



# GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2007

*Analysis of Trends and Issues  
in the Financing of  
Renewable Energy and  
Energy Efficiency in OECD  
and Developing Countries*



UNITED NATIONS ENVIRONMENT PROGRAMME

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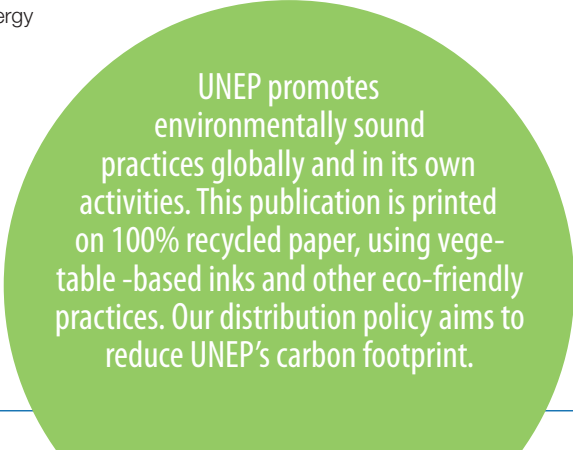
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## Foreword

US energy expert Amory Lovins' advice to energy planners is blunt: "In God we trust, all others bring data". In respect of climate change, that data is now in. Climate change is happening—it is "unequivocal" and the likely impacts are sobering.

When it comes to solving this enormous challenge, however, the new data in this report presents a positive message from and to the world's financiers: investments in sustainable energy are rapidly increasing to meet the need for a low-carbon society.

Global Trends in Sustainable Energy Investment includes data showing that investments in renewable energy and energy efficiency industries set a new record of more than \$100 billion worth of transactions in 2006. In 2007, the upward trend continues, with capital investments occurring in sectors and regions previously considered too risky and too illiquid to merit the attention of the institutional investment community.

The OECD still dominates, but there is now rapidly emerging activity from companies in China, India and Brazil. Indeed, Chinese companies were the second largest recipient of venture capital in 2006 after the United States. In the same year, India was the largest net buyer of companies abroad, mostly in the more established European markets.

*This is full-scale economic development, not just a tweaking of the energy system*

This is more than just interesting data, however. It is a powerful market signal to the arrival of an alternative future for today's fossil-fuel dominated energy markets. Signals move markets, and the signal these investment numbers make is that markets are becoming more liquid, more globalised and more mainstream.

This is full-scale industrial development, not just a tweaking of the energy system. The challenge now for governments, energy planners and policy makers is to build off of this positive market dynamic, turning near-term advances into long-term frameworks and continued sector growth.

These signals are particularly important for governments beginning to consider the next round of climate negotiations. Climate change generates a lot of discussion about the "technologies of tomorrow". The data in this report clearly shows that the finance sector believes the technologies of today can and will "decarbonise" the energy mix.

Many financiers are already ahead of the latest report from the Intergovernmental Panel on Climate Change, seeing investments in current renewable energy and energy efficient technologies as key opportunities to profitably address climate change. If the current market signal remains and is strengthened through policies to lower carbon emissions, this sector will far surpass the predictions of conventional energy analysts, which have mostly assumed a very minor role for these technologies. Financiers will not be the only ones to profit - communities will take their returns in cleaner air and water, and new cleantech jobs.

Achim Steiner  
Executive Director  
United Nations Environment Programme



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# Methodology and Definitions

## Methodology

All figures in this report, unless otherwise credited, are derived from the New Energy Finance Desktop - an on-line portal to the world's most comprehensive database of investors and transactions in clean energy.

The NEF Desktop collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers 15,000 organisations (including start-ups, corporates, venture capital and private equity providers, banks and other investors), 5,500 projects and 6,000 transactions.

Each transaction is assigned a deal value based on information provided by the participants. Where the deal value is not disclosed, NEF assigns an estimated value based on the average value of similar transactions. Deal values are rigorously back-checked when further information is released about the particular organisation and/or project.

Investment totals include all known transactions (both disclosed and estimated deal values), plus an allowance for unidentified transactions (for example, where the total investment into a specific sector within a country is known, but all the individual deals have not been identified). The investment totals are referred to as grossed-up values in the notes to each chart.

The following renewable energy projects are included: all biomass, geothermal and wind generation projects of more than 1MW, all hydro projects of between 0.5MW and 50MW, all solar projects of more than 0.3MW, all marine energy projects, and all biofuels projects with a capacity of 1m litres or more per year.



## Definitions

**Venture capital and private equity:** all equity invested by venture capital and private equity funds into companies developing sustainable energy technologies or providing services to the sector. Equity investment in companies setting up generating capacity through Special Purpose Vehicles is counted in the figure on asset financing.

**Public markets:** all new equity investment in quoted companies developing and manufacturing sustainable energy technologies, and building and operating clean energy power generation capacity.

**Asset financing:** all money invested in renewable energy generation projects, whether from internal company balance sheets, debt finance, or equity finance. Excludes refinancings and short-term construction loans.

**Mergers and acquisitions:** the value of existing equity purchased by new corporate buyers in companies developing sustainable energy technologies or operating sustainable energy projects. The types of deal covered are:

- **Capacity** – the acquisition of renewable power generation and biofuels production companies and projects, and equipment manufacturers
- **Technology** – the acquisition of companies that develop and commercialise products or provide services related to the production of renewable energy or the efficient use and storage of energy
- **Other** – including deals involving carbon management firms

Mergers and acquisitions also include private equity buy-outs, asset re-financings and investor exits through public market and OTC (over-the-counter) transactions.

Note: all equity investments involve a degree of leverage (i.e. ratio of debt to equity), which typically ranges from 0% for venture capital to 80% for asset financing.





# Executive Summary

Investment in sustainable energy is rapidly increasing, with \$70.9 billion of new investment in 2006, which was 43% more than in 2005, and a similar continued growth trajectory so far in 2007. This is in response to a number of global challenges and concerns, including climate change, increasing energy demand and energy security. The investment community recognises the importance of the sector and the opportunities for value creation it presents. Consumers and companies are supporting the roll out of a new energy infrastructure and a change in individual and corporate behaviour. Most importantly, governments and policy makers are introducing legislation and support mechanisms to accelerate the development of the sector.

This report presents the dollar view of the current status of sustainable energy development, including both the renewable energy (RE) and energy efficiency (EE) sectors. The analysis is based on the different types of capital flows and their movement over time, combined with regional and sectoral trends. The implications for all stakeholders of this rapidly evolving capital build-up are examined. The information is intended to provide financiers and policy makers with an overview of the status and drivers of the sustainable energy market development to help them weigh their commitments to the sector.

## Key findings

**Sustainable energy investment was \$70.9 billion in 2006 (Figure 1), an increase of 43% over 2005.** The sectors with the highest levels of investment are wind, solar and biofuels, which reflects technology maturity, policy incentives and investor appetite. Levels of investment are similar between the United States and the European Union (27 Member States), with US companies receiving more technology and private investment, and EU-27 capturing the majority of publicly quoted companies. Investment in developing countries is increasing quickly, mostly in China, India and Brazil.

Figure 1. Global Investment in Sustainable Energy, 2006



Note: Grossed-up values based on disclosed deals. Figures marked \* are based on NEF Desktop database; all other figures are based on industry estimates derived from various sources.

Source: New Energy Finance

**During the first quarter of 2007, the overall upward trend continued.** A total of \$2.2 billion of venture capital and private equity flowed into the sustainable energy sector, an increase of 58% over the same quarter in 2006. Listed stocks were up, with the NEX index (WilderHill New Energy Global Innovation Index) increasing 25% on the quarter, even though new public markets investment was down 18%.

**Sustainable energy now accounts for a significantly larger share of generation investment than of installed capacity.** Its share of generation will increase as technologies mature and as investment into expansion and technology feeds through into installed capacity.

**Investment in sustainable energy is still very much driven by policy, which today includes a broadening array of tariff and fiscal support regimes in many countries that together create a stable environment globally for continued sector growth.** Investor appetite suggests that existing technology is ready for scale-up and that renewable energy can become a larger part of the energy mix without waiting for further technology development. Onshore wind is now an established commodity (while offshore wind continues to be difficult to finance).

Greening of industry and public awareness of climate change and other environmental issues are key drivers of renewable energy and energy efficiency. The market has reached a critical mass, so that if oil prices drop to below \$40, this will likely slow investment in some areas, but it will not stall it altogether

**Venture capital (VC) and private equity (PE) have increased significantly from \$2.7 billion in 2005 to \$7.1 billion in 2006, and look set to continue this growth in 2007.** VC activity has moved up the maturity spectrum, with later funding rounds attracting most investment. There was noticeably higher investment in China during 2006, most of which was PE for solar manufacturing expansion. Biofuels, biomass & waste, solar and wind in roughly equal shares dominate private equity investment for expansion. In early 2007, all stages of venture capital and private equity investment saw increased activity, with later-stage leveraged private equity investments putting in a particularly strong showing.

**Research and Development (R&D) increased to \$16.3 billion in 2006, from \$13 billion in 2005.** EU-27 lags in new technology investment, which may be due to the comparatively low level of private sector involvement. Business funds 55% of R&D in the EU, as compared with 64% in the US and 75% in Japan. The number of incubators rose globally during 2006, as did the number of incubated renewable energy companies and successful transitions to the next stage of financing.

**Public market activity surged in 2006, with \$10.3 billion raised, which is more than double the \$4.3 billion in 2005.** Solar IPOs (initial public offerings) boosted 2006 volumes, raising just over \$4 billion. The NEX index rose 31% during the year, which was well ahead of the stock market as a whole. The biofuels sector was the star performer. In early 2007, new listings slowed somewhat, with \$1.8 billion raised in the first quarter, however, listed stocks continued to perform with a further 33% in the first quarter of 2007.

**New asset financing in renewable energy generating plants in 2006 was \$27.9 billion, an increase of 23% over 2005.** Early indications in 2007 suggest that this pace is set to continue. Wind is the largest sector (followed by biofuels), however, shortages of key components (e.g. wind turbine gearboxes) have slowed down the rate of installation. New financing structures have emerged as an increasing number of traditional and innovative investors become attracted to RE, especially wind energy. Utilities with RE targets are building wind portfolios through acquisition, which is increasing overall price. The US is the leader, followed by Germany and Spain, and then China. Besides asset finance for generating plants, an additional \$9.3 billion was invested in small-scale installations such as rooftop solar photovoltaics (PV) and solar water heating.

**Mergers and Acquisitions (M&A) activity was up 34% in 2006, with deals valued at \$16.9 billion.** Most activity was in the wind sector - more than 40% of deals by value. Leading players in the renewable energy sector are taking strategic stakes. Increasingly, manufacturing companies are looking to vertical integration to secure supplies of key components. There is a trend towards companies in developing countries acquiring assets in OECD countries, suggesting a buy rather than build approach. Widespread availability of cheap capital is enabling this strategy.

**Currently, \$18 billion is under management in approximately 180 investment funds that are focused on sustainable energy.** Both publicly quoted and private funds have seen high growth since 2005 (43% and 59%, respectively). Private funds are split across specialist and, more recently, generalist fund managers who have recognised the value – and profile – of sustainable energy investment. The challenge all funds face is the availability of high quality investments.

**Carbon funds now total \$11.8 billion, with the private sector providing most of the new money coming into the market.** Growth of investment in the project development sell-side of the market shows that money is flowing into the development and commercialisation of Clean Development Mechanism (CDM) and Joint Implementation (JI) projects. The net shortfall in project development activity is currently estimated at around \$11 billion. Of the CDM projects currently in the pipeline (total 1,825), more than half (64%) relate to renewable energy (wind, geothermal, tidal, hydro, biomass or solar) and energy efficiency. These, however, represent only a fifth of the total Kyoto first commitment period credits.

**Energy efficiency is a significant, but largely invisible market, which is now attracting an increasing share of the limelight as investors realise its role in addressing growing global energy demand.** Investment in technologies was the most visible segment of the EE market: in 2006, \$1.1 billion was invested in EE, compared with \$710 million in 2005, which was due to strong support from multinationals and governments.

**Capital has shifted to developing countries, which saw higher private investment in 2006.** This reflects stronger Foreign Direct Investment (FDI), as well as private capital mobilising within emerging markets. China, India and Brazil are all now major producers of and markets for sustainable energy, with China leading in solar, India in wind and Brazil in biofuels. However, barriers to FDI remain, such as restrictions on foreign ownership in China, causing a prevalence of foreign-local joint ventures. Developing countries face the challenge of fast-growing energy demand combined with less mature capital markets (although this is improving) – which skews investment towards conventional, mostly fossil-fuel generation. Innovative work continues on designing financial instruments to encourage investment and manage risk in developing countries

**In conclusion,** sustainable energy markets are becoming more liquid and more global. The various forms of capital now being deployed across the value chain signal the sector's shift into the mainstream. Given the maturing sector fundamentals, the recent capital build-up does not appear to be a sign of short-term volatility, but part of a longer-term trend. With individual sectors there is considerable volatility, however, risk and uncertainty can be diversified across technologies and geographies. These trends have continued through the first half of 2007, with new investment globally in sustainable energy expected to total \$85 billion for the year.

What these figures represent is not a fine-tuning of the current global energy system, but rather full-scale economic development. Investment growth is underpinned by clean energy policy initiatives. Despite the considerable discussion about the need for energy technologies of tomorrow, the investment community already believes that the technologies available today are ready to decarbonise the energy mix.



# Overview of Investment Trends

# 1

- Sustainable energy investment was \$70.9 billion in 2006, an increase of 43% over 2005. The upward trend continues in 2007, with \$85 billion forecast for the year.
- Sectors with highest levels of investment are wind, solar and biofuels, reflecting technology maturity, policy incentives and investor appetite.
- Investors are seeing value creation, with NEX index of clean energy stocks increasing 33% in 2006 and 25% in first quarter 2007.
- The largest share of investment is going to the US and EU-27, with US companies receiving more technology and private investment, and EU-27 capturing the majority of publicly quoted companies.
- Investment in developing countries is increasing in response to government commitments and supply-chain development.

## 1.1 Global Investment in Sustainable Energy

Sustainable energy worldwide continues to attract strong capital investment at all stages of the financing lifecycle. This report shows that investment in sustainable energy worldwide has more than doubled in the last two years, from \$27.5 billion in 2004 to \$49.6 billion in 2005 and \$70.9 billion in 2006 (Figure 2). Investment of \$85 billion is now forecast for 2007.

This trend partly reflects continuing concerns about climate change and energy security. However, other drivers are at work, such as an underlying shift in investor sentiment towards renewable energy and energy efficiency that is enabling the overall sector to reach a critical mass, which itself fosters further growth.

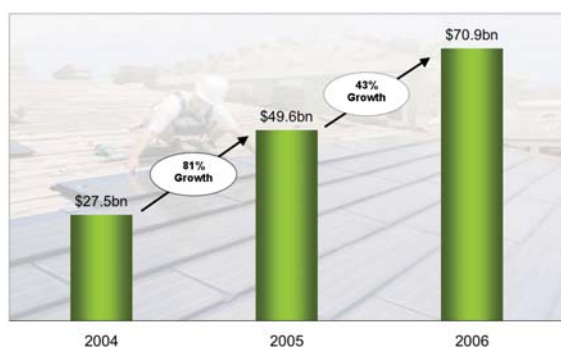
A number of events in 2006 helped push sustainable energy up the political agenda, including the US mid-term elections in November, which confirmed clean energy as a mainstream issue. The Stern Review on the Economics of Climate Change made a strong economic case for investing in low carbon technologies now, while arguing that economic growth need not be incompatible with cutting energy consumption.

Growing consumer awareness of sustainable energy – and the longer-term potential for cheaper, not just greener energy - has become another fundamental driver of the sector's growth. The 43% increase in investment in sustainable energy from 2005 to 2006 was also driven by the persistently high oil prices, which averaged more than \$60-a-barrel over the 12 months of 2006.

The surge in sustainable energy investment activity has led some commentators to compare it with the technology boom of the late 1990s and early 2000s.

However, not only does the volume of investment flowing into clean energy dwarf the dotcom boom, clean energy sector growth has continued for longer than the dotcom boom lasted and is showing no sign of abating. Furthermore, renewable energy and energy efficiency are underpinned by real demand and growing regulatory support (which the dotcom boom did not have), as well as considerable tangible asset backing by manufacturers and project developers.

Figure 2. Global Investment in Sustainable Energy, 2004 – 2006



Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of renewable energy projects, nor investor exits made through Public Market / OTC offerings.

Source: New Energy Finance

Venture capital, private equity and public market investment have experienced the strongest growth (Figure 3). New investment through venture capital and private equity totalled \$7.1 billion worldwide in 2006, an increase of 163% over 2005 levels (Figure 4). This boom is also more than just a short-term trend: there is a healthy number of VC/PE-funded companies emerging on the public markets – as evidenced by strong IPO activity – and high exit multiples are in turn encouraging new early-stage investment.

Investment via public markets increased by almost as much - 140% - to \$10.3 billion, with the flow of initial public offerings of clean energy companies particularly strong in the second and final quarters of 2006.

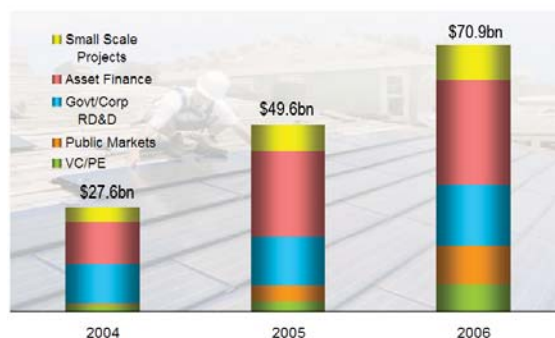
Other categories of investment also saw strong growth in 2006, albeit not at the same stellar rates as venture capital, private equity and public markets. Government and corporate R&D increased by 25% to \$16.3 billion.

Financings of new generation and capacity assets by private companies tapping the financial system rose by 23% to \$27.9 billion. Asset financing remains the largest single source of sustainable energy investment, accounting for nearly 40% of the 2006 total of \$70.9 billion. This reflects the sector's coming of age, as money flows into developing projects and not just technology or early-stage expansion. Not surprisingly, most asset financing deals were in the relatively mature wind sector, followed by biofuels, which experienced a surge of interest in 2006.

Small-scale renewable projects increased from an estimated \$7 billion in 2005 to \$9.3 billion in 2006 (up 33%). Investor interest in this end of the market is mostly driven by clean energy rollout in OECD countries, although some developing country markets are also significant, like solar water heating in China.

During the first quarter of 2007, \$2.2 billion of venture capital and private equity flowed into the clean energy industry worldwide, an increase of 58% over the same quarter in 2006 and 60% over the fourth quarter of 2006. A few large deals dominated this investment activity, such as later-stage leveraged private equity investments. By contrast, the \$1.5 billion raised in the public markets in the first quarter of 2007 was 18% less than in the same period in 2006.

Figure 3. Global Investment in Sustainable Energy by Type, 2004 – 2006



Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of sustainable energy projects, nor investor exits made through Public Market / OTC offerings.

Source: SEFI, New Energy Finance

Figure 4. Global Investment in Sustainable Energy, 2006



Note: Grossed-up values based on disclosed deals. Figures marked \* are based on NEF Desktop database; all other figures are based on industry estimates derived from various sources.

Source: New Energy Finance

Table 1. Sustainable Energy Investment by Asset Class, 2006

| Investment Type (\$bn)               | Total | VC  | PE Growth | PIPE | OTC | PE Buy-Out | PM   | PM Exits | AF   | AF Re-fin. | AF Acq | M&A  | Figures                   |
|--------------------------------------|-------|-----|-----------|------|-----|------------|------|----------|------|------------|--------|------|---------------------------|
| VC & PE (excl PIPE & OTC)            | 6.8   | 1.8 | 3.6       | -    | -   | 1.4        | -    | -        | -    | -          | -      | -    | 14, 15, 16, 17, 18        |
| VC & PE (new investment)             | 7.1   | 1.8 | 3.6       | 1.3  | 0.5 | -          | -    | -        | -    | -          | -      | -    | 1, 3, 4                   |
| All VC & PE Transactions             | 8.6   | 1.8 | 3.6       | 1.3  | 0.5 | 1.4        | -    | -        | -    | -          | -      | -    | 8, 13                     |
| Public Markets (new investment)      | 10.3  | -   | -         | -    | -   | -          | 10.3 | -        | -    | -          | -      | -    | 1, 3, 4                   |
| All Public Market Transactions       | 12.3  | -   | -         | -    | -   | -          | 10.3 | 2.0      | -    | -          | -      | -    | 7, 23, 24, 25, 26, 27, 28 |
| Asset Financing (new investment)     | 27.9  | -   | -         | -    | -   | -          | -    | -        | 27.9 | -          | -      | -    | 1, 3, 4                   |
| Asset Financing (incl. refinancings) | 32.3  | -   | -         | -    | -   | -          | -    | -        | 27.9 | 4.4        | -      | -    | 6, 30, 31, 32             |
| All Asset Financing Transactions     | 37.1  | -   | -         | -    | -   | -          | -    | -        | 27.9 | 4.4        | 4.8    | -    | 29                        |
| M&A Corporate only                   | 16.9  | -   | -         | -    | -   | -          | -    | -        | -    | -          | -      | 16.9 | 33, 34                    |
| All M&A Transactions                 | 29.5  | -   | -         | -    | -   | 1.4        | -    | 2.0      | -    | 4.4        | 4.8    | 16.9 | 10                        |



## 1.2 Investment by Technology

Investment in sustainable energy in 2006 was widely spread over the leading technology sectors wind, solar, biofuels, and biomass & waste. Overall, the wind sector attracted the most investment – 38% of the total – followed by biofuels (26%) and then solar (16%) (Figure 5).

These headline figures, however, conceal significant variations in the type of finance favoured by each of these sectors, which largely reflects a particular technology's maturity and its underlying supporting subsidy regime.

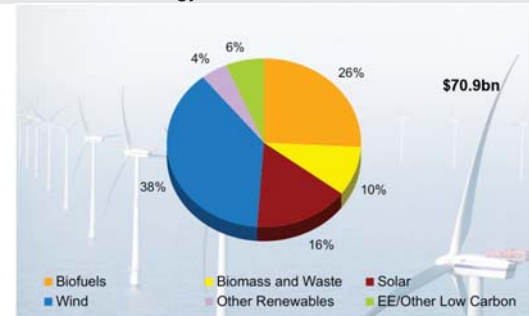
Wind and biomass are the two longest-established renewable energy generation technologies, and consequently much of their capital raised is in the form of asset financings. Wind dominated asset financings in 2006, accounting for more than 50% of the capital invested in this class (Figure 6).

Solar is the next most mature technology and, accordingly, receives most of its capital via share issues in the public markets for manufacturing equipment expansion. Solar dominated in the public market arena in 2006. It experienced \$5.7 billion of investment activity, putting biofuels in second place with \$3.1 billion (Figure 7), and wind in third place with a relatively modest \$1.4 billion. Solar IPOs experienced a boom in 2006, and there is an estimated pipeline of up to 35 IPOs in 2007, including several Chinese companies.

Biofuels stole the limelight in 2006, emerging as a dynamic but high-risk sector, with particular interest seen in the US. It attracted investment mainly at a VC/PE level, but also stood out in asset financing and on the public markets. Biofuels dominated VC/PE investment activity in 2006 (Figure 8) with \$2.9 billion flowing into the sector – twice as much as the next strongest VC/PE technology, solar, with \$1.8 billion.

Small hydro has been difficult to monitor, as it is seen as a small – and therefore poorly reported - business area within the more mature hydropower industry. Technology developments are often being explored – and funded – within the R&D departments of the large hydro players, and many mini-hydro projects are developed by local governments and are hard to track. Small hydro activity is largest in China, where domestic commercial banks are most active in the sector.

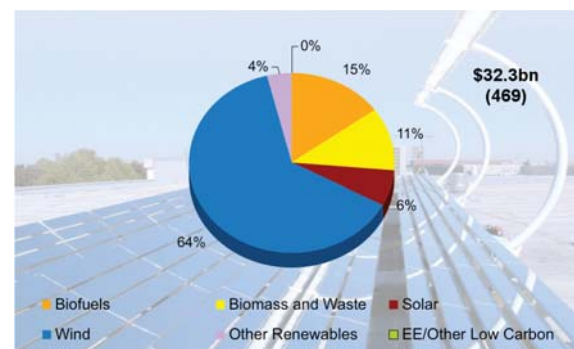
Figure 5. Global Investment in Sustainable Energy by Technology, 2006



Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of projects, nor investor exits made through Public Market /OTC offerings.

Source: SEFI, New Energy Finance

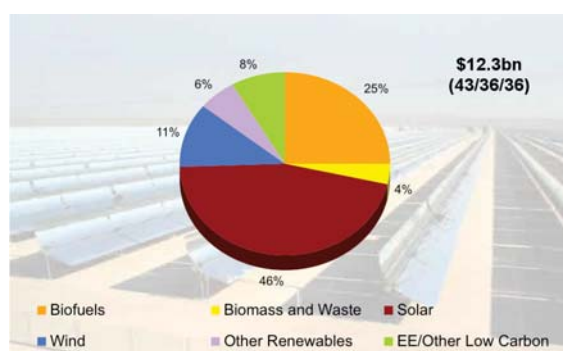
Figure 6. Asset Financing Investment Activity by Technology, 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals).

Source: SEFI, New Energy Finance

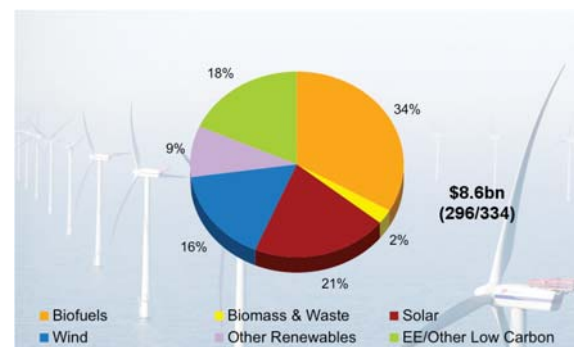
Figure 7. Public Market Investment Activity by Technology, 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other).

Source: SEFI, New Energy Finance

Figure 8. VC/PE Investment Activity by Technology, 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals).

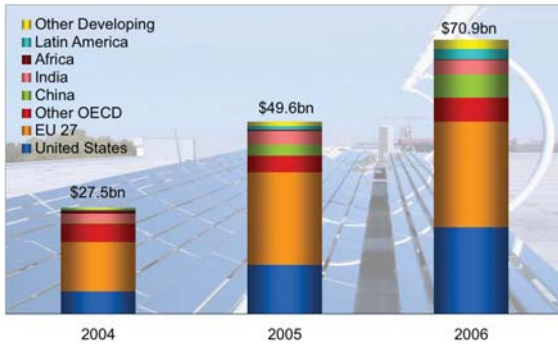
Source: SEFI, New Energy Finance

## 1.3 Investment by Region

Investment in sustainable energy soared in most regions of the world in 2006, with the heaviest capital flows in the US, EU-27 and large emerging economies such as China and India (Figure 9).

The US is the largest single destination globally for venture capital and private equity investment. In 2006, venture capital and private equity investors poured \$4.9 billion of new money into clean energy companies and projects in the US.

Figure 9. Global Investment in Sustainable Energy by Region, 2004 – 2006: \$ billion



Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of projects, nor investor exits made through Public Market /OTC offerings.

Source: SEFI, New Energy Finance

This will surprise some who have criticised the US Government's refusal to sign the Kyoto Protocol. However, the enabling environment for innovation in the US is very strong, with the venture capital industry now a significant source of capital formation in the clean energy sector. Some federal regulations are also helping, such as the production tax credit, and there is plenty of impetus below the federal level coming from state and local governments and from private sector investors and businesses.

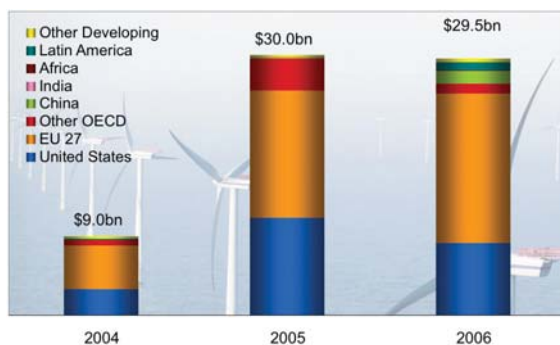
While the US dominated in venture capital and private equity, EU-27 attracted the most significant public market investment in 2006: \$5.7 billion compared with \$3.5 billion in the US. This is partly due to the higher awareness of climate change and the role of renewable energy and energy efficiency in the EU, who ratified

the Kyoto Protocol, unlike the US and Australia. A number of EU countries offer generous incentives to promote renewable energy (such as the German feed-in tariff) and are starting to do so with efficiency. These factors help to explain why stock market investors in the EU have been particularly ready to pour money into renewable energy, and why companies there have reached a relatively mature stage in their development.

Meanwhile, many US firms are still going through earlier stages in their

development, a large number of them spurred on by the biofuels and solar boom. This activity has attracted heavy investment from venture capitalists and private equity funds

Figure 10. M&A Activity by Region, 2004 – 2006



Note: Grossed-up values based on disclosed deals. The figures include PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

The European market's relative maturity also explains why it dominated M&A activity in 2006, which reflects consolidation among established players (Figure 10). Sustainable energy M&A deals worth more than \$20 billion took place in 2006. M&A volumes in the US at \$8.8 billion were relatively modest by comparison. It is important to note that M&A activity does not represent new investment into the sector, but involves money changing hands between investors.

The growth in public companies in EU-27 has also stimulated M&A activity, creating an environment where values are set by public markets and an open playing

field for competitive bidding (for example, Suzlon's and Areva's competing bids for German wind company REpower).

Investment in sustainable energy is still mostly in OECD countries, with the US and EU together accounting for more than 70% of investment in 2006. However, investment in developing countries is growing quickly with 21% (\$15 billion) of global sustainable energy investment in 2006 as compared with 15% (\$4.2 billion) in 2004 (Figure 11).

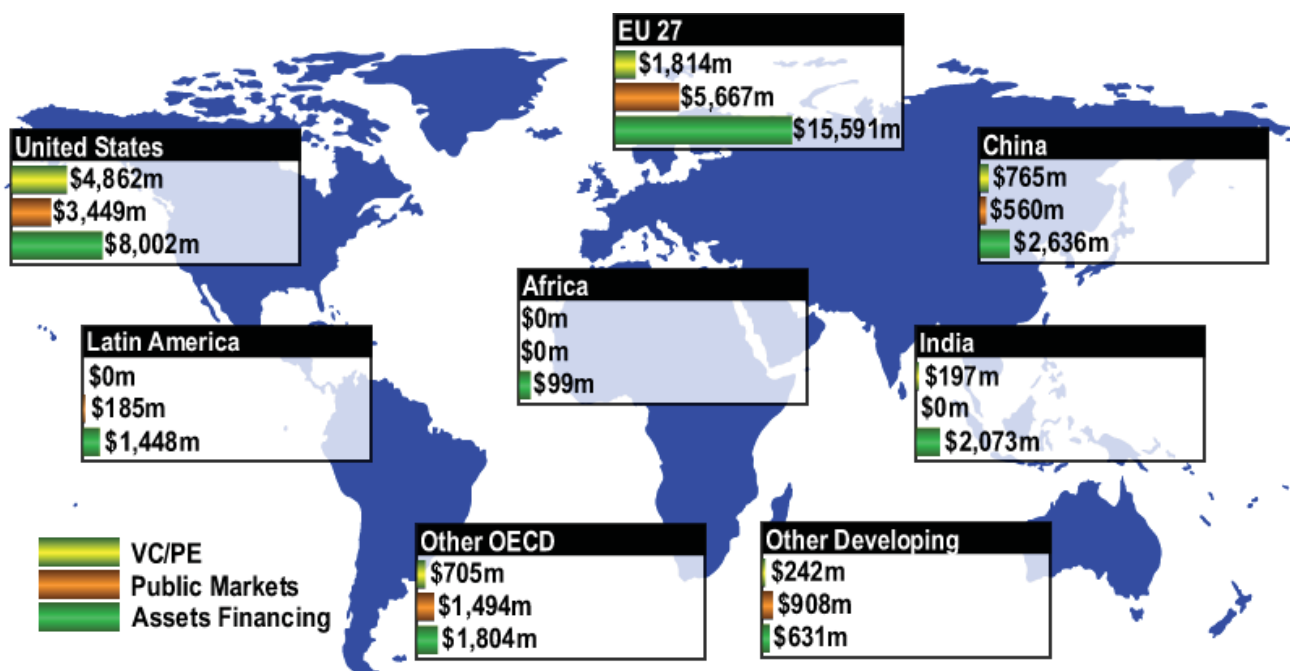


China, however, took a healthy 9% of global investment, which was helped by significant asset financing activity in the wind and biomass & waste sectors. Although four Chinese solar companies went public during 2006, the value of these deals is not included in China's share, as the IPOs took place on foreign exchanges. India lagged a little behind China, but on the back of Suzlon was the largest net buyer of companies abroad in 2006, mostly in the more established European markets. Latin America took 5% of global investment, most of which flowed into financing bioethanol plants in Brazil. Sub-saharan Africa notably lagged behind other regions.

OECD countries have a distinctly broader financing spectrum than developing countries (Figure 11). Asset finance dominated the funding mix, although the US also attracted significant VC/PE investment, which was equivalent to half its asset finance investment. This was a far higher proportion than in either the EU-27 (11%) or other OECD countries (28%). The US's technological leadership relative to other developed countries is discussed further in the VC/PE and R&D sections.

By contrast, investment in Africa was very small and purely in asset finance. Investment in India and Brazil was mostly asset finance in wind and biofuel plants, respectively. China received investment across the spectrum, from venture capital through to public markets, reflecting the country's increasingly prominent position in sustainable energy.

Figure 11. Global Investment in Sustainable Energy, by Type and Region, 2006



Note: Grossed-up values based on disclosed deals. VC/PE figures: include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals). Public Market figures: represent location of exchange on which a company raises money, not location of the company. Includes investor exits made through Public Market offerings. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Asset Financing figures: represent total investment, and so include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals).

Source: SEFI, New Energy Finance

# Putting Sustainable Energy Investment into Perspective

## 2

- Renewable energy accounts for a far more significant share of power generation investment (\$21.5 billion, or 18%) than it does of installed capacity (2%).
- RE will take an increasing share of the power sector as the \$25 billion in additional investment in technology and manufacturing feeds through into installed capacity.
- The finance community has been investing at levels that imply that expected disruptive change is now inevitable in the energy sector.

Renewable energy and energy efficiency are no longer niche sectors that are promoted only by governments and environmentalists. The increased levels of investment and the fact that much of the capital is coming from more conventional financial actors suggest that sustainable energy options are in fact becoming mainstream. Do these developments indicate true disruptive change to the energy sector, or do they still relate to only a small part of the global energy mix?

According to the IEA's World Energy Outlook 2006,<sup>1</sup> new renewables (not including hydro) today only account for 0.5% and 2%, respectively, of the global energy and power sectors. Since the capital stock turnover is very slow - most generating facilities have 40 to 60-year operating lives - these figures say little about today's technology choices and even less about the future energy mix. Mostly, they give a picture of the technology options that were available in the 1950s through 1970s, when most of today's plants were built.

To get perspective on the current and future role of sustainable energy technologies in the energy mix, it is more useful to look at today's investment trends. In 2006, \$110 billion - \$125 billion was invested in about 120 GW of new power generation globally. Of this investment, \$30.8 billion was in new renewables, which includes \$21.5 billion of asset finance in new generating plants and the remainder in small-scale systems, such as rooftop solar. The \$21.5 billion in renewables plant financing represents about 18% of total power sector investment. In terms of newly installed generating capacity in 2006, renewables provided 14% to 15% of the total, with wind alone accounting for 12% or 14GW. At first glance, these figures imply that renewables are more expensive than conventional options, costing on average 28% more per installed GW. However, they do not take into account operating expenditures and specifically fuel costs, which are much higher for fossil fuelled plants. For instance, in developing countries fuel costs alone on an annual basis are equivalent to investments in generating capacity.<sup>2</sup>

Another financing trend to consider is the level of investment in new technology and manufacturing capacity. In 2006, on top of the \$21.5 billion invested in new generating capacity, the RE sector received an additional \$25.2 billion in new technology and manufacturing capacity investment. This is in stark contrast to the rest of the energy industry, which on the whole has seen R&D spending from public and private sources stagnating or on the decline.<sup>3</sup> The RE sector's very high level of investment in technology & manufacturing capacity indicates that investors are expecting strong growth for the sector. When the \$21.5 billion in asset finance, the \$9.3 billion in small-scale systems and the \$25.2 billion in new technology and manufacturing capacity are added up, total 2006 investment in RE power sector comes to \$59 billion, a significant figure no matter how it is compared with global power sector investment.

Looking forward, the IEA's WEO 2006 predicted that new renewables (ex hydro)

would provide 11% of new capacity additions between 2004 and 2015. This forecast seems to be on the low end, since in 2006, the wind sector alone provided nearly 10% of new capacity and its growth has been more than nine times faster than that of the power sector as a whole (24% versus 2.6%). The wind industry has recently forecast 19% growth out to 2010, which would see wind accounting for 18% of global capacity additions in that year.<sup>4</sup>

Forecasting growth rates for energy technologies is a difficult undertaking. Normally, one would expect the proponents of a technology to be overly bullish and the general energy sector analysts and capital providers to be more neutral. Today's investment trends indicate, however, that in the sustainable energy sector the capital providers are now more aligned with industry proponents in terms of expected growth. In fact, the investment community now seems to deviate markedly from conventional energy sector pundits. \$59 billion would not have been invested in RE power sector financing in 2006 if investors had been expecting RE growth to drop from over 20% last year down to 8% - a drop that would be necessary for the IEA's 2015 predictions to hold true.

Looking out further to 2030 or beyond, it is very difficult to predict which technologies will dominate the mix. The IEA in the WEO 2006 predicts that renewables will account for only 9% of the power sector in 2030, or 12% under the Alternative Policy Scenario. Table 2 lists a number of growth scenarios for renewable energy and the corresponding share of new capacity and installed capacity in the year 2030. The table shows that in addition to being more conservative than investment flows would indicate, the IEA figures in the WEO 2006 are also at the lower end when compared with other RE growth rate scenarios.

In terms of climate change mitigation, the table shows for each scenario how many gigatonnes of CO<sub>2</sub>e emission reductions would result from the RE sector annually by 2030. This analysis builds off the conceptual climate wedge framework developed by Pacala and Socolow at Princeton University<sup>6</sup> and specifically looks at the climate mitigation potential of new RE plants displacing coal generation. Whether RE power generation will account for 16% or 47% of CO<sub>2</sub> reductions in 2030 is unclear, however it is clear that it will be a major contributor to climate stabilization. And this analysis does not include the CO<sub>2</sub> reduction potential of hydro generation and non-power sector renewables such as biofuels.

Looking at the energy efficiency sector, although the investment trends are harder to identify, the impacts of improving energy efficiency can be valued economically.

Table 2. RE Power Sector Growth Trajectories to 2030

| Power Sector RE Growth Scenario (2007 – 2030)  | RE Capacity In 2030 (GW) | RE Share and Rank of New Capacity Additions (2004 – 2030) | RE Share and Rank of 2030 Installed Capacity            | Carbon Mitigation in 2030 (GT) | Share of Total Carbon Mitigation Needed in 2030 to Stabilize Emissions |
|--|--------------------------|---|---|--------------------------------|--|
| RE grows at 7%, the rate needed to reach 9% of 2030 installed capacity (figure forecast by WEO 2006 <sup>6</sup> ) | 674                      | 15%, ranking 3rd, after gas and coal                      | 9%, ranking 4 <sup>th</sup> , after coal, gas and hydro | 0.6                            | 16%  |
| RE grows at 10%  | 1300                     | 32%, ranking 1 <sup>st</sup> , ahead of gas and coal      | 17%, ranking 3 <sup>rd</sup> , after coal and gas       | 1.2                            | 34%  |
| RE grows at 19% until 2010 (forecast by GWEC), then 10% thereafter   | 1781                     | 44%, ranking 1 <sup>st</sup> , ahead of gas and coal      | 23%, ranking 3 <sup>rd</sup> , after coal and gas       | 1.7                            | 47%  |

Notes: Calculations based on the following assumptions and sources: 2006 installed RE (ex-hydro) capacity of 132; Global generating capacity in 2004 and 2030 of 4054 GW and 7875 GW respectively (WEO2006); Ave 2004 capacity factors for RE and coal of 44% and 64% (WEO2006); 1GT of carbon mitigated by displacement of 700GW of coal (Socolow); 3.5GT of emissions reduction or 3.5 Socolow wedges will be required to stabilize 2030 emissions at 2004 level.

Investments in supply side and demand side efficiency have been helping decrease global energy intensity, which on average has been dropping 1% to 1.5% per year. Since 1990, energy efficiency has met one-half of all new demand for worldwide energy services. These savings – 3 billion tones of oil equivalent – have a value of \$6 trillion if an average oil price of \$27 is assumed (UNF 2007).<sup>7</sup> The carbon mitigation impact is also significant, even larger than the contribution of renewables. The challenge is to accelerate historical energy intensity improvement trends to levels around 2% or above, which compounded to 2030 means a 61% improvement in energy production and end use efficiency.

The sustainable energy sectors, combining renewable energy generation and transport fuels with improved supply and demand side efficiency, together have the potential to change the structure of today's energy sector, using current technology and building off of a widening array of enabling policy frameworks. The finance community has seen this potential and has been investing at a level that implies their belief that disruptive change is now possible and inevitable in the sector.



# Underlying Changes in the Finance Sector

# 3

- Investment in renewable energy remains more policy than purely commercially driven.
- Investor appetite suggests that existing technology is ready for scale-up now, and that renewable energy can increase its share of the energy mix without waiting for further technology development.
- Onshore wind is now an established commodity, while offshore wind continues to be difficult to finance.
- Greening of industry and public environmental awareness are key drivers for renewable energy / energy efficiency.
- Market has reached a critical mass, so that oil prices falling below \$40 will slow investment in some areas, but not stall it altogether.

The year 2006 saw a continuing positive shift in the attitude of financiers to risk associated with renewable energy, which in turn is broadening the range of financial instruments available to renewable energy investors. The most established technologies like wind are benefiting from lengthening maturities and lower borrowing costs, while equity finance, from venture capital through to public markets, continues to be widely available for all renewable technologies.

Four years ago, banks were only interested in mainstream financing for renewable energy, such as the wind sector in Germany. Now, they are being swept along by a surge in interest in renewable energy and energy efficiency and are responding by developing innovative financing and by broadening their exposure beyond mature technologies in stable markets.

These trends are being driven by a range of factors, including concerns about energy security and climate change, and governments putting renewable energy near (if not at) the top of the political agenda. The US, for example, dramatically changed its attitude to biofuels at a federal level during 2006, which resulted in a biofuels boom.

The general greening of industry is another related driver, with more companies than ever reporting on their environmental performance. Growing public cynicism about 'greenwash' – lip service paid by companies to their sometimes non-existent environmental credentials – is fostering an underlying shift towards companies practising what they preach. According to CorporateRegister.com, the number of companies worldwide reporting on their environmental and social performance is increasing steadily (Figure 12). In the UK more than 80% of the FTSE100 companies have a Corporate & Social Responsibility Report (including environmental reporting) of more than six pages. In the United States 31 states representing more than 70% of the US population have teamed up to create The Climate Registry, an initiative that tracks greenhouse gas emissions.

There has been a fundamental shift in attitude to renewable energy and energy efficiency, by both consumers and businesses. They expect governments to

Figure 12. Growth in CSR Reporting Worldwide, 1992 – 2006



Note: Data includes 13,621 reports from 3694 different companies across 91 countries.

Source: CorporateRegister.com

address climate change and to build renewable energy and energy efficiency into their policies.

Perhaps as a result of this, investment in renewable energy remains policy rather than purely commercially driven. While oil and gas price increases have made renewable energy more competitive in its own right, government support is still needed to stimulate investment. Markets with strong consistent political support (such as Germany) have clearly thrived, while those with stop-start mechanisms (such as the US with its Production Tax Credit) and a bias towards domestic players (such as China with its wind industry) have developed unevenly. Different policies work in different regions and for different technologies, but broadly speaking, policies that reduce the time to market for renewable energy projects (for example, by speeding up the planning process) and give investors reasonable certainty about future support will foster investment. Policy frameworks also affect markets in countries where electricity is heavily subsidised (such as India), and where without government intervention, it is even harder for renewable energy to become commercial.

Increased interest by investors (and beyond) in renewable energy, however, is spurring governments to come up with supportive policies, which is creating a virtuous circle. In particular, investors are confident that certain renewable technologies are ready for scale-up (such as offshore wind, and wave and tidal generation) and that renewable energy can increase its share of the energy mix now, without waiting for further technology development. The weight of money and public opinion is forcing policy makers to adapt accordingly.

Several renewable technologies have now reached a critical mass, which virtually ensures their survival, regardless of the economic backdrop or the challenges of global warming. Investors believe that onshore wind, for example, would now be relatively immune to oil prices falling below \$40 per barrel (although those sectors in direct competition with oil, such as biofuels, would be likely to suffer more, as recent evidence suggests).

Driven by investor confidence and greater competition for deals, a wider range of financing options has become available to borrowers. The bond market is open to onshore wind projects (though new issuance remains very limited) and rating agencies are comfortable evaluating their risks. Onshore wind has been a particular beneficiary of the trend towards mainstream financing, with a 331MW wind farm portfolio of assets in Germany and France being financed in the debt capital markets in the groundbreaking Breeze 2 deal in May 2006. To date, there have been very few bond issues or securitisations in the renewable energy sector, with Breeze 2 (and its precursor Breeze 1) the only bond issues offering investors exposure to the wind sector.

Private debt investors now offer developers greater flexibility, providing not just pure project finance, but also portfolio and turbine finance for wind, with some lending to the solar and biofuels sectors as well. Debt investors are also increasingly willing to assume off-take risk, which gives them an edge in the increasingly competitive financing market.

But it is not only project developers who have benefited from a positive shift in investor perception and surge of money into the sector. As discussed in the public markets section of this report, listed renewable energy companies have seen their shares soar over the course of 2006, and most IPOs in the sector have been enthusiastically received and comfortably oversubscribed. EU-27, in particular, has seen a surge in public market activity and the strong deal pipeline suggests this is set to continue.

The US is experiencing a wave of venture capital investment in renewable energy, with noticeable interest from former technology entrepreneurs during 2006: Vinod Khosla, Bill Gates and Richard Branson are actively investing in biofuels. In addition, former president Bill Clinton, former vice president Al Gore, and former



World Bank president James Wolfenson have all become involved in asset and carbon financing.

The year 2006 also saw a growing number of cross-border deals, which reflects the situation of too much money chasing too few deals, driving asset prices higher. Companies in developing countries have become more aggressive, notably Indian wind turbine manufacturer Suzlon, which has made a number of overseas acquisitions over the past year.

Nevertheless, there is still some way to go. Investor enthusiasm for renewable energy is far from evenly distributed across technologies, types of projects and different regions. Offshore wind projects continue to be approached with caution, with projects running into difficulties with planning and sourcing turbines, and in other emerging sectors of the market major non-or limited-recourse financing is sporadic.

Geographically, too, investment is concentrated in areas where resources, technologies, policies and financial markets are relatively mature. Investors are still sticking to the markets they are familiar with and understand - predominantly EU-27 and the US - even though they openly acknowledge that emerging economies such as India, China and Brazil will become the most important renewable energy markets in the medium term, with massive financing needs.

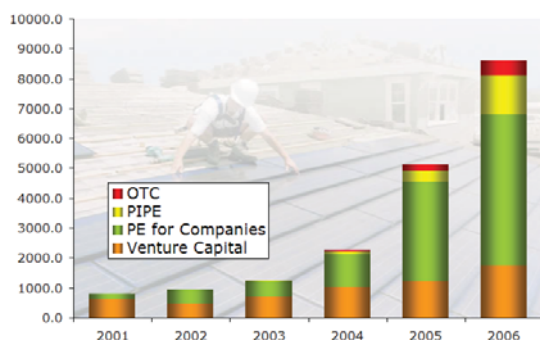


# Venture Capital and Private Equity

## 4

- There was a strong increase in both VC and PE activity from 2005 to 2006 (\$5.1 billion to \$8.6 billion, 297 deals to 334).
- VC activity has moved up the maturity spectrum, with later funding rounds attracting most investment.
- Investment in China increased noticeably during 2006, most of which was PE for solar manufacturing expansion.
- Biofuels, biomass & waste, solar and wind in roughly even shares dominated private equity investment for expansion.

Figure 13. VC/PE Investment by Type, 2000–2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. PE invested in projects is excluded. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

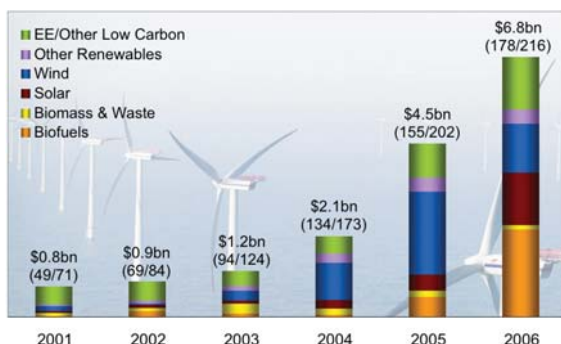
Figure 14. VC/PE Investment by Type, 2006



Note: Grossed-up values based on disclosed deals. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

Figure 15. VC/PE Investment by Sector, 2000-2006



Note: Grossed-up values based on disclosed deals. The figures include PE buy-outs, but exclude OTC & PIPE deals. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

Venture capital and private equity investment activity in sustainable energy totalled \$8.6 billion in 2006, an increase of 69% over \$5.1 billion in 2005. The number of deals increased by 12% (Figure 13).

In 2006, private equity dominated VC/PE investment, accounting for well over half of the investment in this category. Of the private equity expansion capital, \$3.6 billion was invested in existing companies, with a further \$1.4 billion changing hands through buy-outs and corporate spin-offs. Much of this went into the US biofuels industry.

Although 2006 saw lower venture capital flows than private equity, especially at the early stages, VC funding nevertheless held its own in terms of number of deals: 148 deals were completed compared with 74 in private equity. A relatively modest \$42 million was invested in renewable energy companies in the form of seed capital or angel finance. The level of investment increased through further VC rounds, reflecting the growing number of technologies reaching commercialisation (Figure 14).

Private equity investors are also using over-the-counter (OTC) markets and PIPEs (private investments in public equities) to increase their exposure to these sectors. A total of \$1.8 billion was raised in 2006 through OTC and PIPE transactions – an increase of 200% over 2005.

The three most active sectors for venture capital and private equity finance in 2006 were biofuels, solar and wind, accounting for \$2.3 billion, \$1.4 billion and \$1.3 billion, respectively (Figure 15). Most of this money was used to increase manufacturing capacity, particularly in wind. However, in solar a significant proportion of the capital invested – around 40% - went into developing new technologies. In biofuels the proportion was about 20% (Figure 16), reflecting the surging first generation (corn-based) ethanol industry in the US, as well as research into second generation biofuels, including cellulosic ethanol.

In 2006, there was a healthy interest in newer renewable and energy efficiency technologies. VC/PE investors invested nearly \$1.0 billion in energy



efficiency (power architecture and energy smart buildings), and a total of \$371 million in the related sectors of fuel cells and hydrogen.

Marine technology, on the other hand, attracted relatively little VC/PE funding during 2006 – just \$55 million – which reflects the ‘wait-and-see’ attitude that is dominating the sector. Several marine companies now have pilot projects being tested in the water, and while investors are clearly interested in the technologies, there seems to be a hiatus until the results are clear and winners start to emerge in this sector.

In geographical terms, the US dominated venture capital and private equity transactions in renewable energy in 2006, accounting for \$3.8 billion (Figure 17). The total for EU-27 countries was just \$1.5 billion, less than half the US figure.

The US has a long-established VC/PE investor base and a strong track record in developing new technology. It also sees renewable energy as the new tech boom. Since 2000, US companies have attracted well over \$6 billion in VC/PE funding, around nine times more than their nearest rivals in Australia, Spain and UK, each of whom has attracted around \$850m of VC/PE investment. Of this, 70% was private equity for expansion in China’s solar sector. In 2006, China followed the US in terms of value of VC/PE investment. It accounted for 74% of VC/PE investment in developing countries, which increased dramatically in 2006.

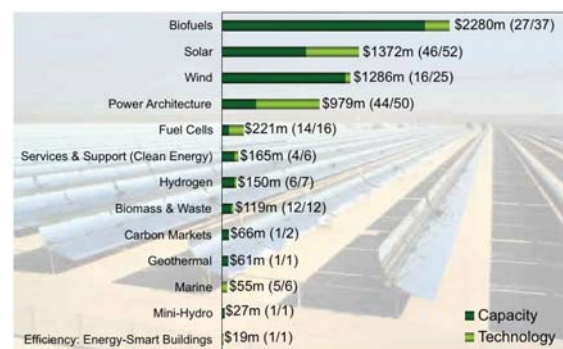
As China’s economic growth continues apace, an increasing number of investors that are attracted by the heady combination of strong growth and the government’s commitment to clean energy are looking for opportunities. The spectacularly successful IPO of Chinese solar company Suntech at the end of 2005 sparked investor interest in finding the next success story out of China. Since then, a steady stream of solar IPOs has followed into early 2007, with many more in the pipeline.

The venture capital sector, in particular, is likely to benefit from the Chinese Government’s desire to boost domestic technological innovation. The National Guideline on Medium- and Long-Term Programme for Science and Technology Development (2006-2020) aims to reduce the country’s reliance on foreign technologies from above 50% to 30% by 2020. The Chinese Government hopes to cultivate home-grown, internationally competitive technologies by implementing preferential policies and channelling investment to promising companies.

By contrast, European companies lag behind in raising VC/PE funding (Figure 18). VC/PE investment in EU-27 actually fell slightly between 2005 and 2006, despite the strong global rise. It is interesting that the UK, Germany and France, which are major European economies with important financial sectors, accounted for a very small share of VC/PE flows into sustainable energy.

This may be due to the deeper financial markets and an increasingly sophisticated investor base in Europe, which is broadening the range of options available to growing companies and enabling them to access the public markets sooner than in other countries. London Stock Exchange’s Alternative Investment Market (AIM), for example, has become a focal point for renewable energy companies seeking capital, particularly over the past couple of years. AIM is less regulated than many other markets

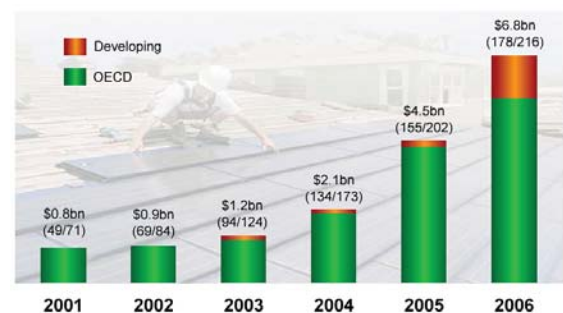
Figure 16. VC/PE Investment by Sector, 2006



Note: Grossed-up values based on disclosed deals. The figures include PE buy-outs, but exclude OTC & PIPE deals. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

Figure 17. VC/PE Investment by Region, 2000 – 2006



Note: Grossed-up values based on disclosed deals. The figures include PE buy-outs, but exclude OTC & PIPE deals. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

Figure 18. VC/PE Investment by Country, 2006



Note: Grossed-up values based on disclosed deals. The figures include PE buy-outs, but exclude OTC & PIPE deals. Figures in brackets refer to (disclosed deals / total deals). EU-27 has been included, as have its constituents, but only for comparison purposes.

Source: SEFI, New Energy Finance

designed for small to medium-sized companies, such as NASDAQ, and its accessibility as well as its relatively low cost have added to its attractiveness.

The fact that many European firms have already reached a more mature stage than their US equivalents, because Europe has been quicker off the mark in renewable energy, is a further reason for the lower levels of early-stage funding. Other factors include highly regulated labour markets in Europe, fewer experienced venture capitalists and fewer serial entrepreneurs.

All stages of venture capital and private equity investment experienced increased investment at the start of 2007. Later-stage leveraged private equity investments have so far put in a particularly strong showing.



# R&D and Clean Energy Incubators

# 5

- R&D increased to \$16.3 billion in 2006, from \$13 billion in 2005.
- EU-27 lags in new technology investment – perhaps because of comparatively low private sector involvement. Business funds 55% of R&D in the EU, compared with 64% in the US and 75% in Japan.
- The number of incubators rose during 2006, as did the number of incubated RE companies and successful transitions to next stage of financing.

R&D spending on renewable energy and energy efficiency by governments and corporates rose from \$13 billion in 2005 to \$16.3 billion in 2006. Corporate-sponsored RD&D (research, development and deployment) in 2006 was \$9.1 billion, with government-backed R&D at \$7.2 billion. R&D figures are based on triangulated industry estimates gathered by New Energy Finance.

Announced corporate RD&D spending almost certainly understates the true value of companies' RD&D investment, as much of this will not be split out from other projects and will not be disclosed. This is especially true where RD&D involves refinements to existing technology, such as wind turbine design, rather than new technology.

Corporate RD&D spending may also be understated because companies are tending to buy out VC-funded technologies, rather than developing them in-house. This trend is emerging as the industry matures, resulting in established players with manufacturing expertise and a good flow of new technology. During 2006, for example, the Indian optical media manufacturer Moser Baer made a series of high-tech investments in the US: in November 2006, it took a significant minority stake in Stion Corporation, a California-based nanostructured multi-junction photovoltaic (PV) material developer (formerly known as NStructures). It has also made VC investments in US concentrator PV firms, SolFocus and Solaria, and intends to begin volume production of SolFocus's concentrating PV (CPV) panels.

Figure 19. Number of Clean Energy Incubators by Country, May 2007



Note: Excludes China

Source: New Energy Finance

Whether funded in-house, by governments or within an incubator, R&D has a critical role to play in the growth of renewable energy, both in proving new technologies and in refining existing ones. Experience from other industries, such as telecoms, software and biotech, has shown that the rate of innovation and speed of commercialisation are dramatically accelerated by the presence of a healthy population of earlier-stage companies.

But just as EU-27 lags behind the US and, increasingly, Asia in terms of VC investment, it also has a less commercial R&D model and fewer clean energy incubators.

In EU-27 business funds 55% of R&D compared with 64% in the US and 75% in Japan. The EU has far more university-based R&D (37%) than in the US (15%) and Japan (26%), reflecting a more commercial attitude to R&D outside EU-27.

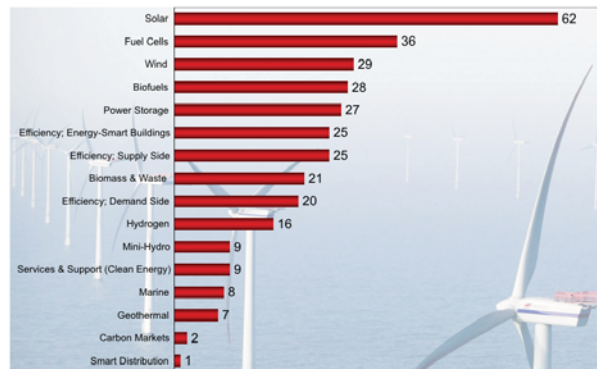
A total of 146 business incubators (excluding China) have been identified around the world that have as their sole or main focus the building of businesses and commercialisation of clean energy technology from a very early stage (Figure 19). This represents an increase of just over 28% since June 2006.<sup>8</sup> The US has a clear lead in terms of number of clean energy incubators.

China has a very large number of business incubators (well over 200), 30% of which have worked on renewable energy and low-carbon technologies. Many of these, however, are not strictly speaking incubators, but rather vehicles for transferring operations from state to private ownership. For this reason, China has not been included in New Energy Finance's incubator charts.

Not only has the number of incubators active in the clean energy space increased, so has the number of companies under incubation. Currently, 332 companies are either under incubation (Figure 20) or have successfully graduated from the incubation process and raised independent funding – an increase of nearly 53% since 2005.

Israel has a particularly strong culture of technology incubation. In 2002, Israel

Figure 20. Clean Energy Incubatees by Sector, May 2007



Note: Excludes China

Source: New Energy Finance

spent relatively more on R&D than any other country, including the US. Israel's national investment in R&D was 4.8% of GDP, compared with 2.2% in the US, 1.7% in the UK and an average of just below 2% across OECD countries. As a result, Israel has become an important source of new renewable technology, including the resurgent solar thermal market. Its technological incubator program was set up in 1991, following mass immigration from former Soviet Union countries, with the aim of providing a sheltered environment where scientists could develop marketable ideas while receiving financial support.

Currently, more than 24 technology incubators operate in Israel, most of which support

renewable energy projects. The incubators are individually owned and non-profit organisations, but they are brought together under the Office of the Chief Scientist (OCS). The incubators receive public and private support. In addition, Israel's universities are very active in renewable energy research, and solar energy in particular, and these work closely with the incubators. In addition, a Knowledge Centre for Fuel Cells and Energy Storage and Conversion has been established.

It is no accident that incubators tend to proliferate where there is a strong venture capital presence, as in the US and Israel. The fact that incubated companies continue to move successfully onto the next stage of funding, even though the VC trend has been away from early-stage funding (as discussed in Section 4), may suggest that incubatees have a better chance of being financed than other early-stage businesses.

# Public Markets

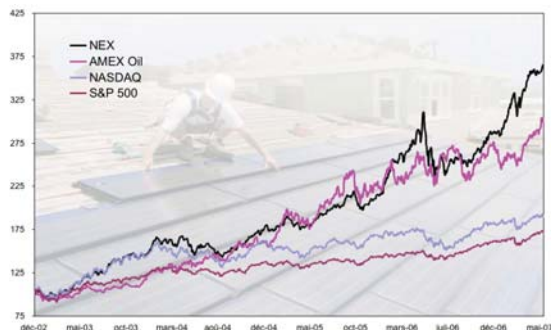
# 6

- Public market activity surged in 2006, with \$12.3 billion raised, more than double the \$5.8 billion in 2005.
- Solar IPOs boosted 2006 volumes, raising just over \$6 billion.
- New listings slowed somewhat in 2007, with \$1.8 billion raised in the first quarter.
- Listed stocks continued their strong performance. The NEX index rose 31% during 2006 and a further 33% in the first quarter of 2007, well ahead of the stock market as a whole, with biofuels as the star performer.

There was a spectacular surge in investment in renewable energy companies via public capital markets in 2006 – even though the year was somewhat of a rollercoaster ride for renewable energy companies, who experienced a magnified version of the general stock market correction in May. Overall, however, the amount of money raised reached \$12.3 billion, more than double the \$5.5 billion raised in 2005. Early 2007 figures have been somewhat more sedate, with \$1.8 billion raised in the first quarter, although a number of significant IPOs have been announced, particularly in solar.

The 2006 upswing reflected a variety of positive influences, including the ‘addiction to oil’ State of the Union speech by US President George Bush in January 2006, a volatile oil price that fluctuated between \$58 and \$80-a-barrel all year, and increasing public awareness of climate change and energy security.

Figure 21. WilderHill New Energy Global Innovation Index, Jan 2003 – April 2007



Note: AMEX Oil, NASDAQ, and S&P 500 rebased – 30 December 2002 = 100

Source: New Energy Finance, AMEX

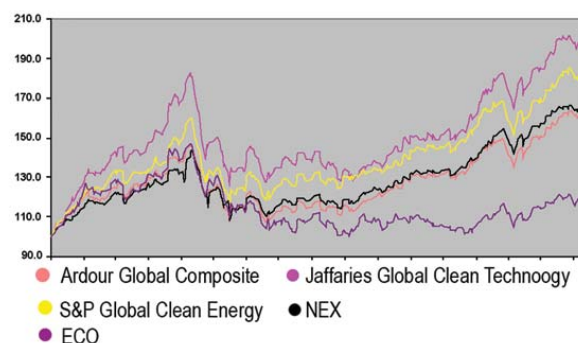
Quoted renewable energy stocks also performed well and have continued to do so in 2007 – albeit not in a straight line. The WilderHill New Energy Global Innovation Index (NEX), which began 2006 at 220, ended the year at 288 and by April 2007 was up to 360 – a rise of 64% over 15 months. This was well ahead of the wider stock market (Figure 21). The index’s overall performance, however, included a substantial mid-year correction in May 2006, when the index lost 25% of its

value in a month – compared with a 10% correction in leading Western stock indices.

Other clean energy indices performed similarly (Figure 22), though all of them have launched more recently than the NEX, so their performance in this figure is partly historical. Jefferies is heavily weighted in wind and solar stocks, which have contributed to its strong performance. ECO focuses on US clean energy stocks, which have pulled its performance down.

Biofuels companies were the best performing within the index, increasing 82.9%, followed by wind, which went up 65.0%. The weakest performer was Hydrogen & Fuel Cells, which fell 12.3% during the year.

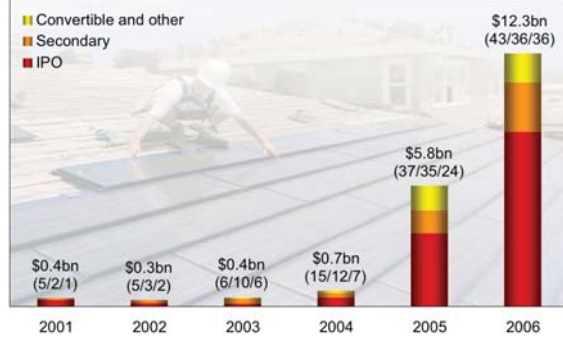
Figure 22. Comparison of Clean Energy Indices



Note: NEX launched Jan-06; Ardour Mar-06; Jefferies Dec-06; S&P Global Feb-07.

Source: New Energy Finance, AMEX

Figure 23. Public Market Investment by Type, 2000 – 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other).

Source: New Energy Finance

The 'Kyoto Effect' can be observed, with quoted renewable energy companies in countries that have ratified the Protocol outperforming those in non-ratifying countries by 41.3%.

Public market activity from renewable energy companies was sporadic throughout 2006, with an understandably low level of activity mid-year following the market correction in May. Overall, though, the 2006 public markets story was one of rising investor interest in renewable energy and strong value creation. This was reflected in a sharp increase in the amount of money held in funds holding quoted renewable energy stocks in their portfolios.

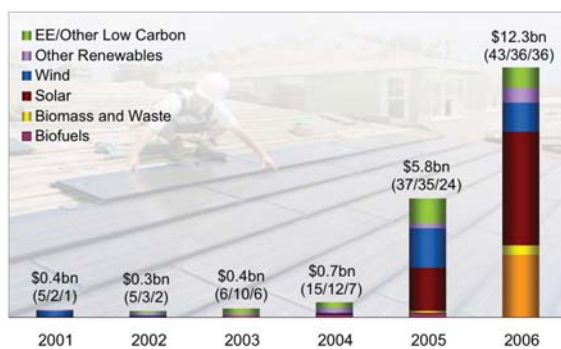
There were 115 public market deals during 2006, of which 36 (31%) were IPOs, which raised \$8.5 billion (Figure 23).

The key public markets deals of the year included Renewable Energy Corporation of Norway's \$1.1 billion IPO (valuing the company at \$7.7 billion) and the \$1.5 billion flotation of Germany silicon wafer supplier Wacker-Chemie (valuing the company at \$5.1 billion).

Other significant fund raisings included the \$224 million flotation of German bioethanol firm CropEnergies, Clipper Windpower's \$97 million secondary issue on AIM, and EDF Energies Nouvelles IPO of \$691 million. There were IPOs by two American biofuels producers, VeraSun and Aventine, raising \$421 million and \$390 million, respectively

In sector terms, solar companies were by far the largest fund raisers on public markets (Figures 24 and 25), raising \$5.6 billion in 2006, with biofuels producers pulling in \$3.1 billion – fifteen times the \$204 million they raised on the public markets in 2005. Wind, the sector most publicly identified with renewable energy, accounted for a more modest \$1.4 billion.

Figure 24. Public Market Investment by Sector, 2000-2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other).

Figure 25. Public Market Investment by Sector, 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other).

Source: New Energy Finance

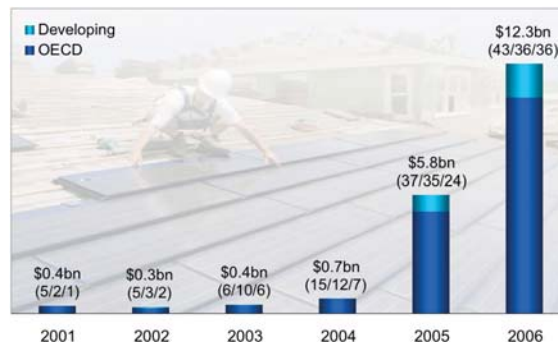
The solar sector's fundraising on public markets in 2006 was more than three times its \$1.7 billion total for 2005. By contrast, the amount raised by wind farms was up less than 10% from 2005.

Geographically, German companies took the largest share of the public market fund raising in 2006, raising \$3.9 billion, just ahead of the US, which raised \$3.4 billion (Figures 26 and 27). The US's and Germany's dominance reflects strong biofuels activity in the US and continued solar growth in Germany, boosted by its production subsidy regime.

Norway raised the third largest amount of money on the public markets in 2006, thanks to solar company REC's \$1.1 billion IPO in May, which accounted for all the public market fund raising from Norwegian companies in 2006.

German and US dominance continued in terms of stock exchanges, with Frankfurt and NASDAQ the most active public markets (Figure 28) in 2006. In third place, London's Alternative Investment Market (AIM) saw \$1.4 billion raised during 2006, even though UK companies raised just \$339 million on the public markets during the year. This reflects the fact that AIM continues to be a magnet for foreign companies seeking public market funding.

Figure 26. Public Market Investment by Region, 2000 – 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other).

Source: SEFI, New Energy Finance

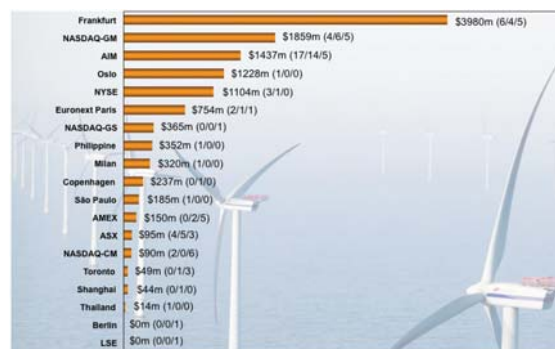
Figure 27. Public Market Investment by Country, 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Country refers to domicile of organisation raising capital.

Source: SEFI, New Energy Finance

Figure 28. Public Market Investment by Exchange. 2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include investor exits made through Public Market offerings. OTC & PIPE deals are not included. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Exchange refers to market on which capital was raised.

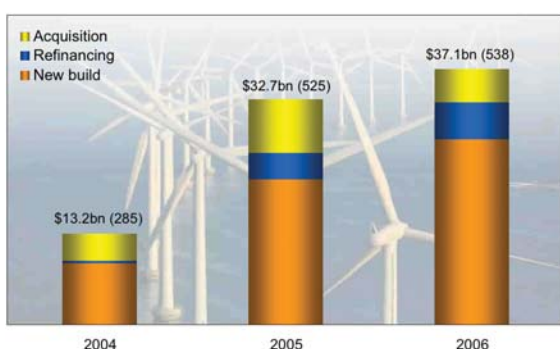
Source: New Energy Finance

# Asset Financings



- 2006 investment in renewable energy capacity assets was \$37.1 billion, an increase of 11% over 2005.
- Early indications in 2007 suggest that Asset Financings are set to continue at the same pace.
- Wind is the largest sector, followed by biofuels, however, shortages of key components (e.g. wind turbine gearboxes) have slowed down the rate of installation.
- New financing structures have emerged as an increasing number of traditional and innovative investors are attracted to RE, and wind energy in particular.
- Utilities with RE targets are building wind portfolios through acquisition, which is increasing overall price.
- US is the leader, followed by Germany and Spain, and then China.

Figure 29. Asset Financings by Type, 2004-2006



Note: Grossed-up values based on disclosed deals. The figures include new build, refinancings and acquisitions of clean energy projects. Figure in brackets refers to (total deals).

Source: New Energy Finance

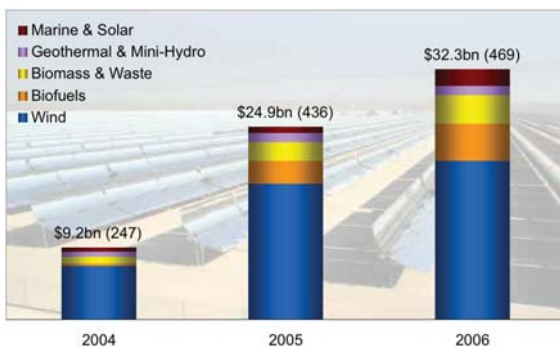
Asset financing includes all money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. It includes refinancings, but excludes short-term construction loans.

Total investment in renewable energy generating assets rose steadily in 2006 to \$37.1 billion, up from \$32.7 billion in 2005 (Figure 29). The year 2006 was far less volatile than 2005 for asset financing, possibly due to the globally increasing number of public support schemes that even out the volatility in any one market. Early indications in 2007 suggest that Asset Financings are set to continue at the same pace, with the leading sectors (wind, biofuels, biomass) attracting most of the investment.

Financing for new build continues to dominate the mix, but refinancings have been on the increase throughout the year, particularly in the wind sector. New build financings, while higher overall in 2006 than in 2005, started to tail off towards the end of the year.

Asset acquisitions fell away sharply towards the end of 2006, reflecting fewer assets available on the market. However, the fewer deals that were completed were larger than usual.

Figure 30. Asset Financings by Sector, 2004-2006



Note: Grossed-up values based on disclosed deals. The figures include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals).

Source: New Energy Finance

The wind sector continued to dominate asset financings in 2006, with project refinancings particularly notable in the second half of the year (Figure 30). Trinergy refinanced a 648MW wind portfolio, Babcock & Brown a 620MW wind and hydro portfolio in Portugal (the largest Portuguese wind project financing to date), and US wind operator FPL Energy three wind projects in Texas worth \$700m.

Competition for wind asset financing is driving innovation in the financial markets. Non-traditional financing is increasing in the sector, with onshore projects having access not only to non-recourse project finance structures, but also bond markets, and offshore projects stimulating some innovative financing solutions and longer deal maturities. More recently, turbine portfolios have started to be financed, essentially



treated as commodities whose value is decoupled from the underlying projects. The value of wind asset deals dropped abruptly in the first quarter of 2007, however, this is similar to what happened in Q1 2006.

Financier appetite is gradually filtering down to other sectors, with the first non-recourse transactions for concentrating solar happening in Spain. As the financier landscape becomes more crowded and more professional, banks are competing and the solar sector is seeing more financial innovation, although traditional financing remains the norm.

Biofuels enjoyed a strong year in asset financing, in line with its resurgence during 2006. More than 42 plants were under construction in the US by late 2006, boosted by the phase-out of the fuel additive MTBE. In Germany there were several biofuel IPOs, providing cash to help ramp up production, and China financed its first large Jatropha-based biodiesel project. And unlike wind asset financings, biofuels transactions increased in Q1 2007. In this quarter, \$2 billion or 75% of the investment came from project financings, where in previous quarters most asset financings were on balance sheet. This shows that debt financiers are being attracted more and more to biofuels.

In 2006, for the first time, bioethanol financings in EU-27 outstripped biodiesel deals, most of them from France, who in its efforts to meet its 7% ethanol targets by 2010 was responsible for 89% of European ethanol investment for the year.

Overall, EU-27 out-invested the US by two-to-one: \$15.6 billion versus \$8 billion of asset financings (Figure 31). Within Europe the largest investors were Spain (\$4.7 billion) and Germany (\$3.4 billion). This reflects the significant investment in wind projects in these countries, which mostly included in new build, but also an increasing number of refinancing deals.

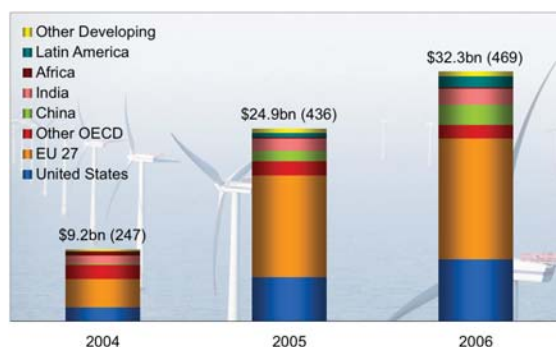
China was the fourth largest location for asset financing, with \$2.6 billion raised, also largely driven by its flourishing wind sector. Growth in 2007 and beyond will be supported by the emergence of powerful local manufacturers of large turbines and suppliers of key subassemblies.

There were various drivers behind these geographical trends. Germany discarded its solar tax credits during 2006, but Spain, Korea and the US introduced new incentives to encourage investment.

There are signs that asset financing is globalising. As the market becomes more liquid, transparent and competitive, it is no longer necessarily the case that US firms finance US projects, European banks finance European projects, and so on. Just as the range of available asset finance has broadened (more financial instruments) and deepened (longer maturities, keener pricing), the market has also become much more geographically fluid.

For the time being, though, non-recourse project finance and balance sheet finance/syndicated equity continue to dominate the funding mix, with very small contributions from bond issues or lease/vendor financing (Figure 32).

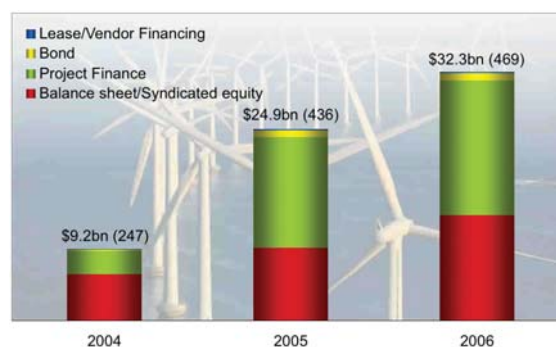
Figure 31. Asset Financings by Region, 2004-2006



Note: Grossed-up values based on disclosed deals. The figures include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals).

Source: SEFI, New Energy Finance

Figure 32. Asset Financings by Type of Security, 2004-2006



Note: Grossed-up values based on disclosed deals. The figures include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals).

Source: New Energy Finance

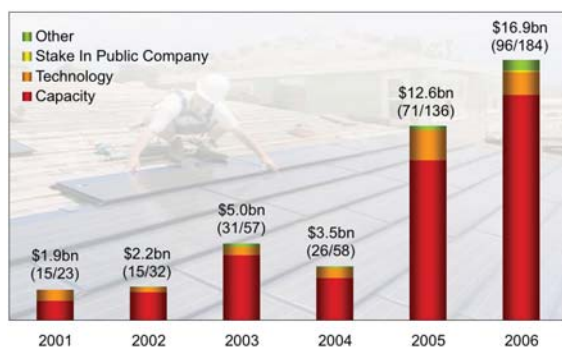
# Mergers & Acquisitions

## 8

- 2006 M&A activity was up 34% on 2005, with deals valued at \$16.9 billion.
- Most activity in the wind sector - more than 40% of deals by value.
- Strategic stakes are being taken by leading players in renewable energy sector.
- Increasingly, manufacturing companies are looking to vertical integration to secure supplies of key components.
- A trend is emerging towards companies in developing countries acquiring assets in OECD countries, suggesting a buy rather than build approach. Widespread availability of cheap capital is enabling this strategy.

In 2006, mergers and acquisitions in sustainable energy totalled \$16.9 billion, up 34% over 2005 (Figure 33). This excludes private equity buy-outs, acquisitions of clean energy projects and investor exits, which accounted for a further \$12.6 billion of transactions in 2006. Total global deal flow exceeded \$11 trillion in the first quarter of 2007, which is an increase of 27% over Q1 2006 and the second consecutive trillion-dollar quarter since early 2000.

Figure 33. M&A by Type, 2000-2006



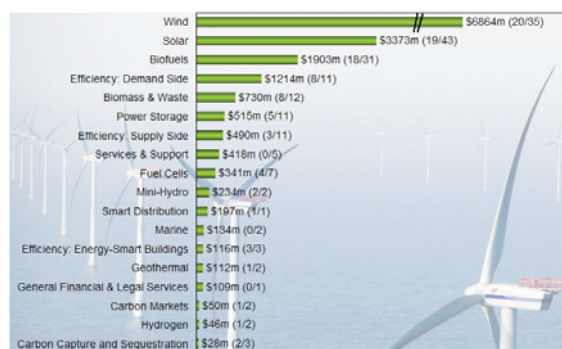
Note: Grossed-up values based on disclosed deals. The figures exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

The flow of mergers and acquisitions sped up in 2006. Most deals, at least in terms of their value, involved companies buying other companies with production capacity, rather than new technology, as they seek to build their generation portfolios, particularly in wind. Generation capacity assets in OECD countries were the main targets. The widespread availability of cheap capital is enabling this strategy. Capacity mergers and acquisitions increased 40% between 2005 and 2006, from \$10.4 billion to \$14.6 billion.

The increase in mergers and acquisitions is a signal to mainstream investors that exit opportunities are being created by corporate activity. As well as buying generating capacity, corporates are also vertically integrating by acquiring other companies in the value chain.

Wind dominated 2006 merger and acquisition activity, accounting for more than 40% of M&A deals by value (totaling \$6.9 billion), but just 19% by number of deals (Figure 34). The average deal size, \$343 million, was far larger than in other sectors.

Figure 34. M&A by Sector, 2006



Note: Grossed-up values based on disclosed deals. The figures exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

Significant wind sector deals included Spanish infrastructure group Acciona's \$1.8 billion acquisition of Corporacion Eolica (CESA), a Spanish wind farm developer; Spanish utility Iberdrola buying an 11% stake in Spanish wind turbine maker Gamesa for \$569 million; and Indian turbine group Suzlon's \$565 million acquisition of Belgian gearbox manufacturer Hansen Transmissions. Supply-side shortages in wind, as well as the sector's scale and maturity, are driving consolidation and strategic stake taking. Energias de Portugal (EDP) moved into the French wind sector with its \$459 million acquisition of Agrupacion Eolica.

Activity in the wind sector continued, with India's Suzlon engaged in a bidding war against French nuclear group Areva for German rival REPower.

In May 2007, the bidding ended with Areva backing out, leaving Suzlon's final bid that valued REPower at \$1.8 billion. In Q1 2007, Goldman Sachs sold its Horizon Energy wind business to EDP for \$2.9 billion, having acquired it for an estimated \$500 million in 2005.

The solar sector, the next most active in terms of M&A, was way behind wind in value terms, with \$3.4 billion worth of deals, but with a far lower average deal size of just \$79 million, reflecting its more fragmented nature. The two largest solar deals involved US targets: Applied Materials acquired Applied Films for \$464 million in an all-US deal, and German solar manufacturer ErSol secured supply of solar-grade silicon by paying \$120 million for Silicon Recycling Services Inc (SRS).

Energy efficiency (demand side) also made a strong showing in 2006 M&A activity, largely thanks to Australian smart metering group Bayard's \$705 million acquisition of Cellnet, a US producer of Automated Meter Reading (AMR) technologies.

India and Australia were substantial net buyers of renewable energy companies in 2006, while EU-27, the US, China and Latin America were net sellers (Figure 35). Australia's position as a strong net buyer is due to two major deals: Bayard's \$705 million acquisition of Cellnet, and Babcock & Brown's \$865 million refinancing of Portuguese wind and hydro group Enersis II. India is net buyer on the back of Suzlon's \$565 million acquisition of Hansen Transmissions, as well as other purchases by Moser Baer, Sterling Infotech and Praj Industries.

Assets in EU-27 and the US were the main targets for acquirers worldwide, hence their position as net sellers of assets.

While these net flows are intriguing, the gross numbers that include merger and acquisition activity within countries and within regions are much larger. Spain, in particular, does not feature in the net flows despite high levels of M&A activity in the country, because all its deals involved domestic companies. In addition, net flows do not include any investment in foreign companies on the public markets, for example, Chinese solar companies listing overseas.

Figure 35. Net Acquirers and Sellers, 2006



Note: Grossed-up values based on disclosed deals. The figures exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings.

Source: New Energy Finance

# Investment Funds

# 9

- Over \$18 billion is currently under management in approx. 180 funds that are focused on sustainable energy.
- Both public and private funds have seen high growth since 2005 (43% and 59%, respectively), continuing into 2007.
- Private funds split across specialists and more recently generalist fund managers who have recognised the value – and profile – of RE investment.
- Challenge faced by all funds is availability of high quality investments.

In 2006 and early 2007, the story as a whole was one of rising investor interest in sustainable energy – and value creation. This was reflected in sharp increases in the amount of money held in funds specialising in holding quoted clean energy stocks in their portfolios.

Figure 36. Sustainable Energy Funds by Type, March 2007

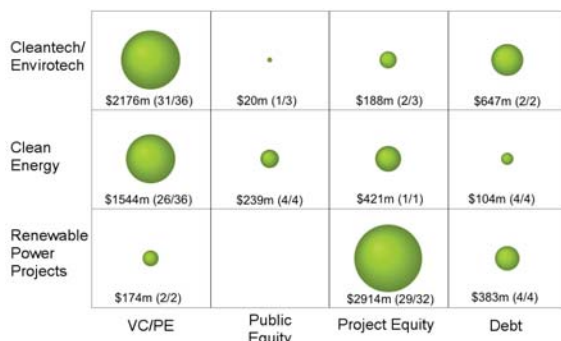


Note: Snapshot as at March 2007. Figures in brackets refer to (funds that have disclosed an amount/ total number of funds). Source: New Energy Finance

As of March 2007, the number of funds seeking clean energy opportunities has risen to 176, of which 150 disclosed a total of \$17.7 billion under management (Figure 36). This figure understates the true sum available for investment in sustainable energy, as both general infrastructure and technology funds, as well as hedge funds, are also active in the sector. A significant share of this money is destined for sustainable energy. Some of it will be invested in other clean tech sectors such as water purification. In addition, 58 carbon funds are in existence, 47 of which have a combined pot of \$11.8 billion to invest in carbon credits of all kinds (see Section 10 and specifically Figure 39).

Private institutional funds (unquoted funds) outnumber quoted funds, however, they are much smaller (Figure 37). There are 139 private funds, 114 of which disclosed a total of \$9.8 billion under management, an average fund size of \$85 million. By contrast, the 37 public funds have a total of \$8.0 billion available for investment, averaging \$220 million each (Figure 38).

Figure 37. Sustainable Energy Funds - Private, March 2007



Note: Snapshot as at March 2007. Figures in brackets refer to (funds that have disclosed an amount/ total number of funds). Private funds are those that are not quoted on a stock market. Table shows focus of fund versus primary type of investment asset. Project equity is private equity investment in projects.

Source: New Energy Finance

Carbon funds lie somewhere between the two, with an average disclosed size of \$155 million.

There is more money under management in EU-27 than in the US, mainly due to a high number of quoted (and hence larger) funds in EU-27 and, in particular, the Merrill Lynch IIF New Energy Fund, which has \$2.75 billion under management. EU-27's less rigorous listing requirements favour the proliferation of publicly-quoted funds, mirroring the flow of clean energy companies to AIM and the Frankfurt Stock Exchange over the past couple of years. European investors tend to be more risk-averse than US investors and welcome the diversification that large quoted funds provide.

In the US, by contrast, there is a stronger private equity tradition and a more active venture capital culture, which has encouraged the growth of smaller, more nimble private funds. US funds are more focused on

investing in renewable capacity projects, driven partly by the US biofuels boom. For example, the \$685 million Carlyle Riverstone Renewable Energy Infrastructure

Fund I backed a 375m-litre bioethanol plant in New Mexico and another in Canada, and is backing Texas biodiesel producer Green Earth Fuels. It has also joined forces with Bunge to build ethanol facilities next to the latter's grain facilities.

Private funds specialising in quoted clean energy investments reached \$9.8 billion by March 2007, up 66% from \$5.9 billion under management at the end of 2005 (Figure 37). Roughly a third - \$3.0 billion - is managed by cleantech / envirotech funds, which have a broad remit and invest predominantly at a VC/PE level. Clean Energy funds, which have a narrower focus, have \$2.3 billion under management (see Figure). They too focus on VC/PE investment: a recent example is The Low Carbon Seed Fund, established by Imperial Innovations Group (a business incubator attached to Imperial College, London) with \$3.7 million to invest in early-stage UK companies.

The largest category is private funds investing in renewable power projects, with disclosed funds under management in March 2007 of \$3.5 billion (Figure 37). These funds tend to have a larger average size than other categories of private funds, reflecting higher average investments in capital-intensive power projects. This category is also raising far higher levels of new funds than the other two. Ongoing private institutional fund-raising at March 2007 (Figure 42) stood at over \$6.0 billion, compared with \$2.0 billion for cleantech, and \$2.6 billion for clean energies.

Generalist fund managers have also started to focus on the investment opportunities in sustainable energy. A number of established pension and insurance funds are targeting the sector.

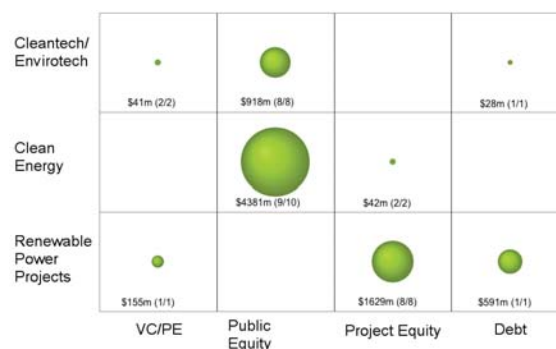
Funds under management by publicly quoted investment companies specialising in the sector reached approximately \$8 billion in March 2007 (Figure 38), up more than 80% from \$4.4 billion under management at the end of 2005. This reflects strong performance by the public markets, as has already been discussed in Section 6.

Publicly traded funds were not immune, however, to the downturn in global stock markets in mid-2006. One fund failed to meet pre-IPO expectations and another was cancelled. The flow of clean energy fund IPOs has slowed significantly since then. Exceptions include Clean Energy Brazil, which floated on AIM in December 2006, raising \$195 million.

Most publicly traded funds invest in public equities (Figure 38). There are also ten funds investing in renewable power projects, with around \$2 billion under management. Most invest in project equity, but one large publicly quoted fund, the Bank of Ireland Renewable Energy Fund with nearly \$600 million under management, is involved in debt financing.

As throughout the funding spectrum, the challenge for all funds is finding good quality investments. As technologies mature, markets scale up and cross-border activity increases, competition for assets becomes more intense.

Figure 38. Sustainable Energy Funds – Publicly Quoted, March 2007



Note: Snapshot as at March 2007. Figures in brackets refer to (funds that have disclosed an amount/ total number of funds). Table shows focus of fund versus primary type of investment asset. Project equity is private equity investment in projects.

Source: New Energy Finance

## Carbon Finance

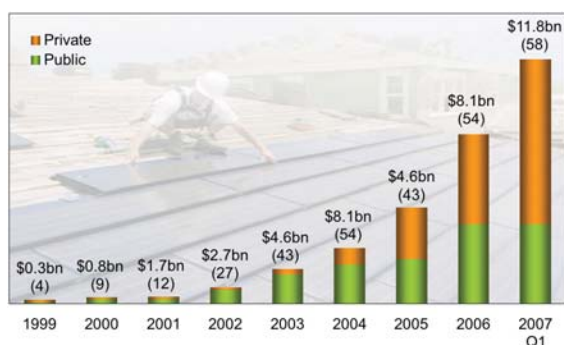
# 10

- By March 2007, carbon funds totalled \$11.8 billion, with the private sector providing most of the new money coming into the market.
- Growth of investment in the sell-side of the market shows that money is flowing into the development and commercialisation of CDM and JI projects, with a net shortfall in project development activity currently estimated at around \$11 billion.
- Of the CDM projects currently in the pipeline (total 1,825), more than half (64%) are renewable energy projects (geothermal, tidal, wind, hydro, biomass or solar). However, these only represent a fifth of the total 2012 credits.

As of March 2007, the money mobilised in the carbon fund sector totalled \$11.8 billion (Figure 39), an increase of \$4.7 billion (approx 50%) since September 2006. The addition of 12 new funds brings the total number of carbon funds to 58. The private sector has provided most of this capital, accounting for nearly 90% of the increase.

Carbon funds cover the full carbon value chain from compliance purchasing (government-backed funds buying carbon credits in order to meet compliance obligations under the Kyoto Protocol) through to intermediary trading (aggregating, brokering and managing risk between buyers and sellers) and project development.

Figure 39. Carbon Funds, 2000 – 2007



Source: New Energy Finance

The growth of investment in the sell-side of the market highlights an important trend: more money is now flowing into the essential process of developing and commercialising Clean Development Mechanism (CDM) and Joint Implementation (JI) projects (85% of the new money raised), rather than simply being set aside for the purchase of credits as and when they are produced.<sup>9</sup>

That means that less than half (42%) of the total money committed to the carbon markets is now for direct compliance purchasing, with the remaining amount (58%) being invested in developing the projects

required to generate carbon credits.

Although most of the money has recently flowed into the sell-side of the market, compliance buyers still dominate in terms of the numbers of funds. Of the 58 funds currently in existence, 37 are compliance funds (up from 33 six months ago) with 21 involved in project development and intermediary trading (up from 18 six months ago).

Figure 40. Volumes traded on the European Carbon Exchange, 2005 – Jan 2007: tCO2/month



Source: ECX, New Carbon Finance

It is estimated that a total of around \$25 billion of carbon credits (at current prices) will be needed to meet compliance targets under the Kyoto Protocol and the EU Emissions Trading Scheme (EU ETS) by 2012. Of this, around \$8 billion will be met through existing forward purchase contracts, leaving a further requirement of around \$17 billion to meet targets to 2012. Because there are projects in the pipeline

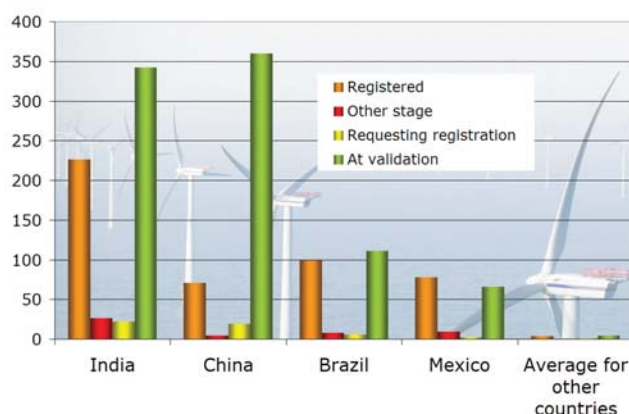
that have not pre-sold their expected credits, the net shortfall in project development activity is estimated at around \$11 billion. Some of this will be covered by money already raised in existing funds but not yet deployed, however, a substantial proportion will need to come from new capital and project activity.

The UK has emerged as the clear leader in carbon fund management, with 72% of private carbon funds and 50% of all carbon funds being managed out of London. Whilst the US maintains its second place as a location in which to manage carbon funds, its share of the total carbon fund management market has slipped to 14% of all money under management and only 6% of private money (these figures include the World Bank funds being managed out of Washington). In third place is Canada with 5% of the world market.

Within the EU-ETS traded volumes of European Union Allowances (EUAs) have increased significantly from 2005 to 2007 (Figure 40). During 2006, a total of 820Mt EUAs changed hands, up from 324Mt in 2005. About 60 -70% of the EUAs are traded through OTC markets, with the remainder traded through exchanges – although brokers use exchanges for approximately 50% of their trades.

Four countries currently dominate CDM activity: of the 125 projects added to the pipeline since mid-September 2006, 78% are in India, Brazil, China and Mexico (Figure 41). India experienced the largest growth with 46 projects added to the pipeline (+11%), followed by Mexico with 27 (+26%), China with 19 (+10%) and Brazil with 4 (+3%). In terms of projected CERs (certified emission reduction, see Figures 42 and 43), China presents the biggest increase, with 47.9Mt of credits added to the pipeline, representing 10% of total Chinese credits and 4% of the pipeline total. Of the projects currently in

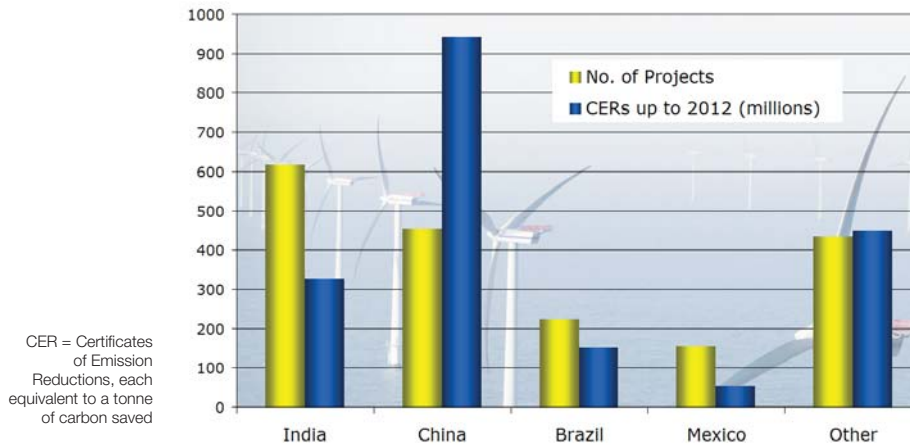
Figure 41. CDM Projects in the Pipeline, Jan. 2006



Source: UNEP Risoe Centre / UNFCCC Databases – New Carbon Finance

the pipeline, more than half (52%) relate to renewable energy (geothermal, tidal, wind, hydro, biomass or solar). This project type, however, only represents a fifth of the total 2012 credits (15 HFC projects account for 32% of the 2012 credits). There are currently only few CDM projects in Africa.

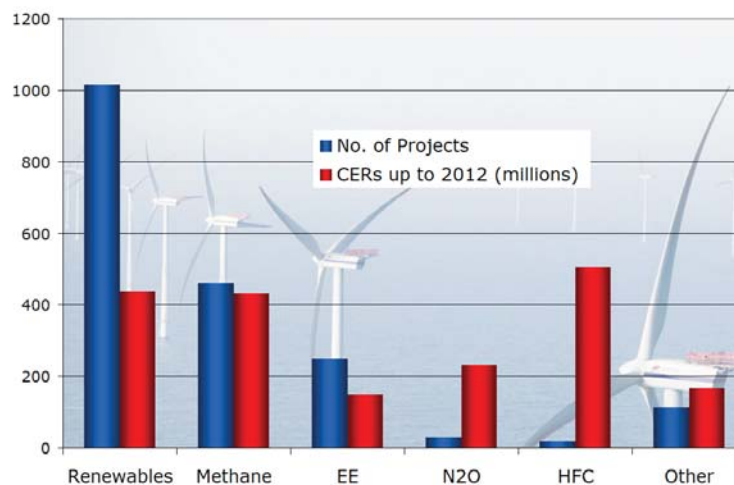
Figure 42. Number of CDM pipeline projects and millions of CERs by Developing Country



Source: UNEP Risoe Centre / UNFCCC Databases – New Carbon Finance

Generally, the number of CDM projects registered has been lower than many people expected. Initially this was due to the demanding registration and verification process, however with many standard methodologies now approved this seems to be less of a problem. Other reasons include the difficulty developers have in raising project financing, the complexity of CDM financing, as well as the uncertainty about what will happen after the first Kyoto Protocol commitment period, which ends in 2012.

Figure 43. Number of CDM pipeline projects and millions of CERs by Technology



Source: UNEP Risoe Centre / UNFCCC Databases – New Carbon Finance



# Energy Efficiency



- Energy efficiency is a significant, but largely invisible market, attracting an increasing share of the limelight as investors realise that it has an important role to play in addressing growing global energy demand.
- Investment in EE technologies is the most visible segment of the market: in 2006, \$1.1 billion was invested in EE, compared with \$710 million in 2005.
- Energy efficiency has strong support from multinationals and governments.

Energy efficiency is hard to define; it is an absence rather than a presence and often involves soft changes in energy management and consumption patterns rather than capital-intensive hardware upgrades. Investment in energy efficiency shows up in three broad areas: in technology (such as high efficiency appliances, energy management systems), in companies (such as Energy Service Companies – ESCOs - which advise on energy usage and may finance EE improvements) and projects (such as district heating or combined heat and power plants). But however hard it is to define, energy efficiency has become an important area of energy sector investment and in most instances is a cheaper option than increased generation.

Demand for global energy services has grown by 50% since 1980 and is expected to grow another 50% by 2030. Investments in supply side and demand side efficiency have been helping decrease global energy intensity, which on average has been dropping 1% to 1.5% per year.<sup>10</sup>

Most governments today have energy efficiency targets. The EU, for example, recently announced that it was aiming to cut energy use by 20% by 2020. China, too, introduced targets in 2006 to cut energy consumption (both per capita and as a percentage of total economic output) by 20% within five years. China has been experiencing sustained intensity reductions of around 5% per year, however, its energy intensity was four times the US's in 2004, and more than six times the UK's, showing that it is still paying a high energy price for its economic growth.

Energy efficiency investment is hard to track in its entirety. The financial benefits of energy efficiency often accrue to the end-user, representing a cost saving rather than a financial return, so a considerable proportion of energy efficiency investment is funded by energy consumers (domestic and industrial) rather than by financiers. In an industrial context, energy efficiency is normally financed internally and isn't generally identified as an investment unless it is of significant scale. So the easily identifiable investment transactions in energy efficiency only make up a small part of the real picture.

The investment flows tracked in this report mainly comprise money flowing into new energy efficiency technology. US VC funding dominates, with very little private equity for expansion. In OECD countries energy efficiency investment tends to take the form of venture capital for technology, while developing countries see more investment in energy efficiency projects. Public sector backed venture capital funds, as found in the US, UK and Australia, are often strong supporters of energy efficiency technology. Roughly a third of the technology start-ups incubated by the UK's Carbon Trust, for example, operate in energy efficiency.

The investment flows tracked into Power Architecture include Energy Efficiency on both Demand and Supply sides, Smart Grid/Distribution and Power Storage. All these sectors have been attracting investment more or less evenly since 2001, with flows increasing steadily. Most energy efficient investment has been in early-stage funding. VC/PE investment rose 54% between 2005 and 2006 to \$1.1

billion (Figure 44). Demand-side efficiency investments have grown since 2005, as has power storage investment.

The year 2006 also saw some M&A activity in the sector, notably Australian energy efficiency group Bayard's \$705 million acquisition of US smart-metering company Cellnet in December.

Multilateral development banks are an important source of funding for energy efficiency. In 2006, the World Bank committed more to energy efficiency projects (\$447 million) than to renewable energy (\$412 million). More than half of the World Bank's energy efficiency investment went into Central and Eastern Europe (including a \$42.5 million energy efficiency project, the Belarus Post-Chernobyl Recovery Project (IBRD), and a \$137 million energy efficiency project, the Hungary OTP Subsovereign Schools Project (International Finance Corporation - IFC)), with far smaller shares flowing into Africa, East Asia and Latin America.<sup>11</sup> The IFC

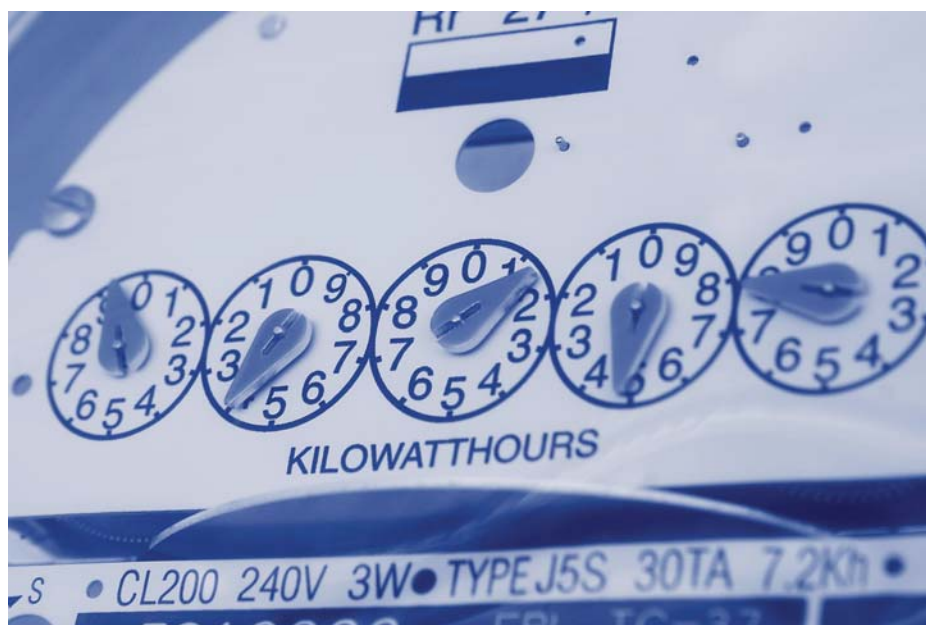
has implemented a number of successful energy efficiency loan guarantee programs, including one in Central Europe and another in China. Several hundred million dollars of project finance have been mobilised.

Figure 44. VC/PE Investment in Energy Efficiency, 2001-2006



Note: Grossed-up values based on disclosed deals. The figures represent total investment, and so include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance



# Investment in Developing Countries

# 12

- Capital has started to shift to developing countries, which have seen higher private investment in 2006 and 2007.
- This includes stronger flows from foreign countries (US & EU), as well as private capital mobilising within emerging markets.
- Some barriers to FDI remain (e.g. restrictions on foreign ownership in China), meaning that foreign-local joint ventures are prevalent.
- Developing countries face the challenge of fast-growing energy demand combined with shallow and unstable capital markets (although this is improving) – which skews investment towards fossil fuel generation (proven, understood, large-scale, less capital-intensive).
- Innovation in financial instruments is continuing to encourage investment and manage risk in developing countries.

For the purpose of this report, developing countries are divided into the broad categories of fast-growing economies such as China, India and Brazil, and less developed countries such as those in Sub-Saharan Africa and parts of Southeast Asia. The former have already started to establish renewable energy sectors, with significant manufacturing capacity and increasing installed generation. India and China both have high installed wind capacity, and Brazil is a world leader in biofuels in terms of both production and consumption.

Energy demand in these countries is growing rapidly, particularly in India and China, and their infrastructure and generating capacity are struggling to keep pace. According to the World Bank, primary energy demand in non-OECD countries is expected to increase worldwide by 2.3-5.2 times between now and 2050.<sup>12</sup> China and India are expected to use their significant coal resources to fuel much of their growth. By 2012, India and China are projected to build nearly 800 new coal-fired power plants. Accelerating the pace of investment in these countries in renewable energy, energy efficiency and clean generation technologies is a priority.

The World Bank estimates that developing countries need annual investment in electricity supply of \$165 billion up to 2010, increasing at about 3% a year until 2030. There is currently a large gap in energy sector financing of about \$80 billion a year, roughly 50% of the overall investment needed. This under-investment in energy is estimated to reduce GDP growth in some countries by as much as 4% a year.

Renewable energy accounts for a relatively small (but nevertheless important) share of the required investment. A World Bank assessment shows that the commitments made by developing countries in the 2004 Bonn International Action Plan translate into capacity additions of more than 80GW of renewables (other than large-scale hydropower) by 2015, requiring \$90–120 billion, or about \$10 billion per year. However, not all developing countries made commitments at Bonn, so that these figures understate the scale of total investment required. The capital-intensive nature of renewable energy makes it more immediately expensive than conventional generation, even though its operating costs are generally much lower. Favourable policy frameworks along with finance sector engagement needed to foster new technologies encourage investment in renewable energy and in so doing help developing countries shift to a low-carbon development path.

The financial sector is developing new financing products to encourage private investment into developing countries, including hybrid products (e.g. quasi-equity to allow private equity investors easier exits), risk management tools (such as currency swaps) and bridging mechanisms for financing. Support from multi/bilateral sources such as the World Bank, the Asian Development Bank and KfW also helps to leverage private investment.

The Kyoto Protocol's Clean Development Mechanism is bringing new revenue streams to projects in developing countries. CDM approval can enhance returns on projects by up to 12% (for wind, hydro and geothermal) and 15-17% for biomass and municipal waste. To date, China and India have dominated the list of CDM-approved projects (China in value terms, India by number of projects), with Africa conspicuously lacking in CDM project flow.

## 12.1 Investment in China

China is already the world's largest producer of renewable energy (including large hydro) with 120GW of generation capacity by 2005, 25% of the country's total capacity. It is also the world's third largest manufacturer of bioethanol, and has the fifth largest installed wind capacity.

Securing energy supply is a critical issue for China, politically, economically and socially. Consequently, the country is pushing hard for renewable energy, with a target of 15% of primary energy supply by 2020. Clean coal, nuclear power and large hydro all play significant roles in China's energy future, alongside renewables and energy efficiency.

Figure 45. Renewable Energy Investment in China, 2004-2006



Note: Grossed-up values based on disclosed deals. VC/PE figures: include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals). Public Market figures: represent location of exchange on which a company raises money, not location of the company. Include investor exits made through Public Market offerings. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Asset Financing figures: represent total investment, and so include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals). M&A figures: exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

China's energy consumption grew nearly 50% between 2000 and 2004, making it the world's second largest user of energy and the third largest importer of oil. With GDP growth averaging 8.5% per year for the past ten years – and set to continue – China is under pressure to diversify its energy sources.

China faces three critical challenges: a high dependence on coal, lack of domestic oil and serious environmental problems – which is why its response to energy security includes a significant role for renewable energy. The Renewable Energy Law, which was introduced in January 2006, was designed to lay the foundations for continued investment in renewable energy.

Rather than become dependent on foreign technology and suppliers, China is working to ensure that a local equipment industry is built up, fostering the creation of competitive local suppliers and buying the best foreign technologies. The government has also identified how China can become a supplier of renewable energy and low-carbon technologies to the rest of the world, leveraging the country's low-cost/high-skill industrial base and exploiting fast-growing demand in the rest of the world.

The arrival of Chinese clean energy companies on public markets during 2006 signals this emphasis on building a global profile, and suggests that investors believe that Chinese companies have the means to capitalize on their enormous potential. Five Chinese companies went public in 2006, all of them outside China: four solar companies (three in the US, one on AIM) and one biofuels company on AIM. A further one went public in early 2007.

China is emerging as a dominant player in the solar industry, currently as a manufacturer, but with every indication that it will also install significant solar capacity, a sector presently dominated by Germany and Japan. China is also catching up in the wind sector. At the end of 2005, China had 1.3GW of installed wind capacity, placing it eighth in the world. During 2006, however, China doubled its wind capacity, adding 1.35GW, pushing it into fifth place. This trend looks set to continue: China recently raised its wind targets to 5GW by 2010 and 30GW by 2020, and is expected to exceed its 2020 target by 24GW.

China is the world's largest generator of hydropower, with 115GW of installed capacity at the end of 2005. Most of this (80GW, or 70%) was from large hydropower, but a significant proportion (35GW) came from small hydro (less than 50MW capacity). Hydro is likely to remain the most important provider of renewable energy in China as it works to achieve its target of 300GW by 2020.

China also has significant potential for geothermal generation and marine power, with several pilot projects in operation and a nascent supply chain.

In terms of investment, China has a rapidly developing venture capital community, with several companies focusing substantially or wholly on clean energy opportunities. It also has 200 business incubators, 30% of which have worked on creating renewable energy or low-carbon technology companies. Foreign investment at this level, however, remains challenging and reliant on local contacts and knowledge, and almost all the investment in China in 2006 (\$4.5 billion) took the form of asset finance. Higher levels of private equity investment focused on expanding solar manufacturing capacity.

China's public markets still pose difficulties for foreign investors, who suffered the Asian crash in 1997 and remain cautious when weighing the risks and rewards. Chinese companies floating on overseas exchanges (such as solar manufacturer ReneSola, which went public on London's AIM in August 2006) therefore remain an obvious target for foreign investors – and fortunately there is still a healthy pipeline of suitable candidates.

## Case Study 1. Solar in China

China has 80% of the world market for solar water heating, but very little installed PV capacity, despite a strong module exports industry. It is already a global powerhouse for cells and modules, but is currently dependent on imported feedstock. This will change by 2015, due to intense investment in silicon refining capacity in 2006-2012, and the country will become a net exporter of every element of the PV value chain by 2020.

Investment in Chinese solar companies totalled \$1.1 billion in 2006, consisting of \$638 million of Venture Capital & Private Equity, plus \$466 million of public market fund raising.

While silicon shortages persist, inexpensive labour gives China an edge in that it is economically viable for it to manually recover and recycle silicon. However, this situation will change as new silicon production within the country comes on stream and the bottleneck eases.

Foreign demand for Chinese PV products drives production, with domestic demand expected to remain a small proportion of revenue (currently around 10%). Exports will continue to dominate the mix.

Even though China is expected to become a net PV exporter, this will not be at the expense of its domestic industry: China is likely to more than meet its target of 300MW installed by 2010, and to easily outstrip its 2020 target of 2GW – which will require total investment of more than \$40 billion in domestic solar thermal and PV installations over the next 15 years.

While PV remains relatively expensive as a form of generation, China will continue to focus on capitalising on other countries' generous feed-in tariffs (it has done particularly well on Germany's), rather than building out its own solar capacity.

Source: New Energy Finance

## 12.2 Investment in India

India is also actively expanding its renewable energy presence, both in terms of installed capacity and manufacturing capability. Much of its growth has been financed domestically. India's competitive domestic banks are an important source of finance for renewable energy companies and projects, and domestic investors have proven their appetite for local issues, with the result that many Indian companies have chosen to go public on Indian stock exchanges (notably Suzlon, in 2005).

IREDA, the Indian Renewable Energy Development Agency and independent financing arm of the country's Ministry for New and Renewable Energy (MNRE), has been particularly active in local financing. It recently increased its share capital to \$226 million, which will allow it to leverage higher levels of private investment. It has also increased its scope to include energy efficiency and energy conservation projects.

Figure 46. Renewable Energy Investment in India, 2004-2006



Note: Grossed-up values based on disclosed deals. VC/PE figures: include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals). Public Market figures: represent location of exchange on which a company raises money, not location of the company. Include investor exits made through Public Market offerings. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Asset Financing figures: represent total investment, and so include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals). M&A figures: exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market / OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

In 2006, roughly half of the VC/PE total (\$100 million) was private equity investment for expanding wind-manufacturing capacity.

Asset financing (\$2 billion) was focused on wind, although the majority of investment is by captive power generators. Public market activity was negligible, with no Indian companies going public in 2006. There was only one M&A deal involving an Indian target during the year, and this was very small: Solar-Fabrik AG's \$3.8 million acquisition of an 80% stake in OJAS Energy, an Indian PV wafer manufacturer.

In the other direction, however, Indian companies aggressively sought opportunities beyond their borders. Suzlon acquired Belgian gearbox manufacturer Hansen for \$565 million; telecoms and beverages group Sterling Infotech entered the renewables market by paying \$28.2 million for a 40% stake in Finnish turbine manufacturer WinWind; solar group Moser Baer made two investments, one in the US and one in Slovenia; and bioethanol producer Praj Industries acquired US engineering firm CJ Schneider.

There is little doubt that activity in India will only increase. India has a population of more than 1.1 billion and GDP growth is approaching 9% a year. At present growth rates, India will outstrip China as the most populous nation by 2030 and will represent a third of total global energy demand by 2050, according to the IEA.<sup>13</sup> This is placing considerable stress on existing energy resources. According to a Draft Report on Integrated Energy Policy from India's Planning Commission,<sup>14</sup> India will need to increase its primary energy supply by 3-4 times and its electricity supply 5-7 times if the country is to maintain 8-10% economic growth through to 2030.

India is already the sixth largest energy-consuming nation in the world. Wind and alternative sources currently account for just 5% of its generation capacity. India relies heavily on imported oil: more than 30% of India's energy needs are met by oil, of which 70% is imported.

Energy independence is one of the country's highest priorities. The government has set targets for energy security by 2020 and energy independence by 2030. By concentrating on three areas - hydroelectric, nuclear power and non-conventional energy - India is aiming to increase its power generating capacity from current

levels of 130GW to 400GW by 2030. India's President APG Abdul Kalam has recently said that the gap could be closed by increasing hydroelectric capacity to 80GW, solar to 55GW, wind to 64GW and nuclear to 50GW, with the balance from biomass and waste to energy.

More recently, the state secretary to the Indian Ministry of New and Renewable Energy recently said that India was aiming for 10GW of renewable energy in its 11th Five-Year Plan (2007-2012), with an overall target of 70GW of new power generation by 2012. In 2007 alone, India plans to add up to 2GW of additional renewable capacity, mostly from wind.

Renewable capacity in India is currently less than 10GW, most of which is wind. India is a significant player in the wind industry, both in terms of installed capacity (it is the world's fourth largest wind generating nation – see Case Study 2), and in terms of its fast-growing manufacturing base.

India has less than 3MW of grid-connected PV and around 85MW of distributed generation - largely because solar technology is still too expensive for the vast majority of its population, although the government has high hopes for solar, targeting installed solar capacity of 50GW by 2032. As with wind, though, India has become a strong manufacturing hub, producing 65MW of PV module capacity a year, with several manufacturers expanding capacity.

India also has a well-established bioethanol industry, and is the fourth largest producer in the world, on the back of its significant sugarcane industry. By contrast, India's biodiesel industry is in its infancy. The government is trying to encourage farmers to plant jatropha (a source of non-edible oil that can be turned into biodiesel) on wasteland across the country, but so far farmers have proved hard to persuade and the planting programme is behind schedule.

India's installed hydro capacity is 33.9GW, of which only around 5%, or 1.7GW, comes from mini-hydro (less than 25MW capacity). Hydropower is an established source of energy in India, and by 2020, India hopes to increase its hydro generation by an additional 50GW, with 162 projects to be developed during 2007-17. It certainly has the scope to achieve this - India's estimated hydropower potential is 150GW (three times the target), of which only 23% has been exploited. India also has considerable geothermal capacity - a geological survey has identified 350 hot spring sites in northwest and western India, with an estimated 10GW of geothermal potential - but almost none has been developed.

## Case Study 2. Wind Investment in India

India is the world's fourth largest wind-energy generating nation, with an installed capacity of 6,270MW at the end of 2006. Wind accounts for two-thirds of India's renewable energy capacity, and a number of large projects (100-500MW) projects are currently in the pipeline.

India's wind market is undergoing a shift from energy-intensive captive users to large, grid-connected generation projects. New Energy Finance forecasts installed capacity of 42GW by 2020.

Offshore wind, currently untapped in India, has significant potential along India's 7000-mile coastline. As offshore wind starts to overcome challenges such as planning, supply and logistics in OECD countries, India should benefit.

India is also a major wind turbine manufacturing base, with Indian manufacturer and developer Suzlon ranked in the top five worldwide. Most of the turbines produced in India are currently exported, and several manufacturers are expanding capacity to meet growing demand. India's manufacturing base is likely to scale up to feed both growing domestic and foreign demand, and Indian production is expected to continue to outstrip domestic demand.

Source: New Energy Finance

## 12.3 Investment in Brazil

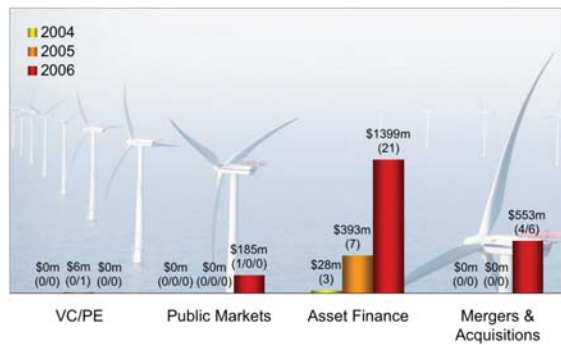
Brazil is the world's largest renewable energy market, largely on the back of its long-established bioethanol industry. Around 44% of its total energy production comes from renewable sources. More than 75% of Brazil's cars are flex-fuel, meaning they can run on any mix of petrol and ethanol, and ethanol has been cheaper than petrol for some time, which encourages its use.

Brazil has been the world's leading producer of ethanol, which is derived from sugarcane in Brazil, for several decades. However, following the bioethanol boom in the US during 2006, Brazil was overtaken as the largest ethanol producer in the world.

Brazil accounted for almost all the renewable energy investment in Latin America in 2006. Asset financing dominated the mix, with \$1.4 billion raised, mainly for ethanol projects.

Public market activity was far lower, but was also represented by Brazilian biofuels – in this case biodiesel – as Brasil Ecodiesel completed a \$175 million IPO on the Sao Paulo stock exchange. Brasil Ecodiesel, which was valued at just under \$700 million, was the first Brazilian biodiesel company to go public.

Figure 47. Renewable Energy Investment in Brazil, 2004-2006



Note: Grossed-up values based on disclosed deals. VC/PE figures: include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals). Public Market figures: represent location of exchange on which a company raises money, not location of the company. Include investor exits made through Public Market offerings. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Asset Financing figures: represent total investment, and so include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals). M&A figures: exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

There was no recorded VC/PE activity in Latin America during 2006, but activity has picked up in 2007, with two significant Brazilian ethanol investments. In March, Brazilian Renewable Energy Company (Brenco) raised \$200 million from a group of high profile investors, including venture capitalist Vinod Khosla, former World Bank President James Wolfensohn, and AOL founder Steve Case. US entrepreneurs invested strongly in US bioethanol during 2006, and this deal perpetuates that trend. Brenco plans to build a series of plants in the state of Sao Paulo, with expected annual output of 3.8 billion litres (1 billion gallons). The company is believed to be ultimately aiming to raise \$2 billion.

Also in March 2007, technology fund Clean Energy Brazil took a 49% stake in ethanol company Usaciga for approximately \$130 million. Usaciga owns a sugar mill in Parana with an ethanol production capacity of around 60 mLpa and intends to use the investment proceeds to develop three further plants with similar capacities.

Investors in Brazilian ethanol have the \$11 billion US ethanol market in their sights. The US currently has an import tariff of \$0.54 a gallon on ethanol. However, on a recent trip to Brazil, US President Bush set in motion the beginnings of a biofuels understanding between the two countries, signing a memorandum of understanding with Brazilian President Luiz Inacio da Silva to share and develop next-generation biofuels technology, to help Central American and Caribbean countries build biofuels industries and to establish international standards for making ethanol a tradable commodity.

Wind in Brazil is also poised to take off, following the country's recent decision to lift its 60% import tariff on wind equipment. Brazil aims to accelerate the development of the remaining 1.2GW of PROINFA-approved wind projects (PROINFA is a government programme that includes feed-in tariffs for wind, bioenergy and hydro, tradable certificates and third party finance). Brazil is also expected to put out a second tender for 6GW of wind projects that were unable to secure a power-purchase agreement under PROINFA, with an attractive price cap of around \$112/MWh. The NDES interest rate for PROINFA projects has also been lowered from 9.75% to 6.5%. As a result, Brazil is very likely to meet its 1.4GW target for renewables for 2008.



The move is also likely to see foreign imports (particularly from India and China) flooding into Brazil, which previously had just one domestic manufacturer. Wobben Windpower, a subsidiary of German turbine manufacturer Enercon, was unable to meet local demand. Major foreign investors, such as Iberdrola, EDP and Acciona, will also be attracted to Brazil as increased competition and far easier access to equipment reduce project costs (of which turbines account for up to 80%).

These recent developments could mark a turning point in private investment in Brazil. To date, private investment in renewable energy has been small, following a series of financial crises in the country over the past 25 years, which has eroded investor confidence. Much of renewables growth in Brazil has therefore been the result of solid government policies, including the PROINFA programme; the PRODEEM and Luz para Todos grant programmes (rural electrification); and the Pro-Biodiesel and Pro-Alcool programmes.



## 12.4 Investment in Africa

Africa accounts for just 5% of the world's primary energy demand. Only 36% of its total population and less than 80% of its rural population have electricity. In Sub-Saharan Africa (SSA) more than 630 million people rely on traditional biomass such as wood and agricultural residues as their primary fuel for cooking and heating, at high health and environmental cost. Africa is rich in renewable resources such as wind, solar and geothermal, but these have hardly been exploited to date.

Investment in renewable energy in Africa is very low, in line with the broader investment context, in which Africa (and particularly SSA) attracts only a fraction of the investment flowing into fast-growing developing countries such as China. Gross national income in many African countries is the lowest in the world - \$100-200 per capita, compared with more than \$35,000 across the OECD. South Africa is an exception, with GNI of nearly \$5,000 per capita.

Figure 48. Renewable Energy Investment in Africa, 2004-2006



Note: Grossed-up values based on disclosed deals. VC/PE figures: include PE buy-outs, and investor exits made through OTC market offerings. OTC & PIPE deals are included. Figures in brackets refer to (disclosed deals / total deals). Public Market figures: represent location of exchange on which a company raises money, not location of the company. Include investor exits made through Public Market offerings. Figures in brackets refer to number of (IPOs / Secondaries / Convertible & Other). Asset Financing figures: represent total investment, and so include new build and refinancing of clean energy projects. Acquisitions of projects are not included. Figure in brackets refers to (total deals). M&A figures: exclude PE buy-outs, acquisitions of clean energy projects, and investor exits made through Public Market /OTC offerings. Figures in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

The overall energy context is also bleak. Most poor people without energy access live in SSA and South Asia, but while government programs are well underway in South Asia, progress is slow in SSA, where far greater action is needed to bridge the considerable energy access gap.

Significant investment is needed to provide all households with electricity access. New connections in SSA are running at less than 1% annually, well below the 1.9% growth in new households. Many SSA countries are faced with an electricity generation shortfall, as investments in generation and transmission have not kept pace with demand.

According to the World Bank, economic growth in SSA has been 3.3%-4.8% in recent years, which should be supported by an increase in electricity supply of around 5% (or 4GW) a year.<sup>15</sup> But SSA (excluding South Africa) has just 32GW of installed capacity for a population of 680 million – compared with Latin America, which has a far larger installed capacity of 200GW for its smaller population of 541 million.

Investment climate surveys show that SSA remains a high-cost, high-risk place to do business, resulting in less investment, less employment, lower incomes, less growth and competitiveness, and higher poverty. A World Bank survey estimates that doing business in Africa costs 20-40% more than in other regions of the developing world.<sup>16</sup>

Hardly surprisingly, then, private investment in Africa to date has focused on North and South Africa. Investment in 2006 was almost all asset financing in South Africa - for the construction of Ethanol Africa's Bothaville bioethanol plant with German construction group ThyssenKrupp, and the 5MW Darling wind farm, which is being funded by the Danish Development Aid (Danida), the Department of Minerals and Energy and the Darling Independent Power Producing Co. In February 2007, the Aja Fatou A Bojang 14MW waste-to-energy biomass plant in Gambia received financing of \$80 million from Naanovo Energy and the Millennium Africa Water & Electricity Power Company.

Initiatives for renewable energy in South Africa have been limited by the country's abundant coal reserves. Now, however, the country has a number of new renewable energy projects under development, including a 100MW solar thermal power plant in Upington, in the Northern Cape, biogas initiatives at several landfill

sights throughout the country, wind farms near Darling in the Western Cape, a wind-assisted pump storage plan in the Eastern Cape, and a small hydro plant in Bethlehem, in the Free State.

South Africa is also on the way to installing its first wave energy project. In April 2007, Canadian project developer Finavera Renewables announced that it had completed the preliminary site evaluation and selection process for its 20MW wave energy project. The project is expected to cost \$40m and will generate up to 30MW of electricity per month from Finavera's AquaBuoy technology.

North Africa is another promising region for renewable energy. Egypt, Morocco and Tunisia account for 85% of the installed wind capacity in Africa & the Middle East. North Africa is also becoming a focal point for solar thermal, with several STEG (Solar Thermal Electricity Generation) projects announced, albeit not yet completed. The most recent, announced in January 2007, involves Abener, the engineering arm of Spanish infrastructure and technology group Abengoa. Abener was selected by Algerian renewable energy agency, New Energy Algeria (NEAL) to build a 25MW parabolic trough solar thermal field to provide add-on heat to a 130MW combined cycle gas power station. The plant's total capacity is expected to increase to 500MW by 2010. So far, however, progress on large hybrid gas/solar plants in Northern Africa has been slow, and Egypt and Morocco have had similar projects in the planning stage for over five years. This contract may represent a breakthrough.

In Sub-Saharan Africa, however, the picture is very different. There has been negligible investment, reflecting less mature financial markets, the lack of an enabling regulatory framework and little investor confidence. Most investment has been in the form of asset financing, which is starting to trickle into biofuels, wind and geothermal projects. There is some experimental investment in planting crops for biofuels production (Jatropha in Zambia, sugar cane in Tanzania and cassava in Nigeria), but this is at a very early stage. Financing in the region is often underpinned by multilateral and bilateral institutions. For example, one of the region's largest projects, the Olkaria Geothermal Power Plant in Kenya, is backed by the World Bank and the EIB, alongside US geothermal specialist Ormat Technologies Inc.



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## About SEFI

UNEP is working to create the policy and economic framework whereby sustainable energy can increasingly meet the global energy challenge. Changing attitudes and helping mainstream financiers to consider sustainable energy investments are key components of the energy work within UNEP and the starting point for the UNEP Sustainable Energy Finance Initiative.

SEFI provides current and targeted information to financiers and facilitates new economic tools that combine social and environmental factors – both risks and returns – as integral measures of economic performance.

SEFI is modelled as a platform to provide financiers with the tools, support and networks to drive financial innovation that improves the environmental performance of the energy mix. The overall strategy is to use this platform and modest amounts of capital to convene financiers, engage them to do jointly what they may have been reluctant to do individually, and to catalyze public-private alliances that together share the costs and lower the barriers to sustainable energy investment.



SEFI is managed jointly by the UNEP Energy Branch in Paris, the UNEP Finance Initiative in Geneva and BASE, a UNEP Collaborating Centre located in Basel.

[www.sefi.unep.org](http://www.sefi.unep.org)

## About New Energy Finance

New Energy Finance is a specialist provider of analysis to the world's leading investors in renewable energy, biofuels, low-carbon technologies and the carbon markets. The company's research staff of 45 (based in London, Washington, New York, Beijing, Shanghai, New Delhi, Tel Aviv and Perth) tracks deal flow in venture capital, private equity, M&A, public markets and asset finance around the world.

New Energy Finance covers all sectors of clean energy: renewables (wind, solar, marine, geothermal, mini-hydro); biomass & biofuels; energy architecture (supply- and demand-side efficiency, smart distribution, power storage, carbon capture & sequestration); hydrogen & fuel cells; carbon markets and services.

Services include the New Energy Finance Briefing, New Energy Finance Desktop, Newswatch daily news service and Focus Reports on sectors and countries. New Energy Finance co-publishes the world's first global clean energy market index, the WilderHill New Energy Global Innovation Index (ticker symbol NEX). New Energy Finance's subscription-based Insight Services providing deep market analysis to investors in Wind, Solar, Biofuels, Biomass, China, VC/PE, Public Markets and the US. The company also undertakes bespoke research and consultancy, and runs senior-level networking events.

New Carbon Finance, a division of the company, provides analysis and price forecasting for the European, global and US carbon markets.



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**Renewable energy and energy efficiency technology industries set a new record of more than \$100bn worth of financing transactions over the course of 2006. Of this, \$70.9bn was new investment, an increase of 43% on 2005, while \$29.5bn consisted of M&A activity, leveraged buyouts and refinancings of assets.**

**The biggest growth has been in public markets and venture capital/private equity investment activity, which increased by 141% and 167%, respectively. Asset financings grew at a more sedate 22.9%.**

**This healthy investment environment bodes well for the continued growth of the sustainable energy sector. The report provides an overview of different types of capital flows and an analysis of the trends in sustainable energy investment activity in OECD and Developing Countries.**

**The information is intended to be a strategic tool for understanding the status of the sustainable energy sector's development and for weighing future public and private commitments to the sector.**

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