9 million
Senior debt breakdown	Facility A - SER 1 wind farm non-eligible debt Bridge Facility Law 488 Bank Loan - commercial loan fronted by RBS Law 488 CDP - financed only by CDP Facility C - SER wind farms Two Working Capital Facilities VAT Facility
Mandated lead arrangers	RBS - €84.9 million BBVA - €74 million BNP Paribas - €74 million Calyon - €40 million Fortis - €40 million ING - €74 million Intesa - €74 million UniCredit - €74 million
Participant banks	Banca delle Marche - €30 million Banca Toscana - €25 million Centrobanca - €14 million
Date of financial close	17 November 2008
Expected return	10 – 15%

Source: Infrastructure Journal and RREEF Research

Conclusion and Implications for Investors

Renewable energy investments can play an important role in pension fund portfolios. The investment environment surrounding renewables is compelling given the growing and continued demand for energy, the projected rise in fossil fuel prices, concerns over traditional supplies of energy, and the global threat of climate change which should give rise to greater government intervention and policies governing the emission of carbon and methane.

Over time, given the unique features of such renewable infrastructure investments, we expect a lower correlation with traditional asset classes. As such, these investments can help diversify a broader, multi-asset portfolio. For investors that are also concerned with the carbon footprint of traditional fossil fuel sources of energy, socially responsible investments in renewables are highly appealing.

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