



 new energy  
finance

# GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2008

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



UNITED NATIONS ENVIRONMENT PROGRAMME

ENDORSED BY



Copyright © United Nations Environment Programme and New Energy Finance Ltd. 2008

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. UNEP would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme.

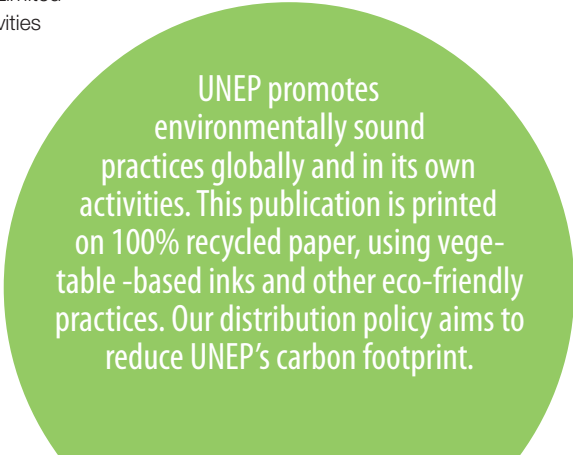
### **Disclaimer**

United Nations Environment Programme: The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations Environment Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning delimitation of its frontiers or boundaries. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the United Nations Environment Programme, nor does citing of trade names or commercial processes constitute endorsement.

New Energy Finance Ltd: The information contained in this publication is derived from carefully selected public sources we believe are reasonable. We do not guarantee its accuracy or completeness and nothing in this document shall be construed to be a representation of such a guarantee. Any opinions expressed reflect the current judgment of the author of the relevant article or features, and do not necessarily reflect the opinion of New Energy Finance Limited. The opinions presented are subject to change without notice. New Energy Finance Limited accepts no responsibility for any liability arising from use of this document of its contents. New Energy Finance Limited does not consider itself to undertake Regulated Activities as defined in Section 22 of the Financial Services and Markets Act 2000 and is not registered with the Financial Services Authority of the UK. When quoting, please cite 'New Energy Finance Research'.

Version 1.2

ISBN: 978-92-807-2939-9, DTI/1066/PA



UNEP promotes environmentally sound practices globally and in its own activities. This publication is printed on 100% recycled paper, using vegetable-based inks and other eco-friendly practices. Our distribution policy aims to reduce UNEP's carbon footprint.

## ACKNOWLEDGEMENTS

This report was commissioned by UNEP's Division of Technology, Industry and Economics (DTIE) under its Sustainable Energy Finance Initiative and was produced in collaboration with New Energy Finance Limited.

## AUTHORS

Rohan Boyle  
Chris Greenwood  
Alice Hohler  
Michael Liebreich  
Virginia Sonntag-O'Brien  
Alice Tyne  
Eric Usher

Thanks to the following experts who provided valuable guidance for this report:

Nick Gardiner, Fortis Bank  
Kirsty Hamilton, Chatham House  
Ryan Hobert, UN Foundation  
Sophie Justice, Royal Bank of Canada  
Pierre Langlois, Econoler International  
John MacLean, Energy Efficiency Finance Corp  
Daniel Magallon, BASE  
Chris Mottershead, BP  
Klaus-Peter Pischke, KfW  
Steve Sawyer, Global Wind Energy Council  
Hans Schut, Triodos Bank

## FINANCIAL SUPPORT

Support for this report was provided by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and by the United Nations Foundation.

Design and Layout  
Touraine Design Studio



# Foreword

## Investors Continue to Create the Climate *for* Change

The numbers from the 2008 Global Trends in Sustainable Energy Investment Report are impressive and continue to break new records in the evolving clean energy sector – nearly \$150 billion of new money in 2007. The message these numbers present is clear: sustainable energy is now a mainstream *and* accelerating investment sector.

This edition of Global Trends shows that investment flows have not only continued to grow – more than 60% compared to 2006 – they have broadened and diversified, giving the sustainable energy sector greater breadth, depth and scale. The only sector that has taken a downturn is biofuels amid rising concerns of feedstock availability, price and environmental sustainability.

The record overall investment, however, comes despite the recent ‘credit crunch’ and is a true cause for hope that rising concerns over climate change and energy prices are leading to a fundamental change in the way we produce and use energy. These figures show that the finance sector’s forward view may be better at seeing the “disruptive change” of new technology.

Indeed, energy analysts that look backward see that renewable energy “only” supplies 5% of global energy. Renewable energy, however, accounted for 9.4% of global energy infrastructure investment and for 23% of new electricity generating capacity in 2007. Investment levels are on track to reach \$450 billion a year by 2012 and \$600 billion a year in 2020.

In terms of climate change, the numbers in Global Trends point to the most cost-effective solutions if carbon emissions are to be reduced in time to avoid the most dangerous climate change scenarios. The twin thrusts from renewable energy and improved energy efficiency can be the sustainable energy engine of a global economy without dangerous carbon emissions.

Rather than waiting for new technology to clean up the current energy infrastructure, the job can be done now from existing solar, wind, geothermal and other currently commercial technologies. Investment flows into sustainable energy have recently increased by more than \$100 billion. This is a positive signal that the investment sector will be able to raise the \$200-210 billion per year the UNFCCC Secretariat says is needed to return global GHG emissions to current levels.

Global Trends comes at a crucial time for international climate diplomacy with less than 17 months to go to the pivotal Copenhagen meeting of the climate convention. Here governments must reach agreement on a new and decisive climate agreement.

The message from the report is one of confidence - confidence that deep and meaningful emissions reductions are achievable and if the clean energy markets are given the oxygen to evolve.

Renewable energy and energy efficiency really are the light at the end of the climate tunnel that illuminates the most cost-effective and timely ways to reduce carbon emissions across the global economy. The challenge now is to accelerate efforts to develop the policies and signals that will continue to create the climate *for* change.

Achim Steiner  
Executive Director  
United Nations Environment Programme

# Contents


Foreword	2
Methodology and Definitions	5
Executive Summary	7
1. Overview of Investment Trends	11
2. Putting Sustainable Energy Investment into Perspective	17
3. Underlying Changes in the Finance Sector	20
4. Venture Capital and Private Equity	23
5. R&D and Clean Energy Incubators	27
6. Public Markets	30
7. Asset Financings	35
8. Corporate Mergers & Acquisitions	39
9. Investment Funds	42
10. Carbon Finance	45
11. Investment in Developing Countries	48
11.1 Investment in China	51
11.2 Investment in India	53
11.3. Investment in Brazil	55
11.4. Investment in Africa	58
12. Special Focus:	
Energy Efficiency – Investment Status and Opportunities for Growth	63
References	67



# Tables and Figures

Figure 1. New Investment in Sustainable Energy 2004–2007	11
Figure 2. Total Investment in Sustainable Energy 2007	12
Figure 3. Quarterly Investment Trend	13
Figure 4. Global Investment by Technology, 2007	13
Figure 5. Asset Financing by Technology, 2007	14
Figure 6. Public Market Investment by Technology, 2007	14
Figure 7. VC/PE Investment by Technology, 2007	14
Figure 8. New Investment by Region (VC/PE, Public Markets and Asset Finance), 2004-2007	15
Figure 9. Acquisition Activity by Region, 2004–2007	15
Figure 10. Global Investment in Sustainable Energy by Region, 2007	16
Figure 11. Renewable Energy Capacity as a proportion of Global Power Generation Capacity, 2005-2007 (GW)	18
Figure 12. Biofuels contribution to food price increases, 2004 - 2007	19
Figure 13. VC/PE Investment by Type, 2000–2007	23
Figure 14. VC/PE Investment by Type, 2007	24
Figure 15. Investment by Sector, 2001-2007	24
Figure 16. VC/PE Investment Type by Sector, 2007	25
Figure 17. VC/PE Investment by Region, 2001–2007	25
Figure 18. VC/PE Investment by Country, 2007	26
Figure 19. Clean Energy Incubators by Affiliation, 2007	28
Figure 20. Clean Energy Incubatees by Sector, 2007 (total 283)	28
Figure 21. Clean Energy Incubators by Country, 2007 (total 167)	29
Figure 22. Public Market Investment by Type, 2000-2007	30
Figure 23. NEX vs NASDAQ, S&P 500 and AMEX Oil	31
Figure 24. Public Market Investment by Sector, 2000-2007	31
Figure 25. Public Market Investment by Sector, 2007	31
Figure 26. Public Market Investment by Region, 2007	32
Figure 27. Public Market Investment by Exchange, 2007	33
Figure 28. Public Market Investment by Company Nationality, 2007	34
Figure 29. Asset Financings by Country, 2007	35
Figure 30. Asset Financings by Sector, 2001-2007	36
Figure 31. Asset Financings by Region, 2001-2007	37
Figure 32. Asset Financings by Type of Security, 2001-2007	37
Figure 33. Corporate M&A by Type, 2000-2007	39
Figure 34. Corporate M&A by Sector, 2007	40
Figure 35. Corporate M&A by Target Country, 2007	41
Figure 36. Corporate M&A by Region, 2001-2007	41
Figure 37. Sustainable Energy Funds by Type, April 2008	42
Figure 38. Clean Energy Funds Launched, 2000-2007	43
Figure 39. Investment Funds by Asset Class, April 2008	44
Figure 40. CDM Projects by Country, April 2008	45
Figure 41. Expected CERs by country (non risk-adjusted), April 2008	46
Figure 42. CDM Projects by Technology, April 2008	46
Figure 43. Carbon Funds, 2000–2007	47
Figure 44. Renewable Energy Investment in China, 2004-2007	52
Figure 45. Sustainable Energy Investment in China, 2004-2007	52
Figure 46. Renewable Energy Investment in India, 2004-2007	54
Figure 47. Renewable Energy Investment in Brazil, 2004-2007	56
Figure 48. Renewable Energy Investment in Africa, 2004-2007	58
Figure 49. Total VC/PE transactions in Energy Efficiency. 2004-2007	63
Figure 50. Energy Efficiency Corporate M&A. in Energy Efficiency, 2004- 2007	63





# Methodology and Definitions

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

The New Energy Finance Desktop collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers 20,000 organisations (including start-ups, corporates, venture capital and private equity providers, banks and other investors), 10,400 projects and 9,400 transactions.

## Methodology

New Energy Finance continuously monitors investment in renewable energy and energy efficiency. This is a dynamic process: as the sector's visibility grows, information flow improves. New deals come to light and existing data is refined, meaning that historic figures are constantly updated. Since last year's report – Global Trends in Sustainable Energy Investment 2007 – investment totals for 2006 have been restated upwards, with total new investment of \$92.6 billion (up from \$70.9 billion). The total new investment in 2007 is \$148.4 billion.

The following sustainable energy projects are included in New Energy Finance's Desktop database: all biomass, geothermal and wind generation projects of more than 1MW, all hydro projects of between 0.5 and 50MW, all solar projects of more than 0.3MW, all marine energy projects, all biofuels projects with a capacity of 1 million litres or more per year, and all energy efficiency projects that involve financial investors.

Where deal values are not disclosed, New Energy Finance assigns an estimated value based on comparable transactions. Deal values are rigorously back-checked and updated when further information is released about particular companies and projects. The data used is historic figures, showing confirmed / disclosed investment. This report covers these project transactions, as well as estimations of investment in small scale technology deployment such as domestic solar systems and solar water heaters.

This methodology also means that New Energy Finance's investment numbers may vary from other sources, notably the 2007 Renewables Global Status Report, released by REN21 earlier in 2008.<sup>i</sup> REN21 uses a top-down methodology, taking MW installed in a particular year and applying a \$/MW installation cost to estimate investment in that year's new installed capacity. Given the industry's rapid growth, REN21's numbers are likely to be slightly lower than New Energy Finance's numbers, as they effectively reflect capex of installed capacity in a particular year, while New Energy Finance's numbers will include some investment earmarked for future years. Another fundamental difference is that New Energy Finance includes investment in biofuels in its figures. New Energy Finance's revised 2006 total of \$63 billion of asset finance for new projects (including small projects) includes biofuels investment of \$14 billion. New Energy Finance's total asset finance figure of \$103.5 billion for 2007 includes \$17 billion invested in biofuels projects.

## Definitions

New Energy Finance tracks deals across the financing continuum, from R&D funding and venture capital for technology and early-stage companies through to public market financing for projects and mature companies and asset financing for capacity projects. Investment categories are defined as follows:

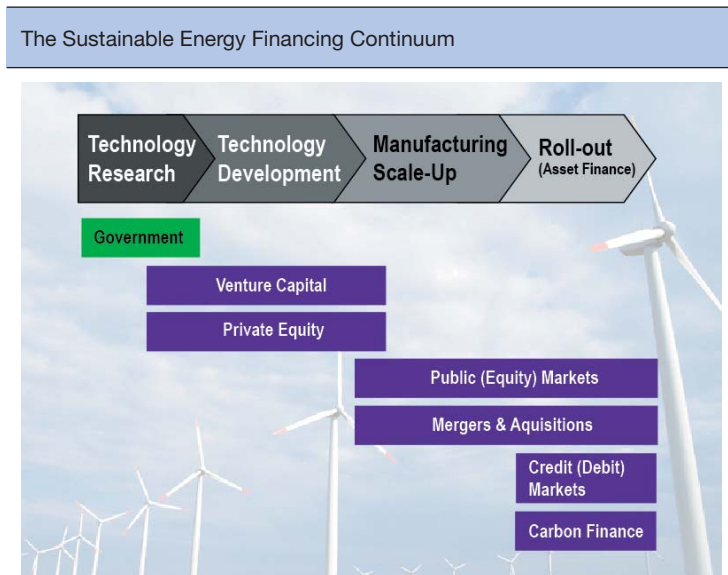
Venture Capital and Private Equity (VC/PE): all money invested by venture capital and private equity funds as equity in the companies developing renewable energy technology. Similar investment in companies setting up generating capacity through Special Purpose Vehicles is counted in the asset financing figure.

Public markets: all money invested in the equity of publicly quoted companies developing renewable energy technology and low-carbon power generation. Investment in companies setting up generating capacity is included in the asset financing figure.

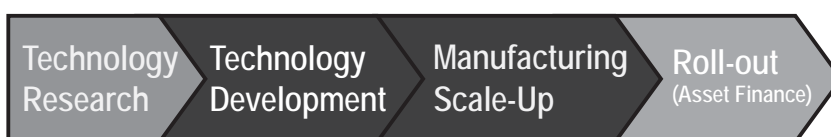
Asset financing: all money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. It excludes refinancings and short-term construction loans.

Mergers and acquisitions: the value of existing equity purchased by new corporate buyers in companies developing renewable technology or operating renewable energy projects.

To make it clear which point in the financing continuum each of the investment sections refers to, we have included a small version of this diagram within each of the relevant sections, with the appropriate financing stage highlighted. So, for example, venture capital and private equity – which is mainly for technology development and expansion - would be illustrated as:



Source: SEFI, New Energy Finance





# Executive Summary

Once again, global investment in sustainable energy broke all previous records, with \$148.4 billion of new money raised in 2007, an increase of 60% over 2006. Total financial transactions in sustainable energy, including acquisition activity, was \$204.9 billion<sup>1</sup>. Asset finance – investment in new renewable energy capacity – was the main driver for this surge in investment, rising 68% to reach \$84.5 billion in 2007, fuelled mainly by the wind sector. Public market investment also raced ahead in 2007, with investment of \$23.4 billion in 2007, more than double the \$10.5 billion raised in 2006.

The impact of the credit crisis in the financial markets started to show through in early 2008, with few new listings on the public markets and stock prices down 17.9%. Corporate M&A surged forward, reflecting the consolidation that tends to accompany tighter market conditions. However, by the second quarter investor uncertainty seems to have passed and overall investment during the first half of 2008 has been just above what was seen in the first half of 2007. Although asset finance is down somewhat, VC/PE investment, public market capital raising and stock prices are all healthy, indicating that the finance community still sees strong fundamentals underlying the sector and is increasingly looking to take part in its future growth.

This bodes well for the industry. Investment in the sustainable energy sectors must continue to grow strongly if targets for greenhouse gas reductions and renewables and efficiency increases are to be met. According to New Energy Finance (Global Futures 2008), investment between now and 2030 is expected to reach \$450 billion a year by 2012, rising to more than \$600 billion a year from 2020. The sector's performance during 2007 sets it on track to achieve these levels, with the current credit crunch testing the markets resolve, but not dislodging it.

Investment flows have not only continued to grow, but have broadened and diversified, making the overall picture one of greater breadth, depth and scale in sustainable energy. The mainstream capital markets are now fully receptive to sustainable energy companies, supported by a surge in funds destined for clean energy investment. At the other end of the spectrum specialist financing has also opened up with the development of innovative financing structures for distributed renewable generation and demand-side management.

Another aspect of this industry deepening has been greater activity in next-generation technologies, such as cellulosic ethanol, thin-film solar technologies and energy efficiency. Wind continues to dominate sustainable energy investment, but the portfolio of available technologies has both widened (as nascent technologies start to come into their own) and deepened (as existing technologies are refined). This is partly in response to changing supply/demand patterns (e.g. continuing silicon shortages, or the controversial competition between food and fuel from food-based ethanol feedstocks), but also reflects improved efficiencies and decreasing costs as renewable technologies strive to reach grid parity. Furthermore, the willingness to look beyond mature technologies suggests that investors are taking renewable energy and energy efficiency increasingly seriously.

The year 2007 also saw a geographic broadening, with renewable capacity rollout continuing to shift away from Europe and towards China and the United States. In recent years, sustainable energy investment in China has been largely for manufacturing expansion as an export industry. In 2007, however, the 2008 Beijing Olympic Games sharpened the country's political resolve and strengthened programmes to promote cleaner generation and cut energy intensity. During 2007, investment in renewables capacity (excluding large hydro) in China increased by 91% to \$10.8 billion.

Acceptance of sustainable energy also became more widespread in the US, extending beyond its traditional heartland of California. A new administration in 2008 is expected to make renewable energy and energy efficiency a political priority and in recent months, regulatory uncertainty in the US (particularly over the possible introduction of a carbon tax) has put a number of coal-fired generation plants on hold. The financial sector is also gearing up for a major shift in political attitude. Citi, JPMorgan Chase and Morgan Stanley have jointly established a set of "Carbon Principles", which will guide how they lend to and advise major power companies in the US. The three banks expect future investment in fossil

<sup>1</sup> The \$204.9 billion total investment includes \$7.5 billion of energy efficiency investment (3.7% of the total), split between VC/PE (\$1.8bn), public markets (\$1.6bn) and M&A (\$4.0bn).

fuel energy projects to be required to supply “reliable electric power to the US market” and have developed the principles to evaluate risks in financing these carbon-emitting projects, given the growing uncertainty around regional and national climate change policy. Under the Principles the banks will also consider power companies’ inclusion of energy efficiency and renewable resources in their portfolios as part of an “enhanced diligence process”.

Political landmarks in 2007 included the Bali talks in December, which were attended by representatives from 180 countries, where a roadmap for future discussions towards strengthened international action on climate change was set out with a target for agreeing a way forward by the end of 2009. This was immediately preceded by a change of leadership in Australia, and with it, a dramatic shift in the country’s attitude to renewable energy.

This report presents the financial perspective, or ‘dollar view’, of the current state of play in sustainable energy development. The analysis in this report consists of actual data on the different types of capital flows and their movement over time, combined with analysis of regional and sectoral trends. This information is intended to be a strategic tool for understanding the status of the clean energy sector’s development and for weighing future public and private commitments to the sector.

## Key findings

**New investment in sustainable energy reached record levels of \$148.4 billion, 60% higher than in 2006.** Asset finance (to build sustainable power generation and biofuels capacity) accounted for 57% of new investment in 2007. Public market investment more than doubled in 2007 with \$23.4 billion of new money raised. Convertible bond issuance increased eightfold in 2007, reflecting progressively less stable stock market conditions. Wind continued to attract the most investment, mainly for new capacity build, but solar investment took off in 2007 – \$28.6 billion of new investment flowed into solar, which has grown at an average annual rate of 254% since 2004.

**Sustainable energy accounted for 31 gigawatts (23%) of new power generation capacity added worldwide in 2007, and 5.4% of installed generation capacity.** Wind power continues to dominate renewable energy capacity. In 2007, wind attracted more investment than nuclear or hydro, and accounted for more new generation capacity in Europe than any other power source. Interest in clean energy investment surged forward, with assets under management in clean energy funds rising to \$35 billion in 2007 and boosting quoted sustainable energy companies’ valuations. The WilderHill New Energy Global Innovation Index (NEX) rose 57.9% in 2007. Sustainable energy companies continued to make their mark on the public equity markets, accounting for 19% of new capital raised by the energy sector in 2007.

**Early-stage venture capital investment surged 112% to \$2 billion in 2007,** boosted by interest in emerging renewable technologies, rather than just those on the brink of commercialisation, as competition for deals intensified. Private equity finance for expansion started strongly in 2007, driven largely by the boom in ethanol production in the US, but this ground to a halt in May 2007 as feedstock costs rose and ethanol prices fell. Overall, venture capital and private equity (VC/PE) investment in biofuels fell by almost one-third in 2007, to \$2.1 billion. However, biofuels investment has not dried up altogether, shifting to Brazil, India and China, as well as towards second-generation technologies. Solar attracted by far the most VC/PE investment (\$3.7 billion), both for new technologies and for manufacturing capacity expansion, although biomass and waste to energy saw the fastest (432%) growth. The US continued to lead VC/PE investment, but grew only slightly year on year in dollar terms. European investment is growing strongly as investors become more willing to take early-stage risk.

**Research & Development spending on clean energy and energy efficiency was \$16.9 billion in 2007,** including corporate R&D of \$9.8 billion, and government R&D of \$7.1 billion. Europe and the Middle East saw the most corporate R&D activity, followed by the Americas and then Asia. Patterns of government R&D are the reverse, with Asian governments (notably Japan, China and India) investing relatively heavily in R&D. The US and UK host the most clean energy incubators, often supported by public funding. Many of the most successful incubators have benefited from government support. Solar is the single most incubated technology, with a bias towards service companies, disruptive technologies and large-scale generation such as solar thermal electricity generation (STEG).

Collectively, though, energy efficiency technologies account for the greatest number of incubated companies.

**Clean energy companies more than doubled the amount of money they raised on the world's public markets in 2007, raising \$27 billion.** Iberenova, the wind power development arm of Spanish power giant Iberdrola, raised \$7.2 billion in a landmark flotation in December 2007, the largest Spanish IPO ever and the fourth largest public deal of the year. Since then, the US and European public markets have effectively closed. Wind dominated public market investment (\$11.3 billion), although wind companies raised no money in the US in 2007. Solar companies continued to raise significant amounts of capital (\$9.4 billion), particularly Chinese manufacturers tapping the US markets. Public market activity from developing countries increased strongly in 2007, with investment tripling to \$2.9 billion, although this is often on overseas markets such as the London or New York Stock Exchanges.

**Financing of sustainable energy assets grew by 61% in 2007 to \$108 billion**, most of it for new generation projects. The wind sector continued to be the leading sector for new capacity, attracting \$39 billion in 2007 and adding another 21GW of capacity. Global installed wind capacity exceeded 100GW in March 2008. Wind investment focused on the US, China and Spain, which together accounted for nearly 60% of new wind farms built worldwide in 2007. Solar was the fastest growing new capacity sector in 2007, increasing 250% to \$17.7 billion. Solar investment was subsidy-driven, with Germany remaining the dominant market for new capacity. Total asset transactions in China and India grew significantly, to \$10.8 billion in China and \$2.3 billion in India, suggesting a shift away from manufacturing to generation capacity.

**Corporate Mergers & Acquisition activity increased 52% to \$25.7 billion in 2007**, buoyed up by equity financing and diversification activity. Wind led M&A activity as supply-chain shortages drove consolidation amongst component manufacturers, while offshore wind projects saw increased interest. Wind assets are gradually being transferred from developers to utilities. Biofuels M&A was driven by industry turmoil, which shook out weaker players, as well as by the rising cost of building new plants, leading developers to acquire existing ones. The US and Europe dominated M&A activity, while Brazilian biofuels became a focus for non-OECD transactions.

**At the end of December 2007, over \$30.0 billion was under management in core clean energy funds**, in addition to \$26.4 billion in environmental funds and \$10.9 billion in funds that invest exclusively in renewable power projects. There was a record number of new clean energy public equity fund launches in 2007: 17 compared to just five in 2006. Several of these were from mainstream fund managers launching 'climate change' funds. The arrival of these heavyweight fund managers to the sector is likely to encourage the larger publicly listed companies they normally invest in to expand into sustainable energy and other low carbon sectors. Private (VC/PE) funds and project funds also increased their funds under management during 2007.

**CDM activity is dominated by India (32% of registered projects), China (19%) and Brazil (13%).** In terms of emission credits generated, however, China leads with 53%, followed by India with just 15%, reflecting the larger average CDM project size in China. Renewable energy accounts for around 55% of CDM projects by number, but only 29% by emission credits. By the end 2007, \$12.95 billion had been raised by carbon funds: \$9.4 billion in private funds and \$3.6 billion in public funds. Private funds grew strongly in 2007, reflecting investor interest in carbon trading, while public funds remained flat. The UK is the leading market for private carbon investment, accounting for 65% of private carbon funds under management.

**There is a continuing shift in investment from developed to developing countries**, with its share of new investment growing from 13% (\$1.8 billion) in 2004 to 23% (\$26 billion) in 2007, a market expansion of 14 times. China, India and Brazil together accounted for most of this investment (82% in 2007).

**In China asset finance reached a record \$10.8 billion**, most of it for new wind capacity, which more than doubled to 6GW. Asset finance in India also grew (to \$2.5 billion), but the country's most notable trend was Indian companies raising money overseas in a series of foreign currency convertible bonds, which no Indian renewable energy company had issued prior to 2007. Investment in Brazil continues to be dominated by ethanol, which drove private equity investment, asset finance and M&A, as investor interest shifted from the beleaguered US ethanol market to Brazil. Wind investment is picking up slowly in Brazil.

Africa continues to lag other regions in terms of sustainable energy investment, however, there is promising large-scale solar development in North Africa and signs of change in South Africa, where targets for renewable energy have been set and the country's first wind farm commissioned.

Investment in **energy efficiency technology** reached a record \$1.8 billion, an increase of 78% on 2006. Energy efficiency accounted for 18% of new VC/PE money flowing into the sustainable energy sector, second only to solar. Supply-side applications saw a surge in early-stage investment (more than double the 2006 figure), although demand-side technologies still raised marginally more money in 2007, particularly in transport and buildings. The demand side also dominated M&A activity in the sector. Financing energy efficiency is challenging, because the benefits are asymmetrical and the industry's diverse and fragmented nature makes it difficult for investors to identify large enough opportunities. In many cases some level of public intervention and support is needed to correct market failures, organise the market and catalyse investment.



# Overview of Investment Trends



- New investment in sustainable energy reached record levels of \$148.4 billion, 60% higher than in 2006.
- Asset finance (to build sustainable generation capacity) accounted for 57% of new investment in 2007. Public market investment more than doubled in 2007 with \$23.4 billion of new money raised. Convertible bond issuance increased eightfold in 2007, reflecting progressively less stable stock market conditions
- Wind continued to attract the most investment (\$50.2 billion), mainly for new capacity build. But solar investment took off in 2007 – \$28.6 billion of new investment flowed into solar, which has grown at an average annual rate of 254% since 2004.
- Most investment flowed into Europe, followed by the US. However, China, India and Brazil are attracting an increasing amount of investment – their share of asset finance grew from 10% in 2004-05 to 20% in 2006-07, reflecting a shift away from manufacturing investment into renewable energy generation capacity.
- In 2008, the impact of the global credit crisis started to show through, with few new listings on the public markets and stock prices down 17.9%. However by the second quarter investor sentiment seems to have recovered and overall investment during the first half of 2008 was just up on the same period last year. The finance community still sees strong fundamentals underlying the sector and is increasingly looking to take part in its future growth.

## 1.1 Global Investment in Sustainable Energy

Global investment in sustainable energy again reached record levels in the year 2007, rising to \$148.4 billion of new investment worldwide, an increase of 60% on New Energy Finance's revised 2006 total of \$92.6 billion<sup>2</sup> (see Figure 1). Since the sustainable energy sector first took off in 2004, annual investment has increased more than fourfold. The total amount invested during 2007 was \$204.9 billion, including existing money (i.e. money already in the sector, but changing hands via deals such as mergers & acquisitions (M&A) and management buyouts (MBOs)).

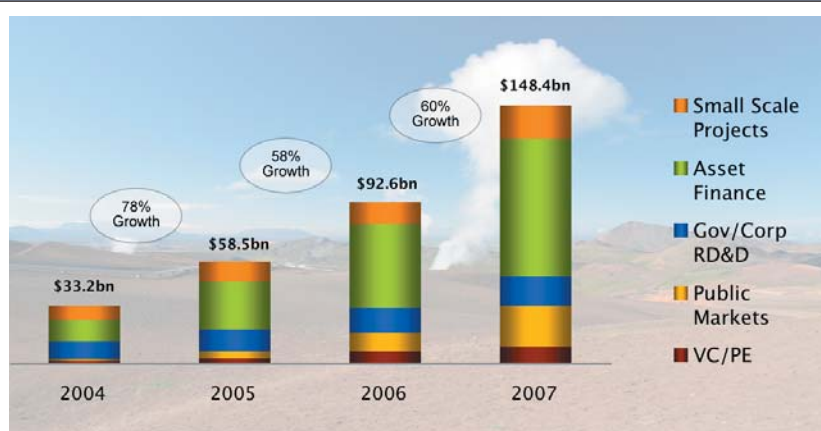
Energy efficiency investment (\$7.5 billion in 2007) accounts for 3.7% of this total. Stripping out energy efficiency investment leaves \$197.7 billion new investment in renewable energy (excluding large hydro). Investment in energy efficiency was split between VC/PE (\$1.8 billion), public markets (\$1.6 billion) and M&A (\$4 billion). As these figures only include

external financing, whereas most energy efficiency investment is made internally by beneficiaries of the technology, true investment in energy efficiency is likely to be much higher than reported here.

Policies promoting renewable energy and energy efficiency, rising oil prices and continuing energy security concerns all drove investment growth in 2007 and helped the sector withstand the credit crunch that set into financial markets worldwide from the middle of the year.

Asset finance was the main driver for the strong growth

Figure 1. Global new investment in clean energy by asset class, 2004–2007



Note: Grossed-up values based on disclosed deals. The figure represents total new investment in clean energy only, and so excludes investor exits made through public market offerings, PE buy-outs, and acquisitions of projects and companies. Total value is adjusted for reinvestment: Geared re-investment assumes a 1 year lag between VC/PE/ Public Markets funds raised and re-investment in projects

Source: New Energy Finance

<sup>2</sup> New Energy Finance estimates that exchange rate movements (and in particular, the weakening dollar) account for approximately \$3.35 billion of total new investment, representing 6% of the increase in new investment worldwide between 2006 and 2007, and 2.3% of total new investment in 2007



in new investment (see Figure 2). In 2007, \$84.5 billion was invested in building new sustainable energy assets, up 68% on 2006's \$50.3 billion. Asset finance also took a larger share of new investment, accounting for 57% of new money raised in 2007 (compared to just below 40% in 2006). Small-scale projects grew just over 50%, from \$12.5 billion in 2006 to \$19 billion in 2007, reflecting greater availability of financing solutions for smaller projects in both developing and developed countries.

In terms of sheer growth, however, public market activity stands out, with \$23.4 billion of new money raised in 2007, more than double the \$10.5 billion raised in 2006. Initial Public Offerings (IPOs) accounted for most of the activity, raising \$13.8 billion. The total was boosted by Iberdrola Energias Renovables' (Iberenova) \$7.2 billion IPO on the Madrid Stock Exchange in December 2007, the largest deal ever seen in the renewables sector. But even without the Iberenova deal, new equity raised on the public markets grew 54% to \$16.2 billion.

Progressively shakier market conditions showed through in the type of public market deals being completed. IPOs noticeably slowed down during the year, although convertible bond issuance held up well. Convertible bonds appeal to investors in uncertain market conditions, as they combine a fixed return with capital growth if the underlying shares rise. The total amount raised in 2007 via convertible issues (\$4.7 billion) was more than eight times higher than in 2006.

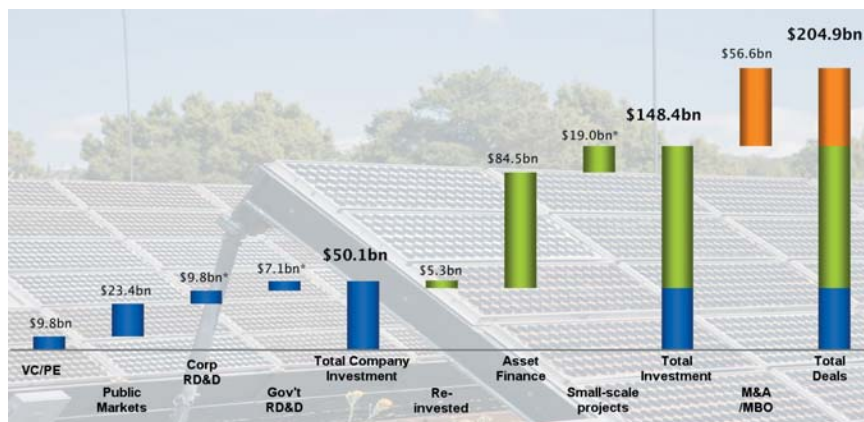
At the other end of the spectrum new venture capital and private equity investment grew by 34% to \$9.8 billion in 2007, driven by fiercer competition for technologies on the brink of commercialisation and a series of successful investor exits. March 2007 saw one of the biggest clean energy exits ever made, as Energias de Portugal acquired Horizon Wind Energy for \$2.93 billion. Goldman Sachs had bought Horizon for \$580 million in March 2005 and invested heavily in its capacity and pipeline ever since. The absolute return over two years was nearly 370%.

Mergers and acquisitions, buy-outs and re-financing reached \$56.6 billion, a rise of 49% over 2006. Most deals were project acquisitions and re-financing (\$21.8 billion) and corporate M&A (\$25.7 billion).

The impact of the credit crisis in the financial markets started to show through in early 2008 (see Figure 3). In the first quarter 2008, public market financing for sustainable energy virtually dried up, dropping to \$1 billion from a quarterly average in 2007 of \$6.8 billion. Part of this drop might have been due to the massive \$7.2 billion Iberenova IPO in December 2007, as a deal of this size could absorb liquidity for some time, even in good market conditions. It could also be that this IPO signaled the top of the market with some investors wondering if the rapid pace of growth could continue. This initial downturn led a number of companies to put their IPOs on hold waiting for market conditions to improve, including several Brazilian bioethanol groups. Lack of confidence also hit the publicly listed stocks which saw their share prices drop. The WilderHill New Energy Global Innovation Index (NEX) was down 17.9%, its first significant decrease since May 2006, when uncertainty in the carbon markets had caused a temporary drop in the price of most clean energy and carbon companies.

In Q1 2008, VC/PE investment was \$2.5 billion, down 32% from the same period in 2007. Within this figure, however, there was a sharp divide between private equity for expansion, which fell, and venture capital, which rose. Late-stage VC, in particular, saw a large increase

Figure 2. Total Transactions in Sustainable Energy, 2007



Note: Grossed-up values based on disclosed deals. Adjusted for reinvestment. Geared re-investment assumes a 1 year lag between VC/PE/Public Markets funds raised and re-investment in projects. Figures marked \* are based on industry estimates from various sources.

Source: New Energy Finance



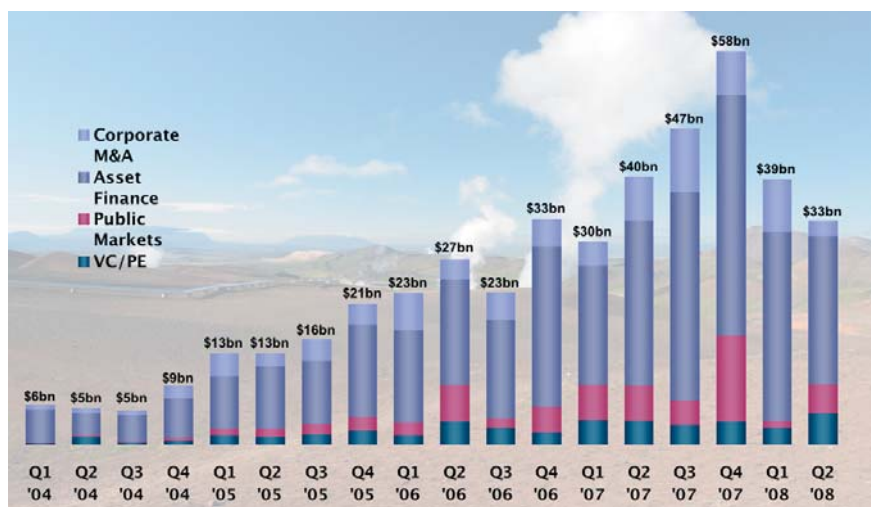
as companies unable to raise money from the public markets turned to venture capital. Private equity suffers most from the credit crunch, with the higher cost of debt souring

the economics for many expansion deals and leveraged buy-outs.

While the public markets and VC/PE were down in Q1 2008, both asset finance and mergers and acquisitions were up. The Q1 2008 total for asset finance was \$27.9 billion, up 59% on Q1 2007. Corporate M&A surged forward, more than doubling from \$3.5 billion in Q1 2007 to \$7.7 billion in Q1 2008. This was mainly thanks to a few large deals, including Scottish & Southern Electric's \$3.2 billion purchase of wind developer Airtricity.

But it also reflects the consolidation that tends

Figure 3. Quarterly Transactions Trend (including indicative Q2 2008 figure)



Note: Grossed-up values based on disclosed deals. The figure includes asset classes tracked by the NEF desktop only: VC/PE, public markets, asset finance and corporate M&A for clean energy. Corporate and Government RD&D and Small Scale Projects are not included. Does not adjust for re-investment

Source: New Energy Finance

to accompany tighter market conditions, which widen the divide between weak and strong players, allowing the latter to take advantage of lower valuations to build their portfolios.

Overall, sizeable investment found its way into the sector during the first quarter of 2008. New investment fell 17% to \$20 billion, although overall investment grew 30% to \$39 billion, reflecting higher acquisition activity – asset sales and corporate M&A both increased strongly.

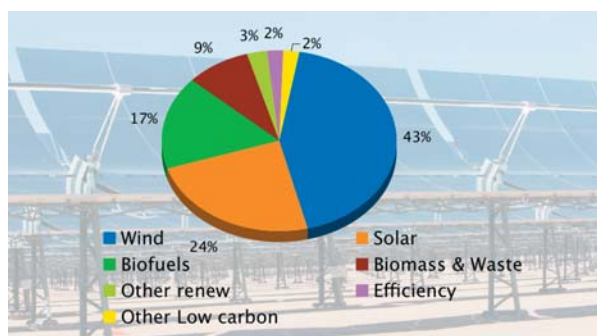
In Q2 2008, several of the Q1 2008 trends have reversed. The public markets have quadrupled, with \$4.3 billion of new capital raised, though still a 17% decrease on Q2 2007. At the same time, the NEX index of publicly listed stocks has regained about 8%, or half the loss suffered in Q1 2008, indicating that investor confidence in the sector is returning.

The VC/PE markets are also up, with \$4.7 billion invested, an increase of 34%. Asset financing is down 10% on Q2 2007 to \$21.9 billion, possibly indicating that the increased cost of debt financing on the global markets is having a direct impact on the sector.

Investment during the first half of 2008 has been just above what was seen in the first half of 2007. The direct impact of the credit crunch on financing costs has slowed investment in new sustainable energy generating facilities.

However, with the level of VC/PE investment, public market capital raising, and stock prices all healthy, it seems that the finance community still sees strong fundamentals underlying the sector (oil price, climate concerns, energy security, supportive policies) and is increasingly looking to take part in its future growth.

Figure 4. Global new investment by technology, 2007



Note: Grossed-up values based on disclosed deals. The figure represents total new investment in clean energy only, and so excludes investor exits made through public market offerings, PE buy-outs, and acquisitions of projects and companies. Small scale projects, government and corporate R&D are excluded at this granularity, bringing total investment to \$117.7bn. Does not adjust for \$5.3bn reinvestment.

Source: New Energy Finance

## 1.2 Investment by Technology

Wind was once again the leading sector in 2007, accounting for \$50.2 billion (43%) of new investment in 2007 and extending its lead after 2006, when it took 38% of new investment (see Figure 4). Solar and biofuels, respectively, attracted the second and third largest investment volumes. Together, all three technologies accounted for

nearly 85% of new investment in 2007, slightly ahead of their combined 80% share in 2006. Solar also increased its share to 24% from 16% in 2006, overtaking biofuels, which was the second most popular sector that year with 26% of new investment.

Wind dominated asset finance, as one would expect given the technology's maturity (see Figure 5). In 2007, 20GW of wind power was installed, led by the US, China and Spain, bringing worldwide installed capacity to 94GW, according to the Global Wind Energy Council (GWEC). Wind also led the way in public market investment, raising \$11.3 billion, although this was buoyed by Iberenova's \$7.2 billion IPO, which accounted for over 60% of the total raised by the wind sector on the public markets (see Figure 6). Without Iberenova, solar would have taken the leading share of public market investment, as it did in 2006.

Solar surged ahead in 2007, increasing its share of almost every investment category. Between 2006 and 2007, the sector increased its overall share of new investment from 16% to 24%, of asset finance from 6% to 21%, and of VC/PE from 21% to 30%. Its share of public market activity remained flat (if Iberenova is stripped out), with solar companies taking just under half (46%) of total public market investment. Solar, which attracted new investment of \$28.6 billion in 2007, has also been the fastest-growing sector, averaging annual growth of 254% since 2004.

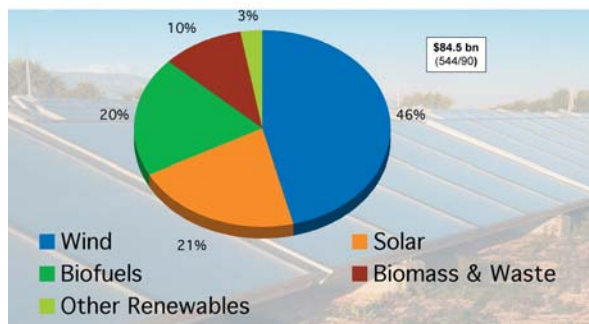
Solar took over from biofuels as the leading VC/PE sector in 2007 (see Figure 7). New PV manufacturing capacity and pre-IPO funding attracted heavy private equity investment, while venture capital money flowed into developing disruptive PV technologies such as thin film. Solar installation companies also attracted early-stage funding, driven by California's ambitious Million Solar Roofs Plan and better financing models for residential solar.

Energy efficiency featured strongly in early-stage financing, taking an 18% share of VC/PE investment on the back of interest in supply-side (power) technologies. VC/PE investments in energy efficiency more than doubled in both North America and Europe in 2007. The energy efficiency sector also raised its profile on the public markets, with issues from several efficiency companies, again mainly on the supply side.

Biofuels was the only sector that saw lower investment in 2007 than in 2006. New money flowing into the sector fell slightly from \$19.4 billion in 2006 to \$19.2 billion in 2007.

In terms of less mature technology sectors that began to get noticed, solar thermal electricity generation (STEG) saw renewed interest in the US, Spain and some developing countries and the biomass and waste to energy sector saw scaled up VC/PE investment activity.

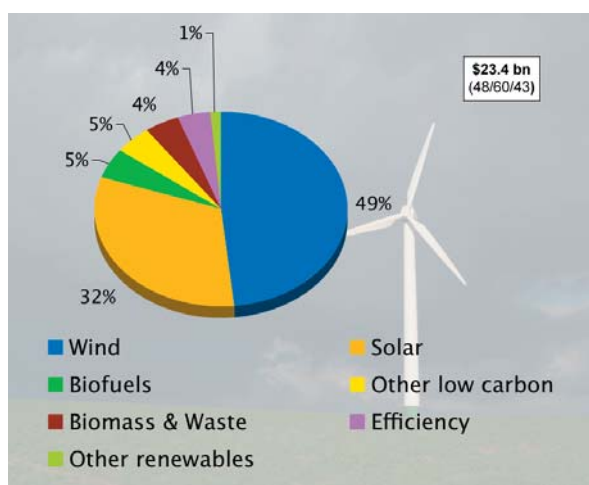
Figure 5. Asset finance new investment by technology, 2007



Note: Grossed-up value based on disclosed deals. The figure represents new build asset investment in clean energy and so excludes asset acquisitions and re-financing. Numbers in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

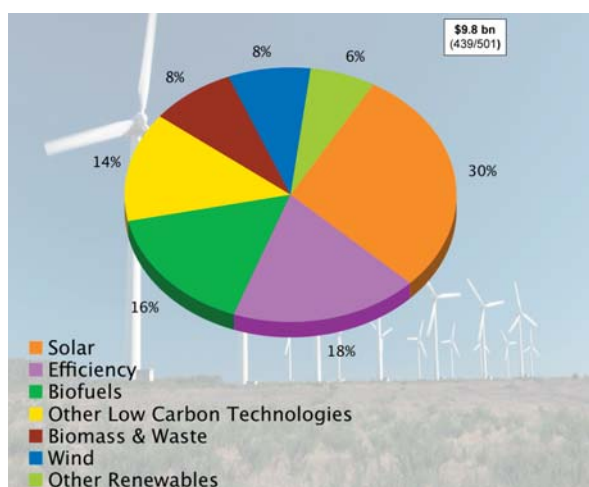
Figure 6. Public Markets new investment by technology, 2007



Note: The figure represents new equity investment only, and so excludes investor exits made through public market offerings. OTC and PIPE deals are not included, as these are included with VC/PE in Figure 7. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

Source: SEFI, New Energy Finance

Figure 7. VC/PE new investment by technology, 2007



Note: Grossed-up values based on disclosed deals. The figure represents new investment by VC and PE players in clean energy companies (therefore excludes buy-outs). OTC & PIPES are included in this figure. Numbers in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

### 1.3 Investment by Geographical Region

Investment in sustainable energy surged forward around the world in 2007, although the EU and the US continued to take the greatest share of both new investment and acquisition activity. China, Brazil and, to a lesser extent, India also saw investment volumes soar.

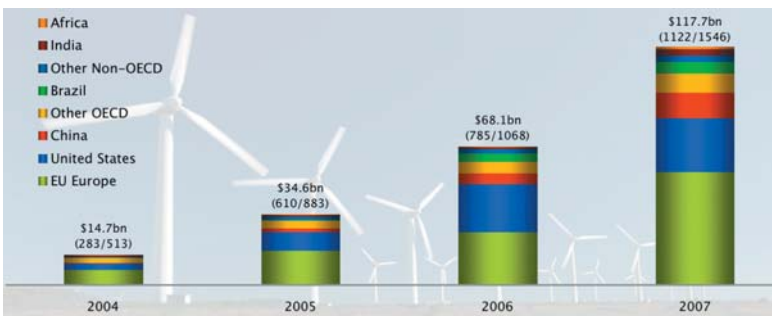
In 2007, new investment in Europe was \$55.8 billion, more than double the US total of \$26.5 billion (see Figure 8), while total investment (including acquisitions) was \$80.2 billion in Europe and \$47.5 billion in the US (see Figure 9). This was thanks partly to the contribution of Ibernova's \$7.2 billion IPO, but also due to very high new asset build in Europe - \$38.8 billion compared to \$16.3 billion in the US, a difference of \$22.5 billion. In 2006, the asset financing difference between the regions was far lower at just \$3.2 billion.

The US remains the focus for early-stage financing, however, attracting \$4.7 billion of new VC/PE investment in 2007, nearly half of the worldwide total. US investment is particularly

skewed towards venture capital, accounting for 75% of total VC investment globally, thanks to its established entrepreneurial culture and the leadership shown by California in the solar sector, which currently dominates VC investment.

The US, however, accounted for a far lower proportion of private equity investment: 43% compared to 32% for Europe, and 23% for Brazil, China and India. This reflects private equity for expansion flowing into the manufacturing bases of China and India, and also high levels of pre-IPO investment in the form of private equity.

Figure 8. New Investment by Region (VC/PE, Public Markets and Asset Finance), 2004-2007



Note: Grossed-up values based on disclosed deals. The figure represents new investment only, and therefore excludes existing public stock changing hands, buy-outs and acquisitions. Figures in brackets refer to (disclosed deals / total deals). Does not adjust for re-investment.

Source: SEFI, New Energy Finance

When it comes to later-stage financing - public market investment and asset finance - Europe was well ahead of the US. European asset finance totalled \$49.5 billion (78% of which was new build), equivalent to 62% of asset finance worldwide. Supportive policy in many European countries, as well as an investor base that is comfortable with financing renewable energy projects and more intense competition for deals, drove asset finance to record levels in 2007.

Europe also fared well on the public markets, with issuers attracted to its diverse (and receptive) investor base and less stringent listing rules than in the US. European public market activity reached a total of \$15.5 billion in 2007 (almost all of which was new investment), representing 58% of global public market issuance.

Corporate M&A was more evenly split on both sides of the Atlantic, with \$11.1 billion worth of deals in the US and \$10.6 billion in Europe, respectively, 43% and 41% of global corporate M&A activity (see Figure 9). Almost all corporate M&A (91%) took place in OECD countries, where renewable energy

markets are more mature and ripe for consolidation. Ready availability of capital fuelled M&A activity, in spite of high valuations. Brazil led M&A activity in developing countries, with \$967 million of corporate M&A (4%). Rising land prices and falling sugar/ethanol prices have made expansion by acquisition more attractive than greenfield projects, while the credit crunch combined with lower ethanol prices is making smaller players vulnerable to takeover.

Figure 9. Acquisition Activity by Region, 2004-2007



Note: Grossed-up values based on disclosed deals. The figure represents total acquisition activity in clean energy companies and includes PE buy-outs, public market exits, and asset acquisitions and refinancing. Figures in brackets refer to (disclosed deals / total deals)

Source: SEFI, New Energy Finance

In Japan total sustainable energy



investment was \$1.2 billion in 2007, almost all of it asset finance. Of that, \$446 million flowed into new asset build (for wind and solar installation) and \$655 million into acquisition and refinancing of existing assets. There was very little VC/PE or public market activity in Japan.

Investment in sustainable energy largely focused on OECD countries, however, the share going to developing countries continued to increase. As shown in Figure 8, developing countries shared 22% of new investment among them (VC/PE, public markets, and asset finance), up from 12% in 2004. Most of this investment was in China and Brazil, which together represented 17%. In actual terms, developing countries attracted \$26 billion of new investment in 2007, double 2006's total of \$13 billion (and 14 times 2004's \$1.8 billion).

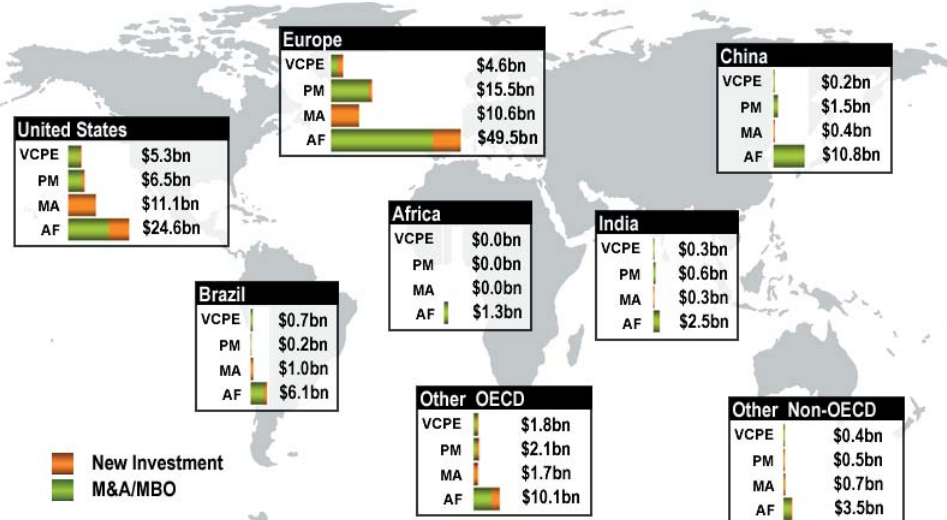
Early-stage investment in developing countries continues to be very limited. Brazil, China and India are all focusing on increasing investment in technology and encouraging domestic innovation, but this is not yet showing through in investment figures.

In asset finance, however, there has been a distinct shift from OECD to the large emerging economies. In 2004-05, 10% (\$1.7 billion) of annual average asset finance went to Brazil, China and India, while 84% went to OECD countries. In 2006-07, however, this share doubled, with Brazil, China and India accounting for 20% (\$13.6 billion) of annual average asset finance at the expense of OECD countries, whose share fell to 75%. Asset finance flowing to the rest of the world remained roughly constant over the same period, at 5-6%. China was the main beneficiary of this shift, attracting \$10.8 billion of asset finance in 2007, followed by Brazil (\$6.1 billion) and India (\$2.5 billion). Investment in Africa was limited to asset finance of \$1.3 billion – mainly for biofuels plants.

There is a broad correlation between dominant later-stage financing and economic development, with the most developed countries such as the US attracting the most early-stage financing and the least developed, such as Africa, seeing almost all their investment take the form of asset finance (see Figure 10). The large industrialising economies (China, India and Brazil) are experiencing increased volumes of private equity and M&A activity, as they become more accepted (and more visible) on the global financing stage.

China, India and Brazil also performed strongly on the public markets. Activity on developing countries' stock exchanges increased dramatically, quadrupling from \$662 million in 2006 to \$2.8 billion in 2007. Fund raising by companies in these countries was higher, although this is not reflected in domestic public market activity, because many chose to raise money on foreign stock exchanges. For example, Indian renewable energy companies raised \$680 million in foreign currency convertible bonds on the Singapore Stock Exchange, and Chinese solar companies raised \$2.5 billion on the US and Europe equity capital markets.

Figure 10. Global Transactions in Sustainable Energy by Region, 2007



Note: Grossed-up values based on disclosed deals. Includes new investment and acquisition-type transactions. Does not adjust for re-investment. Public markets figures are categorised according to location of exchange on which the company raises money.

Source: SEFI, New Energy Finance

# Putting Sustainable Energy Investment into Perspective

## 2

- Renewable energy accounts for 23% of new generation capacity added worldwide in 2007, and 5.4% of global power generation.
- Wind power continues to dominate renewable energy capacity. In 2007, wind attracted more investment than nuclear or large hydro, and accounted for more new generation capacity in Europe than any other power source.
- Interest in clean energy investment surged forward, with clean energy funds rising to \$35 billion in 2007 and boosting quoted sustainable energy companies' valuations. The WilderHill New Energy Global Innovation Index (NEX) rose 57.9% in 2007 (fell 17.9% in Q1 2008 and recovered 8% in Q2 2008).
- Sustainable energy companies continued to make their mark on the public equity markets, accounting for 19% of new capital raised by the energy sector in 2007.

The profiles of renewable energy and energy efficiency continued to rise in 2007 based on a wide range of indicators: in the context of power generation and transport fuels investment, in the context of efforts to address global climate change, as well as in terms of the sector's presence in financial markets worldwide. Finance sector engagement continued to grow, with investment mobilisation often outpacing developments on the policy front.

The \$145.6 billion<sup>3</sup> of investment in new renewables in 2007 was equivalent to 9.4% of global energy infrastructure investment and 1% of global fixed asset investment. This can be roughly compared to the \$200–210 billion that the UN Framework Convention on Climate Change (UNFCCC) Secretariat has estimated it would cost in additional capital mobilisation across the economy in 2030 to return global greenhouse gas emissions to current levels.<sup>ii</sup> A second comparison can be made to the figures in the Stern Review,<sup>iii</sup> which concluded that the cost of stabilising emissions at 550 ppm CO<sub>2</sub>-eq would average 1% of global GDP - approximately \$134 billion in 2015 and \$930 billion in 2050.

Though the UNFCCC and Stern estimates do not include the underlying infrastructure costs, but only the additional funds needed for decarbonisation, the successful mobilisation of capital for renewables recently seen may provide positive reinforcement for policymakers involved in the current rounds of climate negotiations. The fact that annual investment in renewables increased by \$115 billion between 2004 and 2007 demonstrates that it is possible to mobilise the capital needed to stabilise the global climate – provided the right mix of policies and economic conditions are in place.

The quickly expanding universe of supportive renewable energy and energy efficiency policies are certainly one of the reasons behind the scale-up of the sector, even if the current level of direct government support is only just about the same as for other parts of the energy industry. Energy subsidies today total \$250-300 billion globally, of which \$180-200 billion are for fossil fuels and only \$16 billion or ~8% for renewables.<sup>iv</sup> This share is a little less than the 9.4% that renewables currently have of total energy sector investment, implying that subsidy frameworks are just slightly behind the level of investor commitments. However, if a role of subsidies is to help society make the shift to a more diversified and decarbonised energy economy, then the current share allocated to renewables seems in fact low. Unfortunately, subsidy frameworks are mostly backward-looking, providing production subsidies for – and locking in – existing infrastructure, rather than lowering the deployment costs of new technology.

Trends in R&D tell a similar story. In 2007, the renewables sector attracted \$16.9 billion of R&D from governments and corporates, up 30%, from 2005. This R&D spending is still relatively low, which is surprising for a sector that relies on being at the cutting edge of technology. Energy R&D accounted for just 4% of total government R&D in 2005, down from 12% in the early 1980s.<sup>4</sup> By contrast, strong growth in VC/PE investment in clean

<sup>3</sup> Calculated by expressing Asset Finance (\$84.5 billion in 2007) as a percentage of global energy infrastructure investment, as estimated by the IEA in World Energy Outlook 2007 (\$21.94 trillion from 2006-2030, equivalent to \$877 billion a year for each of those 25 years) i.e. 9.6%. Global energy infrastructure spending accounts for 10% of global fixed asset infrastructure spend, so renewable energy accounts for 0.96% of this.

<sup>4</sup> IEA R&D Database. The Stern report suggested that global public energy R&D funding should double, to around \$20 billion.

energy – up 106% since 2005 – demonstrates a more dynamic sentiment among those providing risk capital than those spending R&D.

Besides R&D and VC/PE, some public equity investment is also going towards scaling-up the technology and manufacturing base. For the last couple of years, growing acceptance by the public markets has encouraged sustainable energy and carbon companies to list their shares on stock exchanges worldwide and share prices have been pushed higher. During 2007, clean energy accounted for an estimated 19% of all money raised by the wider energy sector on the public markets, which is significantly higher than in previous years. This effect can be seen in the performance of the Wilderhill New Energy Global Innovation Index (NEX), which rose 57.9% in 2007, building on an already strong 33.3% gain in 2006.

In 2008, clean energy stocks have been unable to escape the uncertainty that has characterised global financial markets. In the first quarter, the NEX fell by 17.9% as compared to NASDAQ and S&P500 declines of 14.1% and 9.9%, respectively. In the second quarter, the NEX regained half its loss and VC/PE rebounded strongly. Other than in biofuels, asset financing of new generation capacity on the ground also continues, although more strongly in the first quarter than the second.

Whether renewables can now be considered a mainstream energy option can be best determined by examining the power sector. Nearly \$90 billion was invested in new renewable power generation plants in 2007.<sup>5</sup> By the end of the year, 241GW of this clean generation capacity had been installed worldwide, of which 25GW and 31GW were added in 2006 and 2007, respectively. In comparison, the aggregate increase in capacity of the nuclear power industry globally averaged 2GW per annum between 2004 and 2007.<sup>v</sup> Renewables still represent only 5.4% of global power generation capacity and 4.6% of production: however, the 31GW added in 2007 accounted for over one fifth of new capacity and production, as shown in Figure 11.

In Europe and the US wind capacity additions in 2007 on their own accounted for 40% and 30%, respectively, of new power capacity. Wind attracted more investment globally last year than any other non-fossil fuel based technology, including large hydro and nuclear power.

Looking forward, the IEA estimates that \$11.6 trillion of investment will be needed in power infrastructure in 2006-2030 (WEO 2007 Reference Scenario), almost half of which is for power stations, which is equivalent to around \$230 billion a year.<sup>vi</sup> Current rates of asset financing for renewable power projects already account for nearly 30%

Figure 11. Renewable power generation and capacity as a proportion of global power, 2005-2007



Sources: Renewable Power Capacity (GW)- REN21, 2004 is estimated using 2005 capacity factor (43%). Global Power Capacity (GW) - calculated from Power Generation using capacity factor (50%) given by EIA. Global Power Generation (TWh) - IEA, 2006 and 2007 estimated using IEA growth rates. Renewable Power Generation - IEA (2004 & 2005), NEF (2006 & 2007)

of this required annual investment. The fact that renewable energy generation capacity accounts for a higher proportion of investment (\$) than of installed capacity (GW) partly reflects the fact that it is more expensive to build renewable than conventional power generation options.<sup>6</sup>

However, in its recently released Energy Technology Perspectives 2008 report the IEA shows that a large part of the additional investment required for low-carbon technologies

<sup>5</sup> Calculated by combining asset finance (less biofuels investment of \$16.7 billion) with small-scale projects.

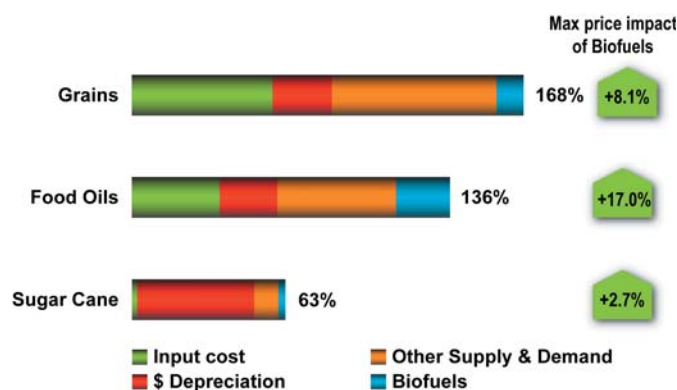
<sup>6</sup> There is also a time shift between the Investment figures and capacity additions that partly accounts for this. This is because committed investments can take one or two years to translate into generating capacity on the ground.



like renewables and efficiency is offset by reduced fuel requirements. The IEA has in fact revised upwards its outlook for renewables, now predicting a “massive switch to renewables for power generation”, which in their aggressive Blue Map scenario would provide 46% of global power by 2050 and 21% of CO2 reductions, as compared to 6% for nuclear.<sup>vii</sup>

Looking at biofuels, the IEA foresees a significant role for this low-carbon fuel in its Blue Map scenario, with transport overall as the area in most need of “decarbonising” investment.<sup>7</sup> To date, however, biofuels have made less of a mark, accounting for just 1% of transport fuels in 2005, with oil remaining the dominant energy source, meeting 94% of the 2,010 Mtoe demand (IEA WEO 2007). However, biofuels capacity has grown strongly since 2004: ethanol production capacity has increased at an average annual rate of 18% since 2004 to 53 billion Lpa, while biodiesel has grown at 71% per year to reach 16 billion Lpa.<sup>8</sup> Biofuels blending mandates around the world will drive biofuels consumption, particularly in transport, although the continuing food-for-fuel concerns may dampen demand and lead to decreasing political will to promote them.

Figure 12. Biofuels contribution to food price increases, 2004 - 2007



Source: New Energy Finance, USDA

of 18% since 2004 to 53 billion Lpa, while biodiesel has grown at 71% per year to reach 16 billion Lpa.<sup>8</sup> Biofuels blending mandates around the world will drive biofuels consumption, particularly in transport, although the continuing food-for-fuel concerns may dampen demand and lead to decreasing political will to promote them.

How much biofuels have contributed to recent increases in food prices is difficult to determine precisely. Figure 12 shows the New Energy Finance analysis, which estimates that biofuels have been one of several factors in recent food price increases.

Energy efficiency investment, although largely invisible, seems to follow a similar trend as investment in renewables. Two broad areas of energy efficiency financing exist, including investment in the providers of the equipment and investment in the use of the equipment. Tracking efficiency

investment is tricky, due both to definition issues and the fact that most efficiency is financed internally and often as part of a larger industrial process change or capital budgeting activity. However, the strong growth in measured external VC/PE investment in energy efficiency – up 306% between 2004 and 2007 – provides a good overall proxy for expected near-term efficiency uptake. From the macro perspective the impact of energy efficiency is easier to quantify, although gives less cause for hope. Energy efficiency in OECD countries has been improving at just less than 1% per year in recent times, a sharp decline from the rate achieved in the years immediately following the oil price shocks of the early 1970s. However, energy efficiency improvements since 1990 have still met 52% of new energy service demands in the world, while new energy supplies have contributed 48%. Most analyses expect future efficiency improvements to be in the 1.4–2.2% range, although McKinsey has projected that demand growth to 2020 could be cut by a further half by capturing more energy productivity opportunities, particularly in co-generation and electric motor optimisation.<sup>viii</sup> These opportunities use existing technologies that pay for themselves, thereby freeing up capital for investment or consumption elsewhere.

<sup>7</sup> IEA predicts the need for a massive \$33 trillion of investment in low carbon transport options out to 2050.

<sup>8</sup> Biofuels production will be lower than installed capacity, but even assuming that capacity is fully used, biofuels only accounted for 1% of global oil production of 4,913 billion Lpa in 2006 [Figure based on World Oil Production in 2006 of 84.6 million barrels per day (WEO 2007) and a conversion rate of 159 litres per barrel.]

## Underlying Changes in the Finance Sector

# 3

- Capital flows became more readily available in 2007 than ever before, but more recently, market conditions have become distinctly less welcoming.
- 2007 saw a continuing shift of emphasis from OECD to emerging markets. Indian and Chinese companies have become increasingly acquisitive outside their domestic boundaries, a trend that goes beyond the sustainable energy sector.
- Financing of small-scale systems is improving access to clean technologies, in both developed and developing countries, by removing the burden of significant upfront costs from the end-user and easing access to finance. Technologies suitable for distributed generation, such as solar, are particular beneficiaries of this trend.
- Sustainable energy companies are becoming more creative about raising capital. Financial innovation in the face of adverse market conditions is starting to emerge, although it is still early days in terms of responding to the credit crunch.

The year 2007 was one of abundance for sustainable energy companies, who found it easy to raise money from eager investors. More recently, however, market conditions have become distinctly less welcoming, and the sector will have to become more creative about raising finance. It helps that in recent years, capital flows available to sustainable energy companies have become more mainstream and have broadened, meaning that the industry has access to a far wider range of financial products and markets than it did five years ago. This trend also applies geographically. Developing country companies with strong fundamentals have established themselves on capital markets worldwide: Brazil, China and India raised \$21.3 billion in new money in 2007, much of it from foreign investors.

One response to tougher market conditions has been a surge in convertible note issuance, which quadrupled from 2006 to 2007. Convertible notes have appeal in unsteady markets, because they combine a fixed return with capital appreciation via conversion, assuming the underlying share price rises an agreed amount. Indian companies, in particular, embraced convertible notes in 2007, issuing a flurry of foreign currency convertible bonds (FCCBs) aimed at foreign investors. Even though convertible bond issues flourished worldwide in 2007, the Indian deal flow was distinctive in that no Indian renewable companies had issued convertibles until 2007, when five leading companies issued FCCBs in six deals: Suzlon (two issues worth a total of \$500 million), Moser Baer (\$150 million), XL Telecom & Energy (\$40 million), Webel-SL Energy Systems (\$16.8 million) and Indowind (\$30 million).

In 2008, Chinese solar companies seem to have picked up the convertible baton. Already in 2008, three have issued convertible notes: LDK raised \$400 million in April, Suntech Power \$575 million in March, and Solarfun \$150 million in January.

This reflects a continuing shift of emphasis from West to East, from developed to emerging economies. As well as becoming a fixture on the international capital markets, Indian and Chinese companies have become increasingly acquisitive outside their domestic boundaries. Indian companies, for example, are planning to invest \$600 million in Brazilian sugar mills / ethanol plants. The year 2007 also saw several aggressive cross-border deals involving Indian or Chinese acquirors, including Suzlon's \$1.6 billion acquisition of Repower in June 2007 and China National Building Material Group's purchase of German turbine blade manufacturer NOI Rotortechnik in January 2007.

This trend goes beyond renewable energy, as seen in the recent acquisition of Jaguar / Land Rover by India's Tata and last year's acquisition of a \$5 billion stake in Morgan Stanley by government-owned fund China Investment Corp (CIC).

Small-scale projects have also benefited from renewable energy's entering the mainstream. Renewable energy asset financing has focused on large-scale capacity roll-out, particularly in the wind sector. Now, however, a range of financial mechanisms are emerging that are improving access to smaller technologies, in both developed and developing countries. Solar – both PV and thermal – has been a particular beneficiary of this trend, as it is well suited to distributed power (the market that small-scale finance seeks to address) and is also still too expensive for most consumers to install on their own.

In developed countries solar equipment manufacturers in the US have led the way, realising that they could help overcome capital-cost barriers by acting as financial intermediaries. One of the main financing tools used is the third-party power purchase agreement (TPPPA), which by some estimates drove 60% of the solar capacity installed in California in 2007. Under a TPPPA, a third party designs, builds, owns, operates, and maintains the solar systems and sells back solar-generated electricity to the end-user. This model removes the burden of significant upfront costs from the end-user, and also allows the solar contractor, who has significantly greater expertise than the end-user, to assume the responsibility for system installation and maintenance. Tax credits and accelerated depreciation for the solar systems help to drive down their cost, as well as reducing the electricity price charged to the end user.

SunEdison and SunPower are two leading TPPPA proponents. SunEdison first used the model in 2004 on a commercial installation, and has since installed 34MW of systems for commercial users financed via TPPPAs (or SPSAs - solar power services agreements - as SunEdison calls them). SunPower uses a similar model for its SunPower Access programme.

A variation on this is where a city or county acts as financial intermediary, targeting residential customers (see Case Study 1. ).

Sceptics argue that residential customers are higher risk than commercial customers – particularly now that property markets worldwide are in disarray and the risk of default increases – and that their small scale makes residential installations relatively more expensive with lower return. Nevertheless, new financing models are having a noticeable impact on installed PV capacity. According to the US Solar Energy Industries Association, 148MW of solar capacity was installed in 2007, nearly 50% more than the 101MW installed in 2006. An additional 42MW of non-grid connected PV was installed during the year.

Solar installation financing is attracting heavyweight investors. Goldman Sachs, GE Capital and MMA Renewable Ventures (part of Municipal Mortgage & Equity) are all investing. In April 2008, for example, MAA Renewable Ventures announced that it was to finance 14 rooftop systems on Macy's California department stores, with SunPower providing panels and systems integration.

Mechanisms and capital for financing solar installations are certainly not limited to the US, or developed countries in general. Developing countries, whose need for distributed generation is not so much driven by energy security and environmental concerns as by

## Case Study 1. Small-Scale Solar Initiative in Berkeley, California

Berkeley, California is set to become the first city in the US to allow property owners to pay for solar system installation and energy efficiency improvements as a long-term assessment on their individual property tax bill. The initiative, due to be piloted from June 2008, is part of Berkeley's Measure G mandate, which is aiming to reduce the city's greenhouse gas emissions by 80% by 2050. Again, the upfront capital costs are removed from the end user, who pays for these via a deduction on her property owner's tax bill, levied by the city. This assessment belongs to the property rather than the individual end-user, who effectively sells it with the property if he moves on.

The city's plan eliminates the two major financial hurdles to solar electric and solar hot water systems—the high upfront cost and the possibility that those costs will not be recovered when the property is sold. The program will be piloted from June 2008. The city will pay the contractor for the system and its installation, net of any applicable state and federal rebates, and will add an assessment to the property owner's tax bill to pay for the system. The interest on the loan will be lower than the property owner could obtain on her own, because Berkeley will secure low-interest debt. The tax will stay with the property even if the owner sold, although the owner would have to leave the solar panels. The property owner will save money on his monthly electricity bill because electricity generated by the solar panels would partly replace power delivered by the utility. After the assessment expired, the solar panels would continue to partly replace utility-supplied electricity.

Source: New Energy Finance

lack of grid access, are also benefiting from financing for small-scale distribution. Many developing countries have rural electrification programmes today and an increasing number of these rely on renewables and distributed financing models to provide access in off-grid areas. Besides electrification, many other clean energy systems and services are being installed with a range of end-user finance approaches.

For example, Grameen Shakti, a subsidiary of Grameen Bank in Bangladesh, runs a Solar PV Program that provides soft credit for installations and expects to have facilitated the installation of 130,000 solar home systems by the end of 2007. In Nepal a Dutch development agency and KfW-backed programme has helped farmers finance the installation of 111,000 biogas systems. In Tunisia the UNEP-supported Prosol solar water heating programme has seen 35,000 installations where bank financing is structured through customer utility bills. These programmes and others like them are now looking to the Clean Development Mechanism (CDM) to help finance the further uptake of these sectors. Although CDM revenues only cover a small portion of the capital costs, if appropriately structured they can be used to bring down barriers to end-user financing that often is the key to market uptake.

It is too early to tell how small-scale financing will be affected by the credit crunch, or how sustainable energy companies will adapt to tighter capital markets, but recent equity capital raisings have already shown signs of innovation. AIM-listed US turbine maker Clipper Windpower, for example, raised \$150 million from One Equity in April 2008. One Equity, an offshoot of JP Morgan, agreed to buy Clipper shares at a price equivalent to the lower of £0.48 and the company's average share price over the five days up to 4 May. Clipper, which is experiencing what it describes as "a strain on working capital", also secured \$50 million from institutional investors in March, a \$60 million credit facility from an undisclosed customer and \$85 million of pre-payments from a second customer. It is in discussions with private equity firms about further financing opportunities.

There is no doubt that necessity is the mother of invention, and the market will see more imaginative capital raising from sustainable energy companies in the coming months and new financing structures emerging in response to tougher market conditions.

Less welcoming market conditions will also drive industry consolidation, as weaker players struggle to raise capital and are absorbed by better-capitalised rivals or utilities. Consolidation was a theme throughout 2007 and early 2008. This is being fuelled by utilities seeking exposure to renewable energy, as well as by integration within the industry.

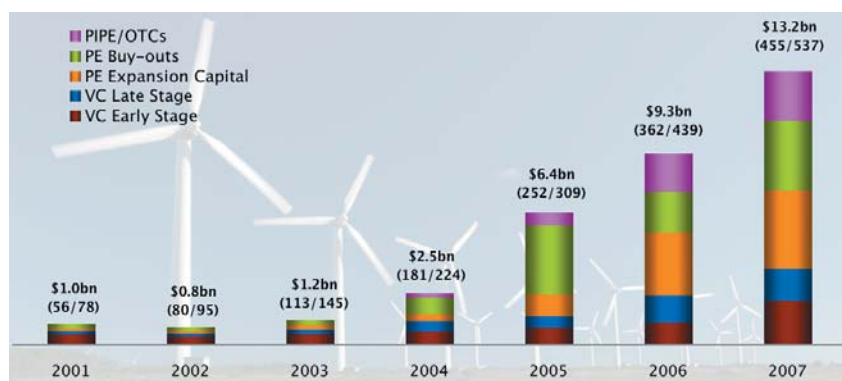
French nuclear giant Areva, for example, has been making inroads into renewable energy. Beaten by Suzlon in a takeover battle for German wind turbine manufacturer Repower in early 2007, it has since acquired 70% of Brazilian biomass project designer Koblitz and a 51% stake in German wind turbine designer and manufacturer Multibrud. Similarly, Germany's Eon acquired Airtricity's US wind assets in October 2007 for \$1.4 billion and UK utility Scottish & Southern Electricity bought the rest of Airtricity for \$3.2 billion in February 2008, making it the largest wind generator in the UK and Ireland.

Increasingly, renewable energy assets are driving consolidation in the wider energy industry, with multinational renewable energy groups being created via M&A as companies strive for scale and supply security. This is happening at several levels: manufacturers / supply chain (e.g. Suzlon's acquisitions of gearbox manufacturer Hansen and German rival Repower), as well as energy suppliers / project developers (Iberdrola's acquisition of Scottish Power, Acciona's of Endesa and the merger of Suez and Gas de France – all bringing together sizable renewable portfolios).

- Early-stage venture capital investment surged 112% to \$2 billion in 2007, boosted by interest in emerging renewable technologies rather than just those on the brink of commercialisation, as competition for deals intensified.
- Private equity finance for expansion started strongly in 2007, driven largely by the boom in ethanol production in the US, but this ground to a halt in May 2007 as feedstock costs rose and ethanol prices fell. Overall, VC/PE investment in biofuels fell by almost one-third in 2007, to \$2.1 billion. However, biofuels investment has not dried up altogether, shifting to Brazil, India and China, as well as towards second-generation technologies.
- Solar attracted by far the most VC/PE investment (\$3.7 billion), both for new technologies and for manufacturing capacity expansion, although biomass and waste to energy was the fastest growing sector (\$1.3 billion, up 431% from 2006).
- The US continued to lead VC/PE investment, but grew only slightly year on year in dollar terms. European investment is growing strongly as investors become more willing to take early-stage risk.
- In 2008, VC/PE financing has remained strong with \$4.7 billion invested in Q2, a 33% increase on 2007.

Global venture capital and private equity investment in sustainable energy companies totalled \$13.2 billion in 2007, 42% higher than in 2006, when \$9.3 billion was invested. Deal numbers also increased, rising 22% to 537 from 439 in 2006 (see Figure 13).

Figure 13. VC/PE Transactions by Type, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents total VC/PE investment in clean energy companies and includes PE buy-outs. OTC & PIPES are included. Figures in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

Private equity investment of \$7.2 billion far outweighed all other funding types, including venture capital of \$3.7 billion. Over-the-counter (OTC) deals – investments in companies listed on junior public markets – reached \$1.7 billion, while private equity investment in public equities (PIPEs) totalled \$692 million.

The total PE investment in companies of \$7.2 billion in 2007 was an increase of 44% on 2006. Private equity investment falls into two distinct branches: funding for expansion and financing for buy-outs (see Figure 14).

The former accounted for \$3.8 billion in 2007, while buy-out deals secured \$3.4 billion.<sup>9</sup>

Private equity finance for expansion started strongly in 2007, driven largely by the boom in ethanol production in the US, but this ground to a halt in May 2007 as feedstock costs rose and ethanol prices fell. Funding for buyouts also flourished as private equity firms enjoyed access to unprecedented levels of liquidity. Towards the end of 2007, however, this had started to dry up as problems on the US sub-prime mortgage-backed securities market snowballed into a global crisis of confidence among lenders.

Venture capital investment grew sharply in 2007, up 54% to \$3.7 billion from \$2.4 billion in 2006. Within this, early-stage VC investment (seed capital and series A and B rounds) showed the greatest increase, surging 112% to \$2 billion in 2007, from just \$944 million in 2006. Previously, VCs had focused on later-stage companies with technologies that were

<sup>9</sup> Note; Private equity financing for projects, which totalled approximately \$10 billion in 2007, is excluded from this analysis, as it is included in Asset Finance totals.



relatively mature. Such opportunities became harder to find in 2007, with the result that later-stage VC investment grew more slowly, rising only slightly from \$1.3 billion in 2006 to \$1.4 billion in 2007. Investors are now being forced to look further down the development pipeline, spurring a dramatic increase in early-stage deals.

Over-the-counter investment grew 31% to \$1.7 billion in 2007, from \$1.3 billion in 2006.

The lure of the OTC markets has grown as the level of fundraising on the public markets has increased (see Section 6). It appeals to companies not able to meet the disclosure requirements of the main markets and those looking to raise funds quickly.

In terms of technology, solar companies led the field by a significant margin (see Figure 15). The sector attracted an estimated total of \$3.7 billion, an increase of 85% on 2006. Solar deals were fairly evenly split between venture capital and private equity investments (see Figure 16), reflecting both the early-stage funding of new solar technologies and the more substantial sums required to finance rapidly expanding solar manufacturing capacity.

Most of the solar spending boom took place in North America, where VCs committed \$717 million in early-stage funding, up from just \$192 million in 2006, while the number of deals completed doubled to 48. In Europe, by contrast, only \$40 million of early-stage VC funding found its way to solar companies in 2007.

Worldwide investment in thin-film technology, which promises to slash the cost of solar through cheap, mass-produced solar systems, was on the ascent. Solar installation companies also featured prominently, thanks in part to the success of the California Solar Initiative.

VC/PE investment in biofuels fell by almost one-third in 2007 to \$2.1 billion from \$2.9 billion in 2006 as the rush to build US ethanol facilities came to an end. Private equity expansion capital investment in US biofuels did not dry up altogether, but its focus switched from ethanol to biodiesel. In December 2007, ethanol producers were thrown a lifeline with the

ratification of the Energy Independence and Security Act of 2007, which mandates production of 15 billion gallons of corn-based ethanol a year by 2015. Another major development was biofuels investment shifting south to Brazil, where extensive investment in the sugar cane industry has helped its bioethanol industry to flourish. Producers in India and China also attracted significant investment.

Although most biofuels investment took the form of private equity for expansion, \$298 million of VC funding was invested, mostly to develop second-generation fuel technologies such as cellulosic ethanol.

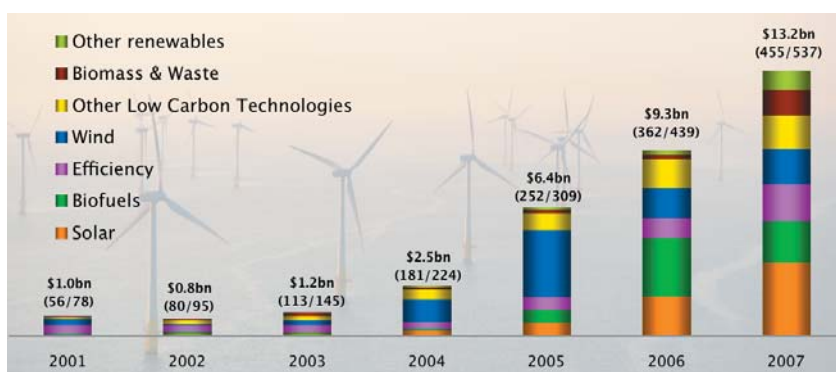
Figure 14. VC/PE Transactions by Type, 2007



Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included. Numbers in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

Figure 15. VC/PE Transactions by Sector, 2001-2007



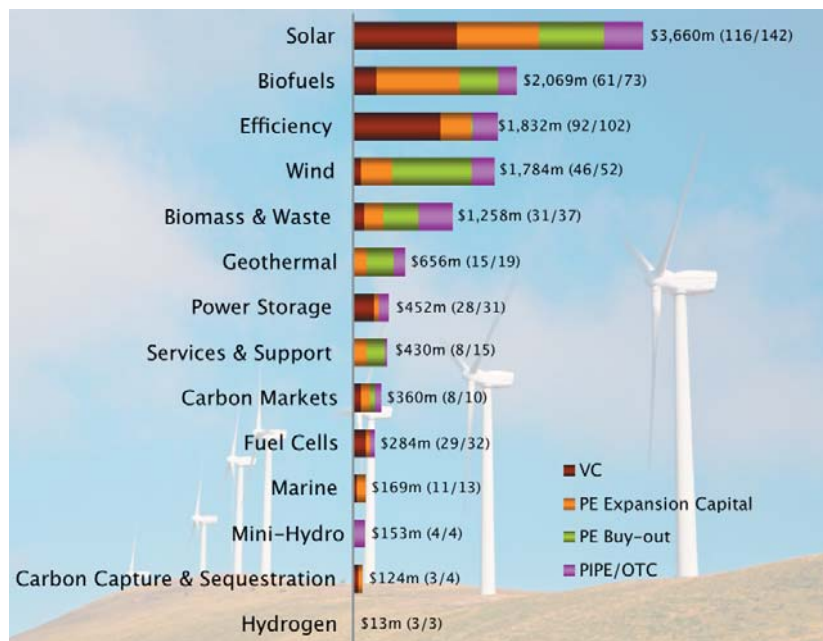
Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included. Numbers in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance



The nascent energy efficiency sector saw strong growth in 2007, with investment jumping by 80% to \$1.8 billion in 2007 from \$1 billion in 2006. Both investors and governments now realise that energy-related carbon emissions can be curbed by improving existing energy supply and demand apparatus.

Figure 16. VC/PE Transactions by Sector, 2007



Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included with VC/PE. Numbers in brackets refer to (disclosed deals / total deals).

Source: New Energy Finance

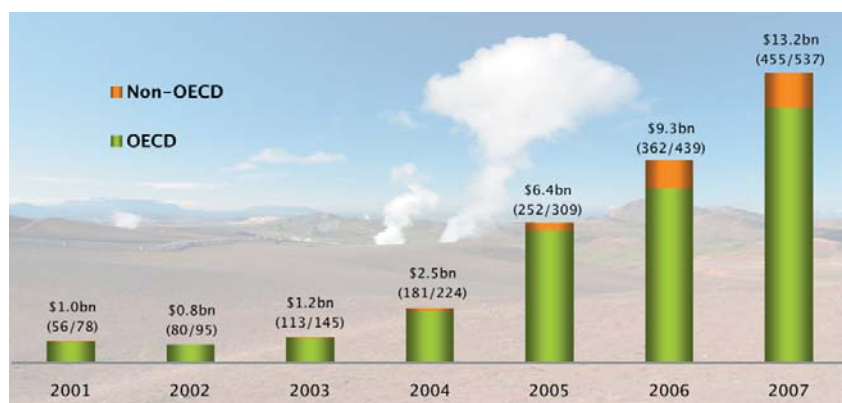
Wind investment increased by 20% to \$1.8 billion from \$1.5 billion in 2006. As wind is a more mature technology, funding tends to gravitate towards PE rather than VC, and a large proportion of funding was raised for buyouts, reflecting consolidation in more mature markets, especially Western Europe. A total of \$996 million was secured for takeover deals, compared with \$391 million for PE expansion, while VC investors committed just \$107 million to wind.

Investment in biomass and waste-to-energy grew faster than any other sector, growing an impressive 431% to \$1.3 billion in 2007 from \$245 million the year before, with the number of deals more than tripling to 37 from 11 in 2006. As with wind

and other mature technologies, there was not much call for VC funding, with investment dominated by a couple of large PE buyouts in the UK and Germany.

Geographically, VC/PE investment remains heavily concentrated in OECD nations; however, such investment in non-OECD countries has grown significantly over the last three years (see Figure 17). In 2007, \$11.7 billion was invested in the 30 OECD countries, compared to just \$1.6 billion in non-OECD nations.

Figure 17. VC/PE Transactions by Region, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included. Numbers in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

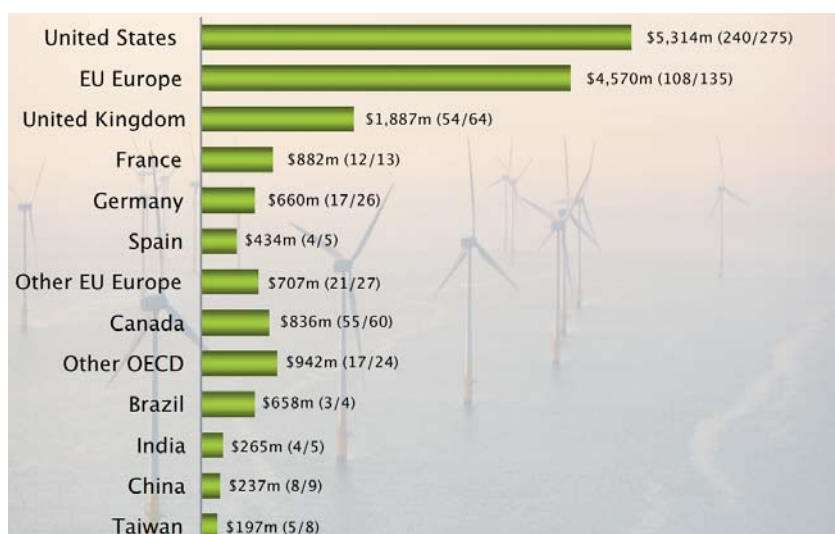
As in previous years, the US-led VC/PE investment, with its long-established VC investor base and flourishing centres of technology research and development, was flat from 2006 to 2007, with a total of \$5.3 billion, and was only slightly ahead of the \$4.6 billion invested in EU Europe (see Figure 18). There was, however, one significant change: the proportion of VC investment increased to \$2.8 billion from \$1.5 billion in 2006, while the volume of PE investment fell, especially PE for buy-outs.

In EU Europe both VC and PE investment grew sharply. There were more deals - 135 up from 91 in 2006 - as well as a 156% increase in the volume of funding to more than \$4.6 billion, from \$1.8 billion the previous year. In contrast to the US, Europe has traditionally attracted more PE rather than VC investment, as its wind and solar sectors are more mature and offer more predictable

returns. In the UK investment increased dramatically to \$1.9 billion in 2007 from \$277 million the year before, largely on the back of PE investment. However, attitudes in Europe are changing as investors become more willing to back newer, unproven technologies, as their US counterparts already do. In France, for instance, there were 13 deals in 2007 worth a total of \$882 million, whereas a year earlier investment had been negligible.

The picture in non-OECD countries was mixed. In 2006, there was a rise in foreign VC/PE investment in China as PE investors looking for quick-turn-around investments ploughed pre-IPO funding into Chinese solar companies. In 2007, these opportunities dried up and investment fell to \$237 million from \$572 million in 2006. In India, \$265 million was invested, which was slightly more than in 2006. Overall, it is much harder to accurately gauge the level of investment in Asia's developing nations, as much of it is undertaken by corporates and governments who tend not to disclose the value of their investments.

Figure 18. VC/PE Transactions by Country, 2007



Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included with VC/PE. Numbers in brackets refer to (disclosed deals / total deals).

Source: SEFI, New Energy Finance

- R&D spending on clean energy and energy efficiency was \$16.9 billion in 2007, including corporate R&D of \$9.8 billion, and government R&D of \$7.1 billion.
- Europe and the Middle East saw the most corporate R&D activity, followed by the Americas and then Asia. Patterns of government R&D are the reverse, with Asian governments (notably China, Japan and India) investing relatively heavily in R&D.
- The US and UK host the most clean energy incubators, often supported by public funding. Many of the most successful incubators have benefited from government support.
- Solar is the single most incubated technology, with a bias towards service companies, disruptive technologies and large-scale generation such as STEG (solar thermal). Collectively, though, energy efficiency technologies account for the greatest number of incubated companies.

Research & Development and business incubation services are essential to the development and commercialisation of technologies that will allow sustainable energy to compete with conventional energy in terms of scale, efficiency and cost. In 2007, R&D spending on renewable energy and energy efficiency was \$16.9 billion, which was slightly higher than 2006's total of \$16 billion. Within this, corporate R&D rose to \$9.8 billion and government R&D to \$7.1 billion.

R&D spending on renewable energy and energy efficiency is relatively low for a sector that relies on being at the cutting edge of technology. The IEA estimates that energy efficiency and renewables receive only 12% of government R&D funding for the energy sector, compared with 40% for nuclear technologies. To put this further into context, energy R&D accounted for just 4% of total government R&D in 2005, down from 12% in the early 1980s.

However, true R&D spend on sustainable energy is almost certainly understated, particularly at a corporate level. In technology companies, such as Siemens, R&D into renewable energy and efficiency can end up being hidden within broader R&D budgets. Furthermore, energy / pure-play companies often choose to buy in proven technologies rather than nurturing them in-house. German solar manufacturer Q-Cells, for example, has acquired several different thin-film technologies and taken them through to production.

Corporate R&D<sup>10</sup> rose 8% in 2007, from \$9.1 billion in 2006. Utility / energy companies have the highest clean energy R&D budgets, followed by industrial firms and car manufacturers: GE, United Technologies, BP, Eon and BASF lead clean energy R&D investment.

Europe and the Middle East saw the most corporate R&D activity, followed by the Americas and then Asia/Oceania (ASOC). This pattern is the reverse of government R&D spending, where Asian governments (notably Japan, China and India) invest relatively heavily in R&D. It is worth noting that Europe and the Middle East emerged as R&D investment leaders, mainly because of the contribution of the large European energy companies (Shell, BP, Eon, Endesa) and chemical company BASF. In the Americas, most R&D investment came from technology companies (GE and United Technologies) rather than from utilities.

Government R&D<sup>11</sup> rose to \$7.1 billion in 2007, up 20% from \$5.9 billion in 2006. Government R&D has a very different geographic profile to corporate R&D, with the highest proportion from Asia, followed by the Americas, and then Europe and the Middle East in third place. In 2006-07, governments in Japan, China and India invested the most (\$978 million, \$615 million and \$400 million, respectively), compared with far lower sums invested by even the most supportive European / Middle Eastern governments such as the UK and Israel.

<sup>10</sup> Corporate R&D total is based on an analysis of the 2006 R&D spend (the latest figures available, for most) of 47 companies. Of these, 17 (36%) did not split out clean energy R&D, so an estimate was made based on their total R&D budget, market capitalisation and perceived inclination to research clean energy technology. Smaller companies were not included as it emerged that a lot of spending reported by big firms (e.g. BP) was funnelled through to smaller companies. Including smaller company budgets would therefore have run the risk of double counting.

<sup>11</sup> Government R&D is based on a New Energy Finance estimate of a 20% increase from 2006 to 2007. The IEA database on government R&D into energy was used as a reference for the 2006 figure (<http://www.iea.org/textbase/stats/rd.asp>). The following assumptions were applied to the IEA data: 16% of government R&D investment in 'Fossil Fuels' was directed to clean energy; 20% of 'Other Power and Storage Tech'; and 25% 'Total Other Tech / Research'. Where IEA data was insufficient (such as for China), New Energy Finance country specialists have given estimates.

However, the Middle East is home to the Masdar Initiative, a \$15 billion project launched in 2006 by the government of Abu Dhabi to develop and commercialise clean energy technologies. Abu Dhabi, which has called the Initiative “the most ambitious sustainability project ever launched by a government”, will invest \$4 billion of equity in the project.

Like corporate R&D, incubation is dominated by the US and Europe. New Energy Finance has identified 167 clean energy incubators worldwide (excluding China), 47% more than in 2006. Today, 344 clean energy companies are either under incubation or have successfully graduated worldwide, 59% more than in 2006. Currently, 283 clean energy companies are being incubated, which is 30% higher than in 2006 and twice as many as in 2005.

Many of the most successful incubators have benefited from government support, with incubators in the US, UK and Germany relying heavily on public funding (see Figure 19).

According to the US Clean Energy States Alliance, 70% of the money raised by US incubators between 2002 and 2006 came from federal and state sources. Linked to this is the fact that most incubators in the US and Germany are not-for-profit. In the UK, however, incubators regularly take stakes in companies under their care.

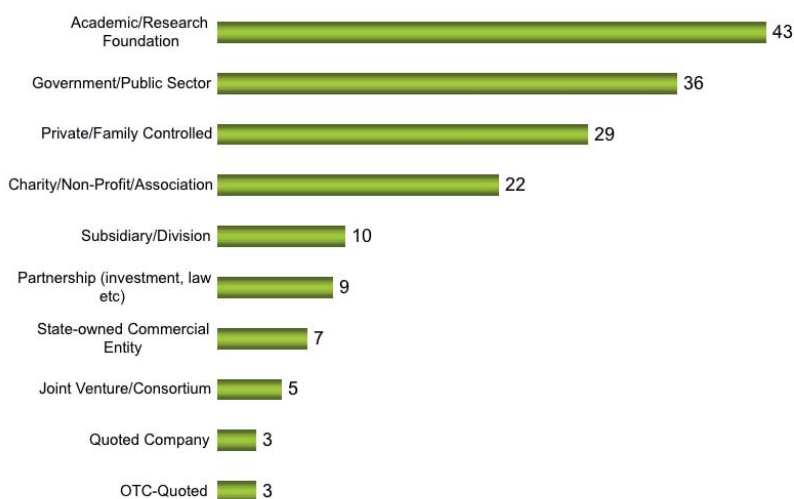
Solar is by far the most active sector for incubatee companies (61 companies), followed by fuel cells, wind and biofuels (see Figure 20). Perhaps surprisingly, the solar sector is dominated by companies supplying services and support, not cutting-edge technology developers. These companies are backed by non-profit and public incubators seeking to popularise solar and make it more accessible to residential users. Solar’s dominance also reflects the race to improve the efficiency of conventional PV, as well as reducing the silicon content in PV via newer technologies such as thin film and concentrated PV, which between them drive a significant proportion of early-stage investment in clean energy.

Energy efficiency technologies collectively account for 63 companies under incubation, making energy efficiency overall the most incubated sector.

Within these sectors, there are regional variations. In the UK fuel cells is the category with the most incubated companies, thanks to a strong research base and government support. Early-stage marine technology is also well supported in the UK.

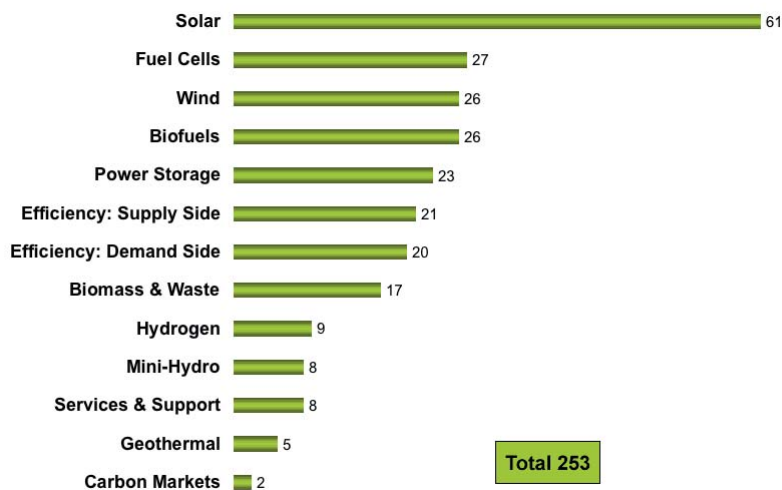
The US is home to the most clean energy incubators – 56, roughly a third of the

Figure 19. Clean energy incubators by affiliation, 2007



Note: Excludes China

Figure 20. Clean energy incubatees by sector, 2007



Note: Excludes China

total – followed by the UK and Germany (see Figure 21). It also accounts for around a third of clean energy incubatees.

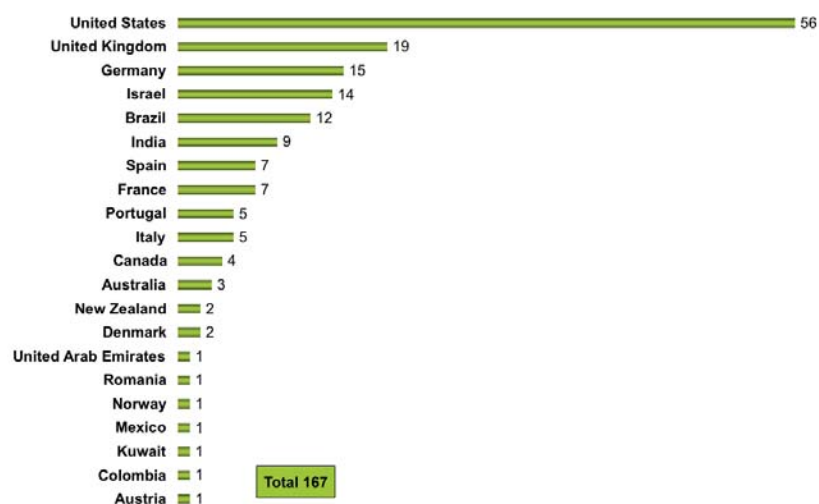
The UK has 19 incubators hosting 53 clean energy companies. A strong academic tradition, active venture capitalists and deep capital markets support innovation and start-up businesses. The launch of the Carbon Trust's Low Carbon Incubator Programme (LCIP) in April 2004 drove a significant increase in clean energy incubation in the UK. Energy efficiency is likely to increase its share of early-stage investment.

Incubation activity in developing countries has also increased over the last year, attracting financial support from organisations such as UNIDO and the World Bank. India and Brazil have registered an increase in both the number of incubators and incubatees in recent years. In India, most business incubators are hosted by educational institutions.

China has been excluded from this analysis (as it was last year) because although it has a large number of incubators that have been involved in renewable energy/low-carbon technologies, many of these are not true incubators, but vehicles for transferring operations from state to private ownership.

Besides incubators, a range of other public funding approaches are being used by governments in different countries to foster new technology development, commercialisation and early-stage deployment. These include public-backed venture capital funds, seed capital facilities, partial credit guarantees and various other public or public-private financing instruments being used both in OECD and developing countries. In 2008, UNEP has launched a SEFI Public Finance Alliance with a number of leading public funding agencies – including the UK Carbon Trust, Sustainable Development Technology Canada, the California Energy Commission and others

Figure 21. Clean Energy Incubators by Country, 2007



Note: Excludes China



# 6

- Clean energy companies more than doubled the amount of money they raised on the world's stock markets in 2007, raising \$27 billion.
- Ibernova, the wind power development arm of Spanish power giant Iberdrola, raised \$7.2 billion in a landmark flotation in December 2007, the largest Spanish IPO ever and one of the largest public deals of the year. Since then, the US and European public markets have effectively closed.
- Wind dominated public market investment (\$11.3 billion), although wind companies raised no money in the US in 2007. Solar companies continued to raise significant amounts of capital (\$9.4 billion), particularly Chinese manufacturers tapping the US markets. Biofuels public market investment fell 60%.
- Public market activity from developing countries increased strongly in 2007, with investment tripling to \$2.9 billion, although this is often on overseas markets such as the London or New York Stock Exchanges.
- In 2008 the public markets effectively closed in the first quarter, but bounced back in Q2 as investors regained confidence.

Clean energy companies more than doubled the amount of money they raised on the world's stock markets in 2007. A total of \$27 billion was invested, an increase of 114% from 2006, itself a 125% improvement on the previous year (see Figure 22). This total includes investor exits, but does not include the \$1.7 billion invested in companies listed on the OTC markets, or the \$707 million that flowed into companies via private investments in public equity (see Chapter 4 Venture Capital & Private Equity for more detail on these types of investment).

Market optimism prevailed in 2007, and the year ended with a burst of IPOs in apparent defiance of the deepening credit crisis. In the first few months of 2008, however, the mood has darkened as the problems on the world's debt markets have deepened.

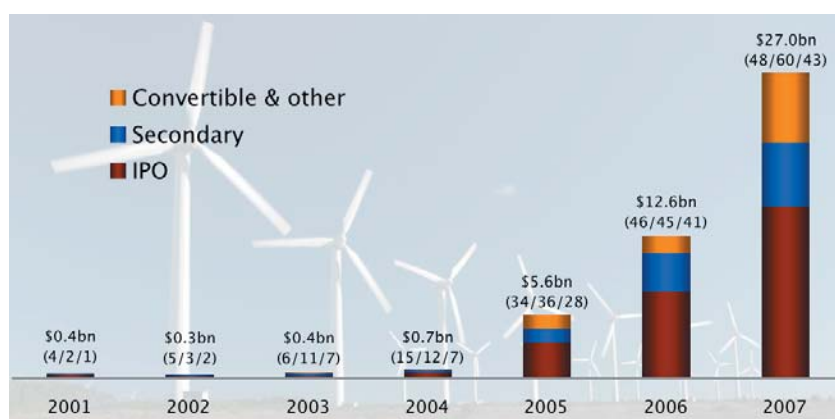
Global equity markets were generally buoyant – the Nasdaq Composite Index gained 9.8%, its biggest annual increase since 2003 – but clean energy stocks enjoyed unprecedented growth.

The WilderHill New Energy Global Innovation Index (NEX), which tracks around 85 stocks in the sector, gained 57.9% (see Figure 23), easily outstripping its 33.4% increase in 2006.

Appetite for clean energy stocks was driven by a number of factors, but mainly by heightened awareness of climate change and persistently high oil prices. The correlation between the NEX and the AMEX Oil index in Figure 23 illustrates the continued strong influence of the price of oil on clean energy stocks.

The NEX's stratospheric but bumpy rise was driven largely by solar and wind. Solar companies within the index ended the year 163% higher, while wind companies rose 65.8%. However, as valuations crept higher, volatility increased, with some stocks gaining or losing 40% in a single day, especially towards the end of the year. The warning signs that the tide was about to turn were clear.

Figure 22. Public Markets Transactions by Type, 2001-2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

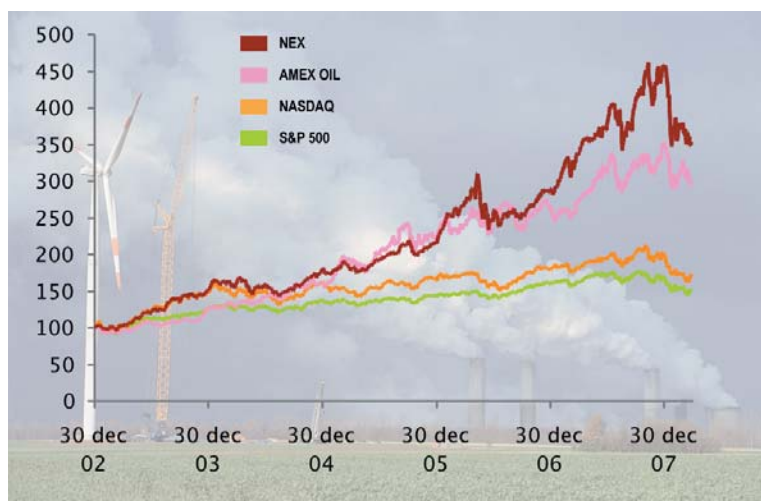
In December 2007, just before the market turned, Iberdrola Energias Renovables (Iberenova) saw a window of opportunity and launched an IPO that would eclipse all others. The wind power development arm of Spanish power giant Iberdrola raised \$7.2 billion in a landmark flotation that dwarfed the largest clean energy deal to date, REC's \$1.1 billion IPO in May 2006. Iberenova's IPO raised the profile of the sector around the world. It made headlines as the largest ever offering by a Spanish company and was feted as one of the five largest public market deals of the year. It also boosted clean energy's standing within the wider energy industry. In 2007, clean energy accounted for an estimated 19% of all money raised by the wider energy sector on the public markets, a substantially higher figure than in previous years.

With the benefit of hindsight, Iberenova's IPO seems to have marked the top of the market. Iberdrola's decision to take its chance in a shaky market was not entirely opportunistic – it had been planning the IPO since the beginning of the year and was forced to accept a valuation at the bottom of its expected range. A key driver was that Iberdrola's renewable energy portfolio had reached a size and growth trajectory that was undervalued (and relatively invisible) in the shelter of a parent company, and that it was under increasing pressure to release via an IPO. The deal reflects a similar trend to that seen in the telecoms sector in the 1990s as traditional landline firms floated off their mobile phone subsidiaries whose high growth and returns justified higher valuations than their parent companies.

Others are keen to follow suit. Energias de Portugal is considering an IPO of its wind power assets in 2008, as are Spain's Eolia Renovables and Italian giant Enel. However, some companies are being forced to postpone their plans. The public markets all but closed in Q1 2008, although mostly bounced back in Q2. Just one of the IPOs completed in the first quarter of 2008 was from European or US companies; almost all have come from Asia and Australia. Iberenova's IPO seems to have absorbed much of the available investment in the European capital markets for the time being, exacerbating market conditions.

The Iberenova deal was sufficiently large to skew the picture of clean energy public market investment (see Figure 24). If this one super-size IPO is excluded,

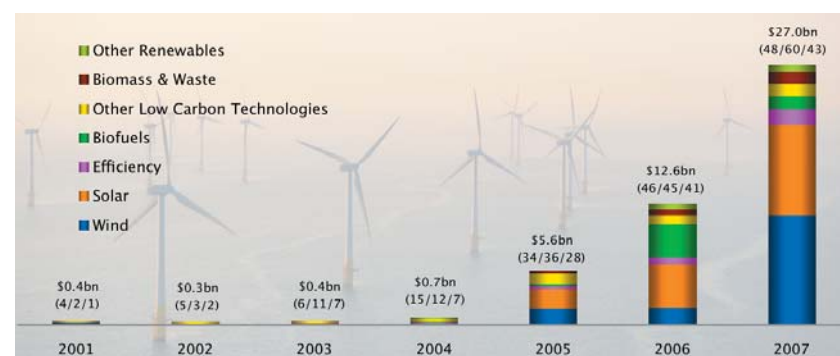
Figure 23. NEX vs NASDAQ, S&P 500 and AMEX Oil



Note: Index values as of 24th March 2007. Rebased to 100 at 30th December 2002

Source: SEFI, New Energy Finance

Figure 24. Public Markets Transactions by Sector, 2001-2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

Source: SEFI, New Energy Finance

Figure 25. Public Markets Transactions by Sector and Type, 2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

Source: New Energy Finance

overall growth in 2007 is a more sedate 57% (not 114%), while the volume of money raised in IPOs increases by just 3% (rather than 98%).

Other types of deals have also grown strongly. Secondary offerings jumped 68.4% to \$5.7 billion in 2007, while convertible bond issues increased more than fourfold to \$6.2 billion (this figure includes a small volume of 'other' deals). Convertible bonds have thrived under adverse credit conditions as companies have sought refuge from the higher cost of debt and found capital harder to access.

Figure 26. Public Markets Transactions by Region, 2001-2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other). Transactions are categorised according to location of exchange on which the company raises money.

Source: SEFI, New Energy Finance

Ibernova's IPO also distorts comparison of the various clean energy sectors. As a wind power developer, Ibernova inflated the total raised by wind companies to \$11.4 billion, giving it a clear lead over all other clean energy sectors; however, if the deal is excluded, the total drops to \$4.2 billion, well behind the \$9.5 billion raised by solar companies, but still ahead of all other sectors (see Figure 25).

Wind investment in 2007, with or without Ibernova's IPO, far outstripped its total in 2006, although the year was characterised by sharp regional discrepancies. No money was raised by wind companies on the main US markets, with activity concentrated in Europe, where \$2.2 billion was raised (excluding Ibernova), and Asia, which saw investment of \$1.7 billion. The year was characterised by large offerings from wind turbine and component makers. Demand for wind turbines continued to outstrip supply as the political and regulatory environment improved in many countries, encouraging developers to move into new markets beyond Western Europe and as wind development increased in certain US states.

Solar companies also had a strong year in 2007. In total they raised \$9.4 billion, more than

## Taking advantage of the markets' expectations for the sector

European utilities began spinning out their renewables subsidiaries in late 2006, starting with the \$691 million EDF Energies Nouvelles IPO in November 2006, the Iberdrola Renovables IPO in December 2007, and the EDP Renovaveis IPO in June 2008. The decision to finance these renewables operations as free-standing entities instead of as part of their larger utility operations illustrates how the capital markets are now distinguishing between old and new energy businesses.

Take the example of Iberdrola in their efforts to raise the capital needed to expand their renewables business. If they had chosen to raise the capital through a share offering from their parent company, investors would have valued earnings from the renewables business at around one-third of the value it was given as a separate listing (based on the prevailing earnings multiples, see assumptions below). This higher multiple was based on investor expectations of much higher growth potential for a renewables business than for a traditional utility operation. Whether Iberdrola Renovables continued growth will meet these high projections will take some years to bear out, however, it is clear that the capital markets have created a dynamic for change in the energy sector, one which even market incumbents are now starting to act on.

Notes: As at December 31st, 2007, the EBITDAs (earnings before interest, taxes, depreciation and amortization) of Iberdrola and their renewables subsidiary were €5,538 million and €564 million, respectively, and the enterprise value of Iberdrola €73,318 million. The IPO gave an enterprise value for Iberdrola Renovables of €23,617 million (this had risen to €25,095 million by 31 December as the share price rose from €5.30 to €5.65). These figures correspond to EV/EBITDA multiples of 13.2x and 41.9x, respectively.



double their 2006 total of \$4.6 billion. Chinese cell and module makers, in particular, made their mark on the US markets in IPOs and follow-on issues. Yingli Solar, for example, raised \$297 million from its flotation on NYSE, and a further \$150 million from a follow-on offering and convertible bond issue at the end of the year. There were also a number of large secondary offerings by established quoted US and German solar companies looking to strengthen their balance sheets in preparation for a period of consolidation.

Energy efficiency companies doubled the volume of money raised on the world's markets in 2007 to \$1.5 billion from \$732 million in 2006. As both investors and governments woke up to the potential of energy efficiency, there were IPOs by two US demand response firms Comverge and EnerNOC, as well as UK residential energy efficiency product supplier Eaga.

Biofuels public market investment fell by 60% to \$1.4 billion in 2007 from more than \$3.4 billion in 2006, although the industry has continued to thrive in Brazil and East Asia, where some companies managed to tap the public markets. In Brazil sugar and ethanol group Sao Martinho raised BRL424 million (\$200 million) from its IPO in February 2007, while Chinese firm China Agri-Industries Holdings raised HKD 3.2 billion (\$413 million) from its IPO on the Hong Kong Stock Exchange.

Deals such as those contributed to the enormous increase in the volume of funds raised on markets in non-OECD countries in 2007 (see Figure 26). In 2006, companies managed to raise a mere \$662 million, but in 2007 this more than tripled to \$2.9 billion. Fast-growing local giants such as Suzlon have also contributed to the increase. The Indian wind turbine manufacturer raised \$551 million in a follow-on offering on the Bombay Stock Exchange in December 2007 and earlier in the year had used its listing on the Singapore Stock Exchange to issue convertible bonds with a value of \$500 million.

Although some companies such as Goldwind Science and Technology, a Chinese wind turbine manufacturer, choose to list on their local exchanges, many do not. Chinese solar businesses LDK Solar and Tianwei Yingli, and biofuels firm Gushan Environmental Energy, all floated on the New York Stock Exchange in 2007. The volume of funds raised by companies based in non-OECD countries is therefore much greater than that raised on non-OECD markets.

In terms of deals, the most active market in 2007 for clean energy was London's AIM with

32 transactions, followed by Nasdaq and Frankfurt. AIM has long been a favourite of the clean energy industry, as it offers access to one of the world's financial centres and has less stringent reporting requirements than the US markets. In terms of the volume of money raised, however, Madrid took the lead on the back of the Ibernova IPO, followed by Nasdaq, Frankfurt and NYSE (see Figure 27).

Figure 27. Public Markets Transactions by Exchange, 2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

Source: New Energy Finance

Much of the money raised on these markets was by overseas companies. For example, \$3.2 billion was raised by companies listed on the UK markets (LSE and AIM), but only \$1.1 billion of it by UK firms (see Figure 28).

Chinese firms, in particular, are eager to list overseas. In 2007, Chinese companies raised \$3.2 billion, but just one deal of \$252 million was recorded on the Shenzhen Stock Exchange. Not only are they attracted by the publicity of listing on a Western exchange, they are eager to access investors who are more aware of climate change than domestic investors and are seeking to gain exposure to China. Moreover, private companies tend to go public overseas, as they do not have to get state approval before doing so. State-owned companies – such as former state-owned Yingli Solar – have to negotiate a lengthy bureaucratic process if they want to float overseas and so generally opt for either the Shanghai or Shenzhen stock exchanges.

Figure 28. Public Markets Transactions by Company Nationality, 2007



Note: The figure represents total public markets transactions (with the exception of OTC & PIPES which are included with VC/PE analysis) so includes transactions of existing stock as well as new equity. Numbers in brackets refer to (IPOs / Secondaries / Convertible & other).

Source: New Energy Finance







- Financing of sustainable energy assets grew by 61% in 2007 to \$108 billion, most of it for new power generation projects.
- The wind sector continued to be the leading sector for asset finance, attracting \$39 billion in 2007 and adding another 21GW of capacity. Global installed wind capacity exceeded 100GW in March 2008. Wind investment focused on the US, China and Spain, which together accounted for nearly 60% of new wind farms built worldwide in 2007. Much of the investment was shaped by regulation – renewable portfolio standards in various US states, an imminent cut in feed-in tariffs in Spain and incentives to build wind farms even if turbines lie idle in China.
- Solar was the fastest growing asset finance sector in 2007, increasing 250% to \$17.7 billion. Solar investment was subsidy-driven, with Germany remaining the dominant market for new capacity, while installations in Spain, Italy and South Korea showed strong growth.
- Asset financing in China and India grew significantly, to \$10.8 billion in China and \$2.3 billion in India, suggesting a shift away from manufacturing to generation capacity.
- In 2008, asset financing remains strong in the first quarter (\$27.9 billion, up 59% on Q1 2007) but then slowed in Q2 (\$21.9 billion, 10% down) as credit conditions deteriorated.

Financing of renewable energy generating assets grew by 61% in 2007 to \$108 billion from \$67.3 billion in 2006 (see Figure 29). This represents all money invested, whether from internal company balance sheets, debt finance or equity finance, but not short-term construction loans.

As in previous years, the bulk of the money was used to construct new power generation projects: a total of \$84.5 billion went into building new capacity, up 68% from last year (see Figure 30). The repackaging of financing on existing assets accounted for a further \$5.7 billion, while \$18.1 billion was spent on the acquisition of renewable projects.

Investment is being spurred on by politicians who are rising to the challenge of combating climate change. Governments are setting higher renewable energy and carbon emission reduction targets and introducing more coherent subsidy regimes.

In China the government has set ambitious renewable power targets and is rolling out regulations to achieve these. In June 2007, the government published the long-awaited Medium-to-Long Term Development Plan that includes targets of increasing the share of

renewable energy in total energy consumption to 10% by 2010 and to 15% by 2020, compared with 7.5% in 2005.

More recently, the EU has proposed the introduction of legally-binding national renewable energy targets for every EU country, as well as a voluntary green certificate trading scheme and strict environmental sustainability criteria for biofuels.

There were also some disappointments. The US Energy Bill, which was passed into law in December 2007, did not include an extension to the wind subsidy, the

Figure 29. Asset finance transactions by type, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents total asset finance transactions so includes acquisitions and re-financing as well as new-build. Numbers in brackets refer to (disclosed / total deals)

Source: New Energy Finance

Production Tax Credit, or the equivalent solar support mechanism, both of which are due to expire at the end of this year.

But asset finance was not only driven by political will. Initially, lenders appeared undeterred by the debt market problems that first emerged in the late summer of 2007. Bankers continued to have faith in renewable energy projects' cash flows, not least because the deals are structured to protect lenders.

Nevertheless, asset finance has not been entirely immune to market turbulence – banks have become more reluctant to agree to very high leverage ratios and have tightened the terms on which they lend money.

In 2007, as in previous years, more money was invested in wind projects than any other type of renewable asset. A total of \$39 billion, up 68% over 2006, poured into the building of new wind farms and the refinancing of

existing portfolios (see Figure 30). This investment sustained the industry's rapid expansion: a massive 21GW of new wind power capacity was added in 2007, a jump of 40% on 2006. Total global installed capacity passed the 100GW mark in March 2008.

Almost 60% of these new wind farms sprang up in just three countries: the US, Spain and China. At the start of 2007, the US had installed capacity of 11.6GW, but over the course of the next 12 months, developers added a further 5.2GW, an increase of 45%. Spain brought another 3.5GW online, while China, rising fast through the ranks of leading wind power producing nations, installed 3.3GW of new capacity.

In the US much of the momentum behind the expansion of the wind industry came from state-level renewable portfolio standards. These require that a minimum amount of renewable energy is included in each retail electricity supplier's portfolio of electricity resources. At the end of the year, more than 20 states in the US, along with the District of Columbia, had adopted such standards.

Across much of Europe, the rate of development also increased. In Spain there was a push by developers in 2007 to get new capacity up and running before the introduction of lower wind energy tariffs on 1st January 2008.

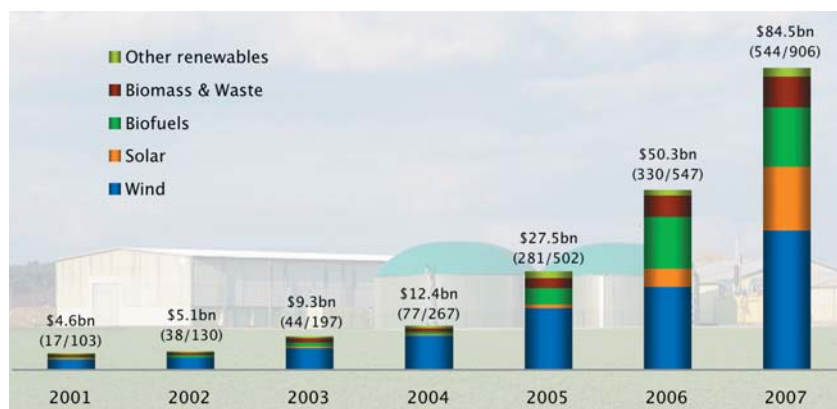
In China installed wind capacity grew strongly to 6GW, but according to the China Electricity Council and the China Wind Energy Association, 2GW of this is not in use. This reflects China's wind incentive system, which is based on capacity rather than generation, as well as delays in building grid connections. However, this is counterbalanced by the fact that most of China's wind projects are financed via CDM, which does require energy to be generated.

Solar asset financing grew to \$17.7billion in 2007, an increase of more than 250% from 2006, when \$5 billion was invested. Over the course of the year, the volume of capacity grew by approximately 40% as 2.3GW of new projects were commissioned.

The main drivers for this increase continued to be the subsidised markets that have hitherto defined the market. Germany dominated global installations, while Spain, Italy and South Korea showed strong growth.

In Spain the volume of installed PV capacity has grown far more rapidly than the government had anticipated, having lavished generous subsidies on the industry. It set a national capacity cap of 371MW at the end of 2005, but instead of lasting until 2010 as expected, it was exceeded in September 2007, less than two years later. Companies are still able to avail of the existing rates so long as they connect their projects to the grid before September 2008. This deadline may have encouraged a rush to finance new projects.

Figure 30. Asset finance new investment by Sector, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents new investment, i.e. for new-build projects only, and therefore excludes acquisitions and re-financing. Numbers in brackets refer to (disclosed / total deals)

Source: New Energy Finance

Solar thermal electricity generation (STEG) projects also made steady progress. In the US, Nevada Solar One, a 64MW parabolic trough project - the first in nearly two decades in the US - built by Spanish construction and infrastructure group Acciona, was completed and connected to the grid in June 2007. In Spain several STEG financings were closed and construction contracts signed. The country is targeting 500MW of STEG by 2010, and most of this will need to break ground in 2008 if this target is to be met.

Financing of new biofuels capacity increased by 16% to \$16.7 billion in 2007, a small gain compared with 2006, when investment grew by over 220% to \$14.4 billion. By the end of the year, many expansion plans had been deferred, plants mothballed and jobs lost.

The food-fuel debate intensified through 2007 and into 2008 as biofuels production was targeted for blame in pushing up the cost of staple foods in a number of countries. This led to a policy backlash in China, where the government decided to withdraw approval for new grain-based ethanol projects in June 2007. In September 2007, the government

also imposed severe restrictions on biodiesel produced from rapeseed. In Mexico the country's president vetoed legislation mandating a biofuels mix after an 80% increase in the price of corn tortillas, a staple foodstuff, sparked riots in January 2007.

Higher feedstock prices have hit the biofuels industry in the US, Europe and Asia. In Southeast Asia palm oil (for biodiesel) cost \$450 per tonne at the end of 2006, but by the end of 2007 had risen to \$1,000 per tonne. By

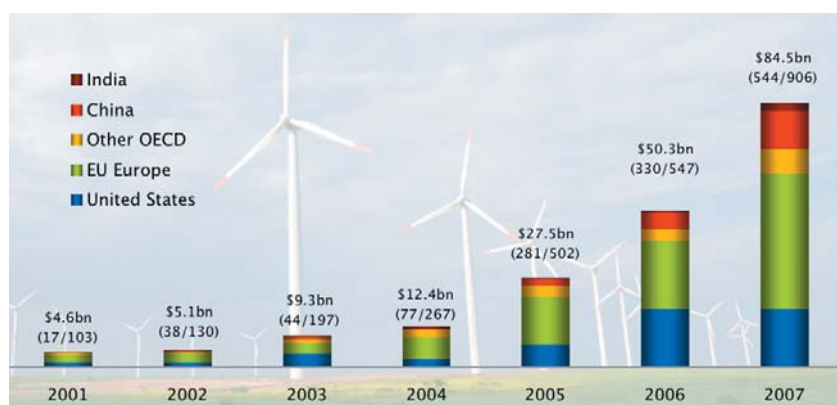
mid-March 2008, it cost \$1,400 per tonne. The notable exception is Brazil, where extensive investment in the sugar cane industry helped its well-established bioethanol industry to flourish. It is one of the few countries capable of generating biofuels economically and efficiently, independent of government incentives. (See also Figure 12).

The funding of biomass and waste-to-energy (WTE) projects totalled at least \$4.8 billion in 2007 across 127 projects. Although this was only a slight improvement on the total invested in 2006 – owing to the larger proportion of capital-intensive WTE projects in that year – there was a 60% increase in the overall capacity in 2007.

Funding of biomass and WTE projects in Asia grew by an impressive 160%. In China alone about 600MW of capacity was commissioned in 2007. The Chinese government has great hopes for biomass and companies appear to be prepared to invest. One of the largest operators, National Bio Energy, announced it is to invest CNY 30 billion (\$4.2 billion) in developing biomass plants and aims to install 2GW of direct-fired biomass capacity during by 2010.

There was a shift in the distribution of asset

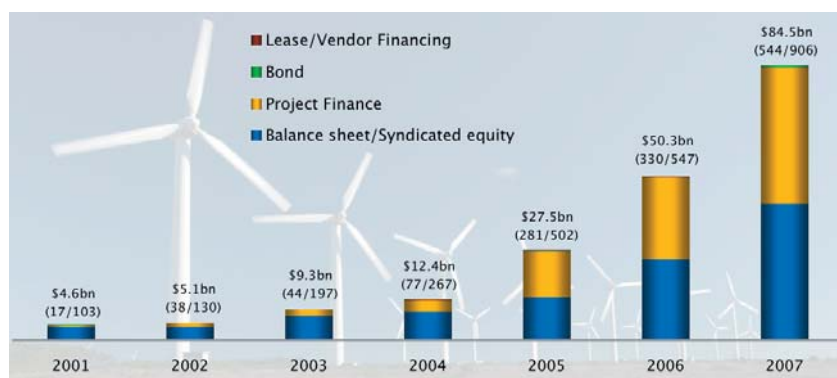
Figure 31. Asset finance new investment by region, 2001-2007



Note: The figure represents investment for new build clean energy projects. Numbers in brackets refer to (disclosed / total deals)

Source: SEFI, New Energy Finance

Figure 32. Asset finance new investment by type of security, 2001-2007



Note: The figure represents investment for new build clean energy projects. Numbers in brackets refer to (disclosed / total deals)

Source: New Energy Finance

financings around the globe in 2007 (see Figure 31). Investment in Europe almost doubled to \$38.8 billion, but remained flat in the US at \$16.3 billion as the number of new bioethanol plants looking for financing fell. China and India both saw tremendous growth. The former grew from \$4.8 billion to \$10.8 billion, an increase of 125%, while the latter surged 250% to \$2.3 billion, albeit from a very low base of \$661 million.

The volume of on-balance-sheet financings versus non-recourse project finance remained evenly split in 2007 (see Figure 32), although activity varied according to technology and geography. A boom in transactions in South American biofuels and a surge in Chinese wind and biomass deals boosted on-balance-sheet financings, while activity in the US and Spanish wind and solar industries prompted a rise in project financing.







- Corporate M&A activity increased 52% to \$25.7 billion in 2007, buoyed up by equity financing and diversification activity.
- Wind led M&A activity as supply chain shortages drove consolidation amongst component manufacturers, while offshore wind projects saw increased interest. Wind assets are gradually being transferred from developers to utilities.
- Energy Efficiency M&A was also strong with \$4 billion changing hands boosted by a few large deals.
- Biofuels M&A was driven by industry turmoil, which shook out weaker players, as well as by the rising cost of building new plants, leading developers to acquire existing ones.
- The US and Europe dominated M&A activity, while Brazilian biofuels became a focus for non-OECD transactions.
- In 2008, M&A increased in Q1 as the credit crunch sparked market consolidation, however, dropped back in Q2 as market conditions stabilized.

Mergers and acquisitions of clean energy companies grew rapidly in 2007. M&A transactions involve existing equity in projects and companies being bought by new corporate buyers. A total of \$25.7 billion changed hands in 237 deals, 52% more than in 2006, when acquirors paid \$16.9 billion in 185 different transactions (see Figure 33). These figures exclude private equity buy-outs, acquisitions of clean energy projects and investor exits. On the wider global power market M&A also increased, by 25% to \$373 billion, according to PricewaterhouseCoopers.

Clean energy M&A has reacted to the global credit crunch with increased activity in the second half of 2007 and into Q1 2008, when corporate M&A more than doubled quarter-on-quarter to \$7.7 billion. Increases were partly driven by market consolidation and were helped by the fact that most deals were capitalised by equity with little call for syndicated debt financing, an area particularly affected by the credit squeeze.

Figure 33. Corporate M&A by business model of target, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents corporate M&A investment in clean energy companies only and excludes projects acquisitions and buy-outs. Figures in brackets refer to (disclosed deals / total deals)

Source: New Energy Finance

As in previous years, most pure-play clean energy acquisitions in 2007 were driven by buyers seeking to expand their existing business, be it in power generation or equipment manufacturing. A total of \$10.9 billion was invested in renewable power companies, an increase of 83% on 2006, while \$7.6 billion was paid for clean energy equipment manufacturing firms, up 44% on the previous year.

Wind led M&A activity in 2007, with \$11.5 billion of deals accounting

for almost 65% of the total paid for power generation and equipment manufacturing companies across all sectors (see Figure 34). Three large wind company acquisitions took place in the second half of 2007. In July, shortly before credit issues began to surface, Goldman Sachs sold Horizon Wind Energy to Portuguese power utility EDP for \$2.7 billion. In August, Germany's Eon acquired the Iberian wind assets of Danish energy company Dong for \$990 million, and early in Q4, Eon also agreed to buy Irish wind farm developer Airtricity's North American operations for \$1.4 billion. Airtricity's remaining assets were acquired in early 2008 by UK utility Scottish & Southern Energy, for €2.2 billion (\$3.2 billion).



These deals were driven by the need to hedge against oil, coal and gas prices and in response to evolving national and international climate change legislation. Furthermore, these European utilities, although not immune from credit concerns, had sufficient credit quality and standing in the capital markets to carry out acquisitions on such a scale.

In another landmark deal UK-based generation company International Power acquired Trinergy's 648MW Italian wind portfolio for €1.8 billion (\$2.5 billion) in August 2007. This was significantly higher than recent comparable valuations, illustrating not only the quality of the portfolio, but also the value created by Italy's supportive policies for renewable energy. It also reflected utilities' eagerness to secure a position in the market, with the result that financial investors such as HG Capital and Babcock & Brown, who were also interested in the assets, were not able to compete.

Developers still own a significant proportion of global wind assets, but this is changing. Many smaller developers

– including those in developing countries - will follow in the footsteps of Airtricity and Horizon – and M&A will be driven primarily by utilities and infrastructure groups such as Spain's Acciona and ACS Cobra Group. Tougher market conditions will accelerate this process, giving utilities an edge over independent developers. Not only does their scale allow them to fund projects more easily using their own resources, avoiding the need to secure project finance, but utilities are also able to access large numbers of turbines, while smaller developers may lack sufficient clout to get onto manufacturers' order books, and are better placed to negotiate long-term power purchase agreements.

Manufacturing bottlenecks also drove M&A. A deficit of gearboxes, ball bearings and casings, typically manufactured by small and therefore vulnerable companies, is leading to consolidation in the wind industry supply chain. Tower Tech, the US-based wind tower manufacturer, for instance, spent \$162 million on three firms active in various stages of the supply chain. Similarly, a tight market for turbines contributed to French engineering group Alstom's decision to pay \$506 million for Spanish turbine producer Ecotècnia.

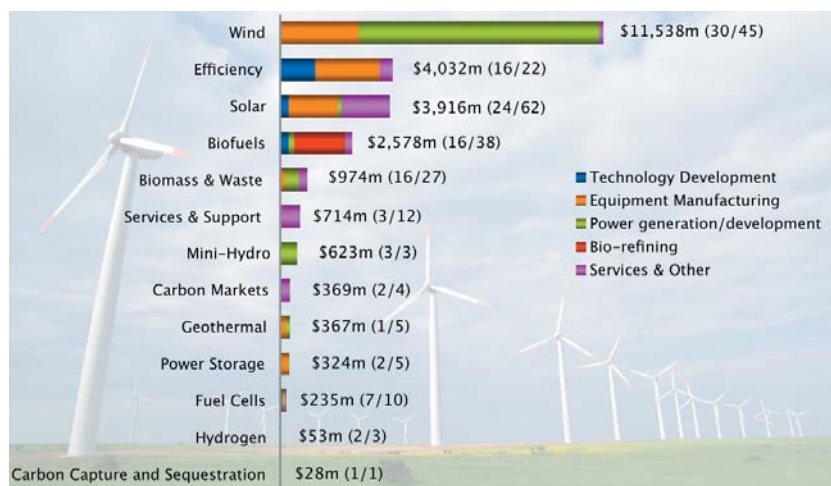
Interest in offshore wind moved up a gear in 2007. French nuclear giant Areva acquired a 51% stake in German off-shore turbine manufacturer Multibrud for \$106 million, and New York fund managers Christofferson Robb & Company (CRC) bought the 300MW Thanet project situated 11km off the southeast coast of England.

Energy efficiency companies also came to the fore in 2007 as governments and businesses realised that improvements in existing infrastructure and machinery could deliver large reductions in emissions cheaply. A total of \$4 billion changed hands – more than in solar and biofuels – but in fewer deals. There were just 22 energy efficiency transactions, compared with 62 in solar and 38 in biofuels. Interest focused on equipment manufacturing businesses, while \$1.3 billion was invested in technology companies.

Energy efficiency M&A was boosted by a few large deals. Baldor, a maker of high-efficiency electric motors and generators, bought Rockwell Automation subsidiary Reliance Electric Company for \$1.8 billion. In another big deal, energy management software provider Itron paid \$1.7 billion for its European rival Actaris Metering Systems.

In biofuels \$2.6 billion changed hands in 38 deals, with the collapse of the US biofuels market in May 2007, spurring consolidation. VeraSun Energy, the second-largest producer in the US, was a key player. In November 2007, VeraSun launched a \$700 million all-

Figure 34. Corporate M&A by sector, 2007



Note: Grossed-up values based on disclosed deals. The figure represents corporate M&A investment in clean energy companies only and excludes projects acquisitions and buy-outs. Figures in brackets refer to (disclosed deals / total deals)

Source: New Energy Finance

Figure 35. Corporate M&A by country of target, 2007



Note: Grossed-up values based on disclosed deals. The figure represents corporate M&A investment in clean energy companies only and excludes projects acquisitions and buy-outs. Figures in brackets refer to (disclosed deals / total deals)

Source: New Energy Finance

stock bid to acquire US BioEnergy, the third-largest producer. In August, VeraSun had acquired three plants from ASAlliance Biofuels for \$725 million and US BioEnergy completed its \$133 million acquisition of Millennium Ethanol.

The rising cost of building new plants also boosted M&A activity, as increases in steel and nickel prices made it cheaper to buy existing plants. At the end of November 2007, for example, ethanol project developer Ethanex Energy agreed to buy Midwest Renewable Energy's 94.5 million litre Sutherland ethanol plant

and abandoned plans to develop three greenfield projects in Illinois, Missouri and Kansas. Ethanex will pay \$220 million for the plant, which it will expand to 415 million litres.

Target companies were evenly split between the US and Europe (see Figure 35), with most European deals taking place in the established clean energy markets of Germany, the UK, France and Spain.

Figure 36. Corporate M&A by region of target, 2001-2007



Note: Grossed-up values based on disclosed deals. The figure represents corporate M&A investment in clean energy companies only and excludes projects acquisitions and buy-outs. Figures in brackets refer to (disclosed deals / total deals)

Source: SEFI, New Energy Finance

Acquisitions in the Brazilian ethanol market accounted for a large proportion of non-OECD M&A activity (see Figure 36). Spanish construction giant Abengoa paid \$297 million (plus \$387 million of debt) for Brazilian sugar and ethanol producer Dedini Agro. However, Cosan, the biggest ethanol producer in Brazil and the second largest in the world, failed in its attempt to buy control of one of its main rivals, Vale do Rosario.

Brazil is expected to experience a wave of acquisitions as the two-year decline in sugar and ethanol prices and a 10% increase in the price of agricultural land over the last year have made acquisition opportunities more attractive than greenfield projects.

# 9

- By Q1 2008, \$30.0 billion was under management in core clean energy funds, in addition to \$26.4 billion in funds with significant exposure to clean energy and \$10.9 billion in funds that invest exclusively in renewable power projects.
- The Q1 2008 total of \$67.3 billion of sustainable energy funds under management was nearly a fourfold increase over Q1 2007 (\$17.8 billion).
- This rapid capital build up was due to a record number of new clean energy public equity fund launches in 2007 – 17, compared to just five in 2006. Several of these were from mainstream fund managers launching ‘climate change’ funds. The arrival of these heavyweight fund managers to the sector is likely to encourage the larger publicly listed companies they normally invest in to expand into sustainable energy and other low carbon sectors.
- Many funds are diversified, with 30-40% invested in renewable energy and around 20% in energy efficiency, which entered the limelight in 2007. Diversification is driven by a desire to limit volatility, linked to a high exposure to pure sustainable energy stocks.
- Private (VC/PE) funds and project funds also increased their funds under management during 2007. VC funds focused on the US (mirroring investment trends), while project funds were among the largest sustainable energy funds (mirroring strong growth in asset financing).

During 2007, funds with a sustainable energy focus grew in popularity. New ones sprang up and most increased in size. At the end of April 2008, there was a total of \$30.0 billion under management (as compared to \$6.8 billion in Q1 2007) in core clean energy funds (those that invest more than 50% in renewable energy or energy efficiency companies) (see Figure 37). These figures do not include the \$26.4 billion in environmental funds (\$4.5 billion in Q1 2007) that also have significant exposure to clean energy (those with less than 50% of their investments in renewable energy or energy efficiency) and climate change funds (for which sustainable energy is a smaller, but still significant proportion of the total portfolio); nor do they include the \$10.9 billion in funds (\$6.5 billion Q1 2007) that focus exclusively on renewable power projects.

All in all, by the end of the year, there was an estimated total of \$67.4 billion residing in funds known to have some interest in the sustainable energy sector. Of this, by far the largest share - \$41.9 billion, or 62% - was in public equities, aimed at buying shares in publicly listed companies.

At the same time, venture capital and private equity funds had an additional \$14.5 billion under management.

The Q1 2008 total of \$67.3 billion of sustainable energy funds under management was nearly a fourfold increase over Q1 2007 (\$17.8 billion). Investor enthusiasm for the sector was illustrated by the surge in public equity funds launched in 2007 (see Figure 38). There were 17 new funds with more than 50% of their investments

in clean energy, up from five launches in 2006, one in 2005 and not one in 2004. Among the new arrivals were 12 actively managed funds, including DnB NOR Renewable Energy, Pictet Clean Energy, Allianz RCM Global EcoTrends, Sarasin New Power and LODH Invest Cleantech, plus five exchange-traded funds such as Market Vectors Global Alternative Energy.

Figure 37. Sustainable energy funds by type and asset class, March 2008



Note: Snapshot as at March 2007. Value in brackets refers to number of funds

Source: New Energy Finance

The reasons for the surge are clear: investor and public concern about climate change increased last year around the world, and clean energy shares performed very strongly, catching the eye of many investors. The WilderHill New Energy Global Innovation Index or NEX increased 57.9% in 2007.

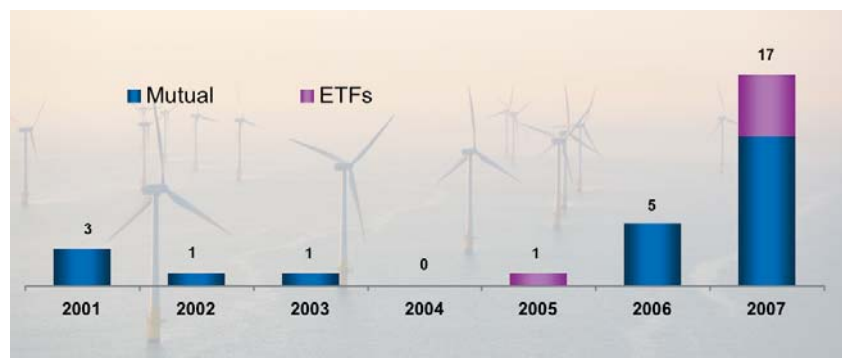
Investors were not disappointed. The average return of the 10 unlisted funds that had at least

12 months of performance data at the end of December 2007 was 57%. DnB NOR Miljøinvest was the best performer, rising 88%, largely thanks to its heavy wind weighting at the start of the year when the sector performed strongly, and its subsequent shift to booming solar stocks in the second half of 2007. The worst performer was Credit Suisse's Future Energy fund, though it still rose by a healthy 41%.

Of the four listed public equity funds with a 12-month track record at the end of 2007, two outperformed the NEX.

The actively managed OHRA

Figure 38. Funds launched by type (public equity only) , 2001-2007



Note: Includes actively managed funds that have at least 50% of their investments in clean energy

Source: New Energy Finance

New Energy Fund gained 77%, while the index-tracking PowerShares WilderHill Clean Energy Portfolio rose 60%. The worst performer was UK investment trust IMPAX Environmental Markets, which made a more modest gain of 12%.

All but one of the five funds that outperformed the NEX were pure-play, meaning they focused more than 50% of their investments in clean energy companies. Despite this apparent correlation, research by New Energy Finance has shown that there was no clear relationship between performance and concentration in pure-play clean energy stocks. There is, however, a link between volatility and investment focus. Pure-play investors such as Merrill Lynch IIF New Energy Fund, KBC ECO Fund Alternative Energy and the Guinness Atkinson Alternative Energy Fund were more volatile than those with more diverse portfolios.

Funds launched in 2007 tended to build a less volatile portfolio by investing in a broader range of environmental sectors such as water, recycling and carbon trading. Sarasin New Power Fund, which launched in April 2007, decided to diversify away from the mainstream clean energy companies, because of concerns that sectors such as wind and solar would overheat. Similarly, the Pictet Clean Energy fund spread its net beyond clean energy.

As the clean energy and energy efficiency sectors have entered the mainstream, they have for the first time attracted the attention of heavyweight fund management groups. HSBC, F&C, Schroders, Deutsche Asset Management and Virgin Money have all launched funds with a wide 'climate change' remit aimed at retail as well as institutional investors. In the case of the HSBC Climate Change Fund, renewable energy sectors are expected to make up some 40% of the total. For Schroders' fund, the figure for clean energy stocks is 29%.

Clean technology accounts for 55% of Deutsche Asset Management's DWS Invest fund. This covers clean energy but also sectors such as filtration, forestry and transport, including companies involved in reducing car weight and increasing fuel efficiency. Deutsche Asset Management has moved aggressively into climate-change related funds and has around \$7 billion spread across a number of funds, making it the largest fund manager in clean energy - although Merrill Lynch has the largest single fund.

All these funds devote a portion to energy efficiency, often around 20%. Energy efficiency has become fashionable this year, as investors and governments realise that the quickest way of cutting carbon emissions is to reduce the emissions from conventional generation and encourage lower energy consumption. Energy efficiency highlights in 2007 included Comverge's \$110 million IPO in April 2007 and EnerNOC's \$103 million flotation the following month.

The arrival of these heavyweight funds will bring significant benefits. First and foremost, they are likely to encourage established public companies to expand into clean energy. The broad emphasis of these funds should also mean that less glamorous market segments such as waste, filtration and climate change adaptation will receive a share of the attention that is currently going



to wind and solar. On the downside, there is a risk of too much money chasing too few sensibly priced opportunities.

The 12 months to the end of December 2007 also saw the launch of five new Exchange-Traded Funds (ETFs), three in the US and two in Europe. Previously there was just one, the Powershares WilderHill Clean Energy Portfolio, which was launched in May 2005 and was valued at around \$1.5 billion at the end of January 2008. Their popularity is largely due to the fact that they are cheap and accessible. Unlike mutual funds, ETFs do not charge marketing and distribution fees, front-end and exit fees. Furthermore, shares in an ETF can be bought and sold at any time on the stock exchange.

Non-public funds also grew strongly in 2007. The volume of money in VC/PE investment vehicles has escalated in line with the rapid growth of VC/PE

investment in clean energy over the last six years. In 2007, VC/PE investment grew 43% to \$13.3 billion, and it is estimated that there was \$6.9 billion sitting in clean energy VC/PE funds at the end of December 2007, and a further \$6 billion in VC/PE funds backing companies active in the 'environmental' or 'climate change' areas (see Figure 39).

As in previous years, US firms dominated venture capital activity. Seven of the top 10 investments (ranked by disclosed investment rounds) were in the US, and 75% of all VC investment was in businesses based in the Americas, mostly in the US. Private equity investment was more balanced, with Europe, the Middle East and Africa accounting for 56% and the Americas for 36%.

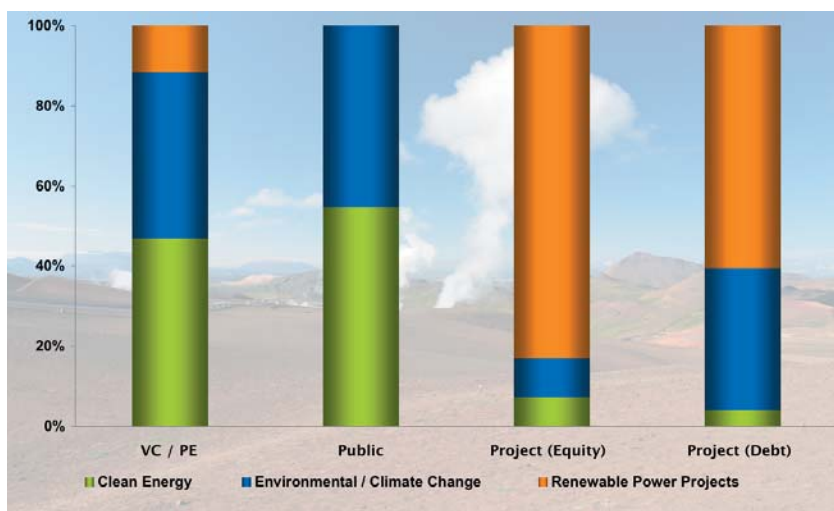
Analysis of the investments made reveals growing diversity – as seen in public equity funds. While 2006 showed portfolios biased towards a specific sector such as solar or wind, the top portfolios in 2007 were more widely spread. UK-based investor Low Carbon Accelerator's portfolio, for example, ranged across seven clean energy sectors.

Funds investing in renewable power projects tend to be larger than their VC/PE counterparts. Six of the top 10 largest clean energy funds are focused on projects. Among the more notable renewable power project funds is Carlyle/Riverstone Renewable Energy Infrastructure Fund I. It is one of the largest funds of any type, with approximately \$685 million under management, and has made investments in biofuels plants, a biomass-fired cogeneration facility and geothermal projects.

However, some large VC/PE funds are emerging. In May 2008, Kleiner Perkins Caulfield & Byers launched its \$500 million Green Growth fund for later-stage opportunities, with significant investment from Generation Investment Management (which is chaired by Al Gore). KPCB also has a separate \$700 million fund focused on early-stage technology.

In the developing world besides the funds targeted at the CDM, a number of new private equity funds have been launched or are planned for the sustainable energy sector. Some of the investment is coming from the development banks such as the US Overseas Private Investment Corporation (OPIC), the Asian Development Bank, the French Proparco and others. For example, ADB undertook a call for fund investments in 2007 that has seen it commit \$100 million to five private equity funds who together are raising \$1.2 billion for financing clean energy technologies and projects in Asia.

Figure 39. Sustainable funds by focus and asset class, March 2008



Note: Snapshot as at March 2007.

Source: New Energy Finance



# 10

- CDM activity is dominated by India (32% of registered projects), China (19%) and Brazil (13%). However, in terms of emission credit volume, China leads with 53%, followed by India with just 15%, reflecting the larger average CDM project size in China.
- Renewable energy accounts for around 55% of CDM projects by number, but only 29% of emission credit volume.
- \$12.95 billion had been invested in carbon funds by the end 2007, \$9.4 billion in private funds and \$3.6 billion in public funds. Private funds grew strongly in 2007, reflecting investor interest in carbon trading, while public funds remained flat.
- The UK is the leading market for private carbon investment, accounting for 65% of private carbon funds under management. This reflects Europe's position as home to the world's leading carbon market, and London's position as a financial centre within Europe.

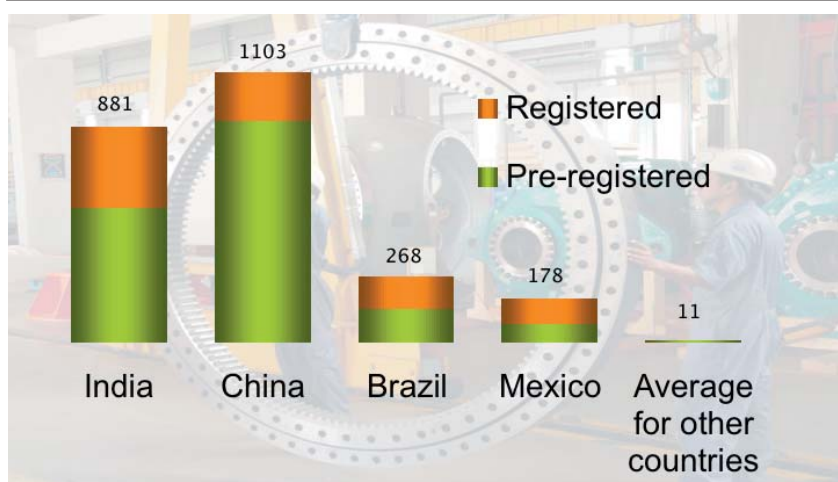
The Clean Development Mechanism (CDM), which was set up under the Kyoto Protocol, is designed to channel funds from developed countries into projects in developing countries that avoid greenhouse gas (GHG) emissions – including renewable energy and energy efficiency projects. Projects that are approved by the CDM Executive Board are granted Certified Emissions Reductions (CERs), which can be traded on carbon markets such as the European Union Emission Trading Scheme (EU ETS), the world's largest multinational GHG emissions trading scheme. Carbon credits can also be generated from emission reduction projects in developed or transition countries (under Joint Implementation). Underlying demand is driven by legally binding emissions reduction targets signed up to by developed countries under the Kyoto Protocol of the UN Framework Convention on Climate Change.

Much of the supply of CERs comes from India and China, which together account for more than two-thirds of the projected CERs between now and 2012 from projects that have been registered or are undergoing validation.

Of the 1,018 CDM projects currently registered, 32% are in India, 19% in China and 13% in Brazil (see Figure 40). However, in terms of CERs expected from these projects between now and 2012, China is the clear leader, accounting for 53% of expected CERs to 2012, with India

a long way behind with just 15% (see Figure 41). This is due to the larger average size of CDM projects in China, reflecting the difference between the decentralised fragmented Indian industry and the highly centralised Chinese one. The Chinese pipeline also includes more projects targeting high global-warming potential gases such as HFCs and N<sub>2</sub>O from the production of refrigerants and nitric/adipic acid. China also offers greater potential for Coal Mine Methane projects, as its coal mines are underground, whereas the open cast Indian coal mines make the recovery of the gas much harder.

Figure 40. CDM projects by country, April 2008



Source: New Carbon Finance, UNEP Risoe CDM/JI Pipeline 1 April 2008

Largely because of China and India's dominance, CDM projects are very

unevenly distributed geographically. Of the total CER supply to 2012, 80% is expected to come from Asia, while Latin America is expected to contribute just 15% and Africa 3%. Excluding South Africa, Nigeria and Egypt, which are the main CDM countries in Africa, the continent represents less than 1% of the global CER supply. This is mainly due to Africa's low emissions and its more risky investment environment. However, there has been an increase in CER buyers

willing to pay premium prices for CERs from African projects which guarantee benefits to local communities, alongside emission reductions.

The sectoral distribution of CDM projects is also quite uneven (see Figure 42). Although there are only 19 HFC projects globally, due to their large size they represent 20% of the CER pipeline volume. Conversely, renewable energy projects (including large hydro) represent some 55% of the pipeline in terms of number of projects, but only 29% of the CER pipeline volume. Wind and biomass account for a fair

share of the pipeline, with some 409 and 508 projects, respectively, in the pipeline. Some 466 energy efficiency projects have been presented to the UNFCCC, almost all of which are for efficiency improvements in heavy industry and on the supply side; less than 3% are for residential or commercial improvements. About 47% of energy efficiency projects are being developed in India, where their small scale leads to higher transaction costs than in neighbouring China. Indian industry associations have called for more bundling of projects to address this.

It is hard to forecast exactly how many CERs will result from the current pipeline. Based on the calculations made in the Project Design Documents (the submissions made to the CDM Executive Board), the global supply of CERs up to 2012 will be 2.5 billion CERs from projects currently in the pipeline. Some of these projects, however, will be rejected by the Executive Board, many will be delayed and all will end up issuing a different amount of CERs than expected. Some manure management projects in South America, for example, have been issuing less than 20% of their expected CERs, while large N<sub>2</sub>O plants in Asia have been producing more than 10% above their expected supply.

Adding to the uncertainty is a higher failure rate for CDM submissions. In mid-2007, more resources were made available to the CDM Executive Board, enabling them to start checking all projects requesting registration. This has led to a higher rate of project reviews and more rejections. As of April 2008, 76 projects failed to reach registration after a request had been submitted.

Projects are at the supply end of the CDM chain and carbon investors sit at the other end, providing the demand for CERs (and other kinds of carbon credit). Carbon funds cover a range of investment activities, including government-backed funds buying carbon credits to meet Kyoto obligations, trading intermediaries who are commercially motivated, and funds investing directly in projects.

In 2007, there was a strong increase in private funds, while public funds remained almost flat (see Figure 43). At the end of 2007, \$12.95 billion had been raised by carbon funds: \$3.6 billion in public sector funds (for compliance) and \$9.4 billion in private sector funds (of which \$1 billion is compliance).

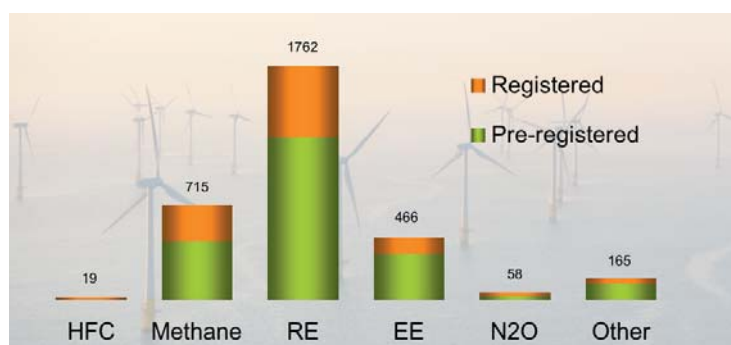
Public funds, which are driven by compliance, were instrumental in setting up the carbon markets in early years, while the arrival of private sector money indicates the market's increasing maturity and investor awareness of the potential returns. Private investment

Figure 41. Expected CERs by country (non risk-adjusted), April 2008: (units: 2012 MtCO<sub>2</sub>e)



Source: New Carbon Finance, UNEP Risoe CDM/JI Pipeline 1 April 2008

Figure 42. CDM projects by technology, April 2008



Source: New Carbon Finance, UNEP Risoe CDM/JI Pipeline 1 April 2008

is driven by returns rather than compliance, and as carbon trading has become more established, private funds have flourished.

Of the 67 carbon funds in the market, 37 are public compliance funds, 14 are intermediaries and 16 are for project development.

The UK leads the private carbon fund market, with 65% of private money raised managed out of the UK. This reflects the fact that Europe is home to the world's largest carbon market and London is a key financial centre within Europe. By contrast, most public carbon funds (42%) are managed out of the US (with just 5% out of the UK), due to its being home to the World Bank. At the end of 2007, Sindicatum Carbon Capital (UK) and Istithmar (UAE) announced that they would raise a new \$600 million fund to invest in JI and CDM projects in India, Indonesia and China.

Figure 43. Carbon Funds, 2000–2007



Source: New Carbon Finance.

The UK is also by far the leading investor in CDM, investing in 368 registered projects, which amounts to 37% of the total. This reflects its leading position as a manager of private carbon funds. Switzerland is next with 16%, followed by the Netherlands (12%) and Japan (11%).

Intermediaries benefited from a surge of interest from VC/PE investors in 2007, which saw the most deals ever recorded in carbon. Intermediary companies operate between project developers and investors and play an important

role in structuring deals, particularly those involving CDM. To date, 47% of primary CERs have been issued to intermediaries, compared with 16% issued directly to governments. Most VC/PE investment activity has been in the US and UK, mirroring carbon trading activity, with eight of the 12 VC/PE-funded companies based in these countries. This trend should persist as governments continue to impose restrictions on greenhouse gas emissions, and as more countries and industries get involved in cap-and-trade schemes.

There has been an emergence of funds investing in post-2012 credits, with the European Investment Bank (EIB) and Asian Development Bank (ADB) both providing upfront financing of projects to aid project development after 2012 until an international agreement is put in place. Q1 2008 saw the emergence of private interest in the post-2012 market, with NEFCO launching a \$79 million fund directed at private investors that will consider procuring post-2012 Kyoto credits eligible for trading on the EU ETS. Finnish emission broker Greenstream Network has also announced that it is introducing a fund focused on the post-2012 market. This is a good indicator that private sector money is confident that there will be demand for credits beyond the Kyoto period.

In April 2008, Japan unveiled a programme aimed at opening a domestic channel for investment and technology from large corporations to smaller companies to help them reduce carbon emissions. Under the Ministry of Economy, Trade and Industry's "Domestic CDM System", corporate benefactors will be matched with appropriate partners and, in return for their support, receive "Domestic Credits" toward voluntary emissions reduction targets. METI hopes the framework will contribute substantially to cuts in GHG by Japanese small- and mid-sized companies between now and 2012. The initiative will be supported by more than 20 major Japanese businesses.

# Investment in Developing Countries

## 11

- There is a continuing shift in investment from developed to developing countries. While developing countries' share of total investment remained almost constant at around 20% between 2006 and 2007, this conceals a significant shift in asset finance. In 2004-05, developing countries accounted for 10% of global asset finance, which doubled to 20% in 2006-07, reflecting a surge in sustainable energy capacity in these countries.
- In China asset finance reached a record \$10.8 billion, most of it for new wind capacity, which more than doubled to 6GW, possibly marking a turning point in renewable generation capacity roll-out in the country. China has also set stringent energy efficiency targets, which according to government figures are being met.
- Asset finance in India also grew (to \$2.5 billion), but the country's most notable trend was Indian companies raising money overseas in a series of foreign currency convertible bonds, which no Indian renewable energy company had issued prior to 2007.
- Investment in Brazil continues to be dominated by ethanol, which drove private equity investment, asset finance and M&A, as investor interest shifted from the beleaguered US ethanol market to Brazil. Wind investment is picking up slowly in Brazil.
- Africa continues to lag other developing countries in terms of sustainable energy investment, although there is promising large-scale solar development in North Africa and signs of change in South Africa, where targets for renewable energy have been set and the country's first wind farm commissioned. However, investment volumes remain very low.

This report divides developing countries into the broad categories of fast-growing economies such as China, India and Brazil, and less developed countries such as those in much of Africa. This split between countries that are striving to establish their own sustainable energy industries – both in terms of manufacturing capacity and installed generation – and those at the other end of the spectrum that are struggling with implementing their first generation projects did not shift significantly during 2007.

China, India and Brazil continue to dominate sustainable energy activity in developing countries. China has established itself as an important exporter of solar modules as companies address quality issues and gradually win the confidence of foreign manufacturers, while India continues to dominate in wind turbine supply. Brazil's focus remains on biofuels, much of which is consumed domestically.

The key challenge facing fast-growing developing countries is energy supply and energy security. Their energy demand is growing quickly as their manufacturing-focused economies boom and their populations become wealthier. Fast economic growth and the scale of energy undersupply in China and India, in particular, are forcing their governments to look mostly to conventional generation technologies rather than sustainable energy solutions. This means that investment into the developing countries most active in sustainable energy – China and India – is still mostly directed at manufacturing capacity, rather than installing generation capacity.

Unless the right policy framework and financing solutions are put in place, developing countries are likely to follow a carbon-intensive development path, as developed countries have done before them. Conventional generation is an attractive option for China and India, both of whom have significant coal resources that could help solve both their energy-security and energy-supply challenges. By 2012, India and China are expected to build nearly 800 new coal-fired power plants. Even though China in particular is promoting renewable energy and energy efficiency with increasing success, its surging electricity demand requires large-scale generation capacity – which still tips the balance in favour of conventional generation.

In contrast to these fast emerging economies, Russia has taken a very different approach. Russia has wealth, is rich in resources (renewable as well as oil/gas/coal) and understands entrepreneurship. It also has a unified power system connecting 70 local energy networks and allowing power to be transferred across the country. Yet renewable energy has still not taken off in Russia. It has enough conventional energy and, unlike China and India,



its economy is not growing at such a runaway speed that it is being forced to consider every generation option. In addition, Russia is becoming richer, but wealth is distributed unevenly, which puts renewable energy beyond the reach of those who would most benefit from it, including the 10 million Russians currently with no grid access. Russia's interest in renewable energy is therefore primarily as an investor – for the time being.

Russian oil tycoon Arngolt Bekke, is the founder of (and major shareholder in) German offshore wind turbine manufacturer / project developer, Bard Engineering, which has ambitious expansion plans to build 100 offshore wind turbines a year, all in-house. Bard will focus exclusively on offshore turbines – unlike Enercon, its main competitor at the large end of the turbine market – and has built itself up over just four years. Bekker plans to build seven 80-turbine farms with an installed output of at least 2.8GW and expects to have invested more than \$307 million by the time the first turbines are in the water in early 2009. In the longer term, the company intends to build a turbine of more than 7MW.

Russia's first wind farm, the Kalmykia Wind Farm, is under construction. Phase 1 was completed in December 2007, when the first turbine was installed, with the remainder due to follow by 2010. The plant is being financed by Czech Export Bank, CHKDNOV Energo, the government of Kalmykia, and Falcon Capital, a Czech corporation that is the project's principal investor. In April 2008, Dutch wind developer Windlife International announced that it planned to build a 200MW wind farm near Murmansk. The developer expects permission for the project to be granted by October 2008, with construction starting 2009 and the turbines installed in 2010-2011. The project will cost around \$400 million: debt financing has been arranged with the EBRD and Windlife will provide equity.

## Case Study 2. Public Financing for Sustainable Energy

International development banks and organisations provided \$8.3 billion to clean energy projects in 2007, up from \$6 billion in 2006. This sum is likely to continue to increase significantly over the next few years, potentially doubling by 2009. Investment from development organisations accounted for 5.6% of total clean energy investment in 2007.

The European Investment Bank (EIB) was the largest investor in clean energy in 2007, investing \$3.2 billion, followed by the World Bank Group (\$1.43 billion) and the European Bank for Reconstruction and Development (EBRD, \$1.21 billion).

A number of bilateral development banks, including KfW, JBIC and others, have also been active in developing countries. KfW, for example, committed \$389 million to renewable energy projects from 2003-07, and has set up a facility to provide more than \$2 billion in low-interest loans for investment in energy efficiency and renewable energy from 2005-11.

Development funding flows into renewable energy (often distributed generation projects for remote areas) and clean water projects, in line with its general aim of reducing poverty and improving living standards in poorer countries. However, development organisations such as the EBRD also finance energy efficiency. In 2007, \$1.08 billion of the \$1.21 billion (89%) lent by the EBRD to clean energy projects went into energy efficiency – largely to bring the efficiency of conventional power plants in Eastern Europe in line with EU environmental standards, as well as significant investment in industrial efficiency in Russia and the Ukraine.

Investment in clean energy from development organisations is likely to increase substantially over the next three years. The EIB, EBRD and Asian Development Bank (ADB) have all made commitments for the next few years, and the World Bank has said it will increase its investment in the sector. And commitments are meeting results, with for instance ADB meeting their 2008 \$1 billion clean energy target only months into the year.

In February 2008, the World Bank and the regional development banks proposed setting up two climate investment funds, a Clean Technology Fund and a Strategic Climate Fund for financing climate mitigation adaptation activities respectively in developing countries. The funds would be supported by the US, UK and Japan, and would receive \$2 billion of the climate funds announced by President Bush in January, as well as part of the \$1.6 billion pledged by the UK to “environmental transformation” last year. Japan has announced the creation of a \$10 billion financial mechanism to support the fund. Other countries are being urged to follow suit. The fund would support publicly and privately financed projects based around technologies that can cut emissions, increase efficiency and save energy in developing countries.

Source: New Energy Finance

Russia is also starting to develop ethanol plants on the back of its wood and wheat industries, similar to Canada. Three biofuels projects were announced in December 2007 – the Tulun Biobutanol Plant, ‘Biocomplex’ Omsk Ethanol Plant and Rebrikhinsky Bioethanol Plant (using wheat straw). And in the solar sector Russian polysilicon producer Nitel Solar was forced to cancel its IPO on the London Stock Exchange in early 2008, but has since secured \$100 million of equity funding from Chinese PV cell and module maker Suntech Power. The money will be used to continue building a plant in Siberia with the capacity to produce 3,700 tonnes of polysilicon.

The situation in other developing countries is quite different. Here the pace of sustainable energy development is far slower, reflecting the fact that renewable energy and energy efficiency receive less political support and have limited access to finance. Development banks play a significant role here and their involvement can help to leverage private (and other public) finance (see Case Study 2. ).

Just as China and India are becoming equipment suppliers to developed countries, so South East Asian countries are becoming feedstock suppliers. Malaysia and Indonesia, in particular, have become important sources of biofuels feedstock, mainly the environmentally controversial palm oil. For logistical reasons, these countries supply their neighbouring countries in Asia. In January 2008, Chinese oil producer Sinopec announced that it would invest \$5 billion into Indonesia to produce biofuels.

There has been relatively little development in Latin America, beyond Brazil. One highlight, however, is Mexico, which is one of the most promising areas for wind energy development. The Mexican Wind Energy Association (AMDEE) estimated that at least 3GW of wind capacity will be installed by 2014, from current installed capacity of less than 100MW. The government has set a target of 8% of the country’s power generation (excluding large hydro) to come from renewable sources by 2012. Transmission availability is a major barrier to development, along with a lack of incentives for developers and a clear regulatory framework to encourage investors. In spite of this, several private companies, including major players such as Gamesa, Iberdrola, GE Wind and Endesa, are exploring opportunities in Mexico.



## 11.1 Investment in China

China is the world's largest producer of renewable energy - but only if large hydro is taken into account, which accounts for 20% (145GW) of the country's total power generation capacity. If hydro is removed from the figures, the picture is dramatically different: the combined capacity of wind, biomass power and other smaller renewables is only 9GW, accounting for just over 1% of China's total installed capacity. China is also the world's third largest manufacturer of bioethanol (after the US and Brazil) and is the largest manufacturer and market for solar water heaters. China is aiming for 15% of its energy to come from renewable sources (excluding large hydro) by 2020.

Installed wind capacity took off in China during 2007. Over 3.4GW of wind energy capacity was added in 2007, bringing total installed capacity to 6GW, an increase of 156% compared with capacity installed during 2006 and a 134% increase in terms of total installed wind. However, it should be noted that incentives for building wind farms are not linked to the power generated, so many turbines are not yet operational or even connected to the grid. The growing wind power market in China has encouraged domestic production of wind turbines, and there are now more than 40 companies manufacturing wind turbines in China. In 2007, domestic products accounted for 56% of the market, compared to 41%

in 2006, according to Professor Li Junfeng, Secretary General of the Chinese Renewable Energy Industry Association.

China's Renewable Energy Law, which became effective on 1 January 2006, gives specific incentives for RE development, including preferential grid access, subsidies and tax breaks. In September 2007, the long-awaited Medium-to-Long-Term Development Plan for Renewable Energy set out new targets and includes an analysis of the investment required if the 2020 targets are to be achieved: \$251 billion in total, or \$16.7 billion a year (see Figure 44). Almost two-thirds of this is earmarked for hydro, with wind, biomass, rural biogas and finally solar PV, which is currently way behind in terms of both investment and capacity.

China continues to resist

accepting binding caps on its carbon emissions, although it has introduced energy efficiency targets (energy intensity down by 20% by 2010 from its 2005 level), spurred on by the approaching 2008 Beijing Olympics. China failed to meet its energy efficiency targets for 2006, but there are signs that it is getting back on track: according to official government figures, energy intensity fell 3.27% in 2007.

Renewable energy in China is being driven by the government's efforts to wean the country off its dependence on oil imports and meet its soaring energy demand (both energy security issues), as well as by serious environmental/health problems and rural electrification targets. China is the world's second-largest energy consumer and its third largest oil importer, and there are no signs of its appetite for energy diminishing. Between 2000 and 2006, China's energy consumption rose 77.3%, and in 2007 its GDP grew 11.4% (and has been growing at double digit rates since 2003). The government's clamp-down on energy intensity is forcing the closure of inefficient coal plants, but these are broadly being replaced by more modern coal generation rather than renewable capacity: China is building coal-fired plants at a rate of 1GW every five days.

In 2007, VC/PE investment was lower than in 2006 (a record year for China), and declined

Table 1. Installed Renewable Energy Capacity and Targets in China

	2007 Capacity	2020 NDRC Target
Hydro	145GW	300GW (including 75GW small)
Wind	6GW	30GW
Solar PV	100MW	1.8GW
Solar Water Heating	130m m2	300m m2
Biomass Power	3GW	30GW
Biogas	9.9 billion m3	44 billion m3
Biomass Solid Fuel	n/a	50m tonnes
Bioethanol	1.6 billion litres (grain-based)	12.7 billion litres
Biodiesel	119 million litres	2.4 billion litres
Geothermal (power & thermal)	32MW (power)	12m tce (power & thermal)
Marine	n/a	100MW (tidal)

Source: New Energy Finance, NDRC

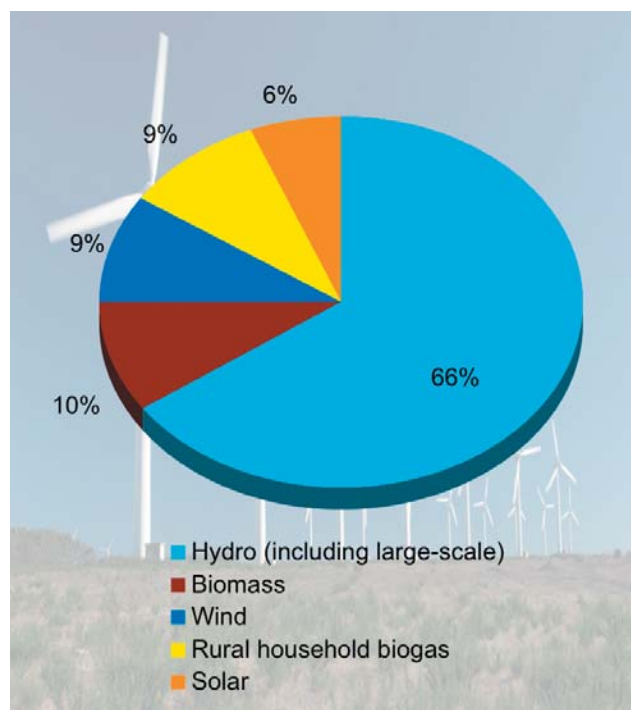
throughout the year (see Figure 45). The year saw \$237 million invested, mostly in the form of private equity, including Goldman Sachs and Actis Capital's acquisition of a 26.7% stake in PV manufacturer Jiangsu Shunda for \$100 million. This reflects the fact that there is still very little private venture capital in China, with government sponsorship accounting for most early-stage investment. Early-stage investment has flowed mainly into energy efficiency and the solar and wind sectors, while late-stage funding has been dominated by expansion capital and pre-IPO funding for the solar sector.

Public market activity on Chinese stock exchanges grew strongly in 2007 relative to previous years, but the real public market story was Chinese companies continuing to raise money on foreign stock exchanges. In 2007, Chinese companies raised \$3.4 billion overseas, driven by Chinese solar companies completing IPOs on US stock exchanges. This may change as Chinese companies seeking public equity turn back to domestic stock exchanges. In December 2007, Chinese wind turbine manufacturer Goldwind raised \$243 million in an IPO on Shenzhen Stock Exchange, the exchange's first pure renewable IPO, and in February 2008, thin film manufacturer Shenzhen Topray Solar raised \$60 million in an IPO on the exchange

Asset financing also soared in 2007, with new investment reaching \$10.8 billion (nearly twice as much as in 2006) and propelling China into second place worldwide for asset finance, after the US (\$16.3 billion). The majority of this was for wind projects. This may mark a turning point for renewable generation capacity rollout in China, where investment to date has largely focused on building manufacturing capacity.

Chinese M&A activity, however, remained very low in 2007. Just \$386 million worth of deals involving a Chinese target were completed. Most of this was accounted for by China Power New Energy's \$159 million acquisition of hydro developer Fujian China Power. Until this deal, Chinese M&A consisted of very small deals (average size \$12 million). Commercial M&A activity in China remains underdeveloped and dominated by reorganisations of state-owned assets and transfers between related parties.

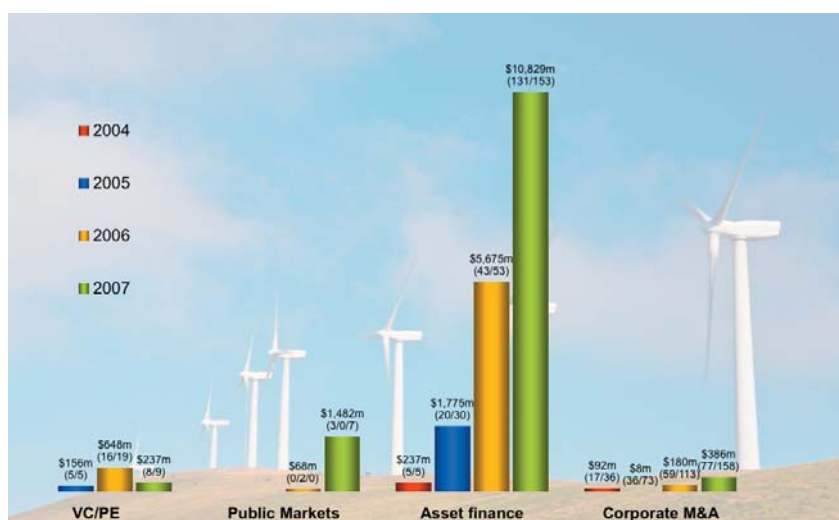
Figure 44: Chinese Government renewable energy new investment forecast by sector, 2006-2020: \$bn at 2006 prices



Note: price estimates for sectors:  
 Hydro: CNY 7,000 (\$875) / kW  
 Biomass Power: CNY 7,000 (\$875) / kW  
 Wind: CNY 6,500 (\$813) / kW  
 Solar Power: CNY 75,000 (\$9,375) / kW  
 Rural Household Biogas: CNY 3,000 (\$375) per household  
 No estimates available for other renewables sectors and biofuels

Source: SEFI, New Energy Finance,

Figure 45. Sustainable Energy transactions in China, 2004-2007



Note: Grossed-up values based on disclosed deals. The figure includes total transactions for asset classes tracked by the NEF dektop. Numbers in brackets refer to (disclosed/total number of deals) except for public markets where all deals are disclosed and number in brackets refer to (IPOs/Secondaries/Convertibles & other)

Source: SEFI, New Energy Finance,



## 11.2 Investment in India

India saw a sharp increase in renewables deployment in 2007, at the end of which it had installed renewable energy capacity of 11.4GW, most of it from wind power (7.8GW). The government has set a target of renewable energy to be 10% of its total energy mix by 2032 and has announced incentives to promote and attract foreign investment to the sector.

India is under pressure to increase its power capacity fast enough to sustain GDP growth of more than 8% and to meet the growth target of 9% set in the 11th Five Year Plan for 2007–2012. India currently has nearly 141GW of total installed power generation capacity, of which 8% comes from renewable energy, 64% from thermal plants, 25% from large hydro and 3% from nuclear energy. However, the country faces a power deficit of nearly 8% as the power sector struggles to meet the burgeoning economy's electricity needs. There is further pressure on the system in the form of the government's "Power for All" mission, which aims to provide power to all households by 2012, requiring an additional 78.7GW of capacity. Renewable energy is expected to play an important role in the overall energy-capacity addition programme.

The Rajiv Gandhi Grameen Vidyutikaran Yojana (India's rural electrification programme, launched in 2005) aims to provide power to nearly 125,000 un-electrified villages by 2012. Most of these villages are in remote areas and cannot be accessed by the national grid. The government is therefore promoting small-scale stand-alone solar and biomass projects to power them. So far, it has installed 69,549 solar street lights, 363,399 home lighting systems, and 585,001 solar lanterns. Recently, Indian banks have begun to scale up lending to the solar home lighting sector, initially through a partnership programme with UNEP and more recently on their own as this new commercial credit market takes hold.

Wind power has dominated India's renewable energy industry, both in terms of installed generation capacity and manufacturing (see Case Study 3). But solar is starting to make its mark in the country, even though installed PV remains very low. In 2007, the Indian government introduced a semiconductor policy for manufacturers of all semiconductors, storage devices, solar cells and photovoltaics, which has already seen investment flowing in. The Ministry of New and Renewable Energy (MNRE) also announced an accelerated programme on energy recovery from urban waste including biogas. Overall, India plans to add 2.1GW capacity from biomass, bagasse and power from industrial and municipal waste by 2012.

On the biofuels front, the Indian Ministry of Petroleum and Natural Gas launched the

5% Ethanol Blended Petrol Programme in the country in April 2007 and intends to hike it to 10% by October this year. It has also permitted sugar companies to produce ethanol directly from sugarcane juice instead of just molasses. However, this is effectively a 'soft mandate', as it is subject to feedstock availability and sufficient production capacity. The government is keen to avoid competition between food and biofuels feedstock. There is currently no biodiesel blending requirement.

Also in 2007, the MNRE announced an incentive scheme under which it will provide financial assistance of \$304/MWh for PV and \$254/MWh for solar thermal power fed to the electricity grid. A maximum of 10MW capacity in each state will be considered under this scheme, with each developer

Table 2. Installed Renewable Energy Capacity and Targets in India

	2007 Capacity	Official target (during 11th 5-Year Plan 2007-12)
Large Hydro	34.2GW	
Small Hydro	2.0GW	+1.4GW
Wind	7.8GW	+10.5GW
Solar PV	2.1MW	+50MW
Solar Water Heating	2.15m m <sup>2</sup>	+11.6m m <sup>2</sup>
Biomass Power	1.4GW	+2.1GW (Including WTE, currently negligible)
Biogas	8.7MW	
Bioethanol	20m lpa (2006)	10% blending in Oct 2008, 20% by 2020
Biodiesel	negligible (2006)	2.4 billion litres
Geothermal (power & thermal)	n/a	
Marine	n/a	

Source: New Energy Finance, MNRE

to have a maximum of 5MW capacity.

In 2007, VC/PE investment increased slightly to \$265 million, compared to \$236 million in 2006 (see Figure 46), although the numbers of deals completed halved, reflecting larger deal size. Deals included two biofuels investments and Merrill Lynch's first renewable energy investment in India, investing \$55 million in wind turbine manufacturer Vestas RRB.

Fund raising on Indian stock exchanges reached \$628 million in 2007, compared to no activity in 2006. Indian companies largely looked to foreign markets for new capital, raising \$1.4 billion overseas in 2007. Public market activity was marked by a series of Foreign Currency Convertible Bonds (FCCBs) from established Indian renewable energy companies, including integrated wind company Suzlon (\$300 million in May, and a further \$200 million in September), Moser Baer (\$150 million), Indowind (\$47 million) and Webel (\$16.8 million). FCCBs have been an increasingly common feature of Indian corporate capital raising since 2004, but until 2007 no convertible bonds had been issued by Indian renewable companies. Suzlon also raised \$551 million via a secondary offering (an institutional placement) on the Bombay Stock Exchange in December 2007 to fund its acquisition of Repower – bringing the company's total capital raising for the year to over \$1 billion.

Asset financing reached \$2.5 billion, almost all of it for new wind capacity. India added 1.7GW of new wind capacity in 2007, taking total installed capacity to 7.8GW and placing it fourth in the world, both in terms of new capacity added and total installed wind capacity.

Figure 46. Sustainable energy transactions in India, 2004-2007



Note: Grossed-up values based on disclosed deals. The figure includes total transactions for asset classes tracked by the NEF dektop. Numbers in brackets refer to (disclosed/total number of deals) except for public markets where all deals are disclosed and number in brackets refer to (IPOs/Secondaries/Convertibles & other)

Source: SEFI, New Energy Finance,

### Case Study 3. Wind Investment in India

India is the world's fourth largest wind-energy generating nation, with an installed capacity of 7.8GW at the end of 2007. Wind accounts for two-thirds of India's renewable energy capacity, and a number of large projects (100-500MW) 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

## 11.3. Investment in Brazil

Brazil is the world's largest renewable energy market, thanks to its hydropower and its long-established bioethanol industry, the latter of which has thrived alongside the country's sugarcane industry. Renewable sources make up 45.8% of the country's energy mix and 84% of its power generation capacity, including large hydropower, which provides four-fifths of the country's electricity.

Eighty percent of Brazil's new cars run on both ethanol or petrol (all of which is blended with around 25% ethanol) and ethanol accounts for more than 40% of fuel consumption. After two decades of slow growth, Brazil's ethanol consumption rose by 3.7 billion litres to a record 18 billion litres in 2007, driven by a surge in new flex fuel car sales and decreasing ethanol

prices at the pump when compared with gasoline. Ethanol consumption is expected to rise to 22 billion litres in 2008, more than 40% of Brazil's petrol consumption, driven by its price competitiveness rather than the government's 25% mandate.

Brazil was the world's largest producer of ethanol until 2006, when it was overtaken by the booming US ethanol market. Most of Brazil's ethanol (just over 80%) is consumed domestically. In spite of ambitions to expand its ethanol exports, in particular to the \$11 billion US market, Brazil's exports fell slightly in 2007 to 3.5 billion litres from 3.8 billion litres in 2006. Brazil's ethanol exports are held back by tariffs and subsidies that developed markets have put in place to protect their own industries, including a \$0.54/gallon tariff for exports to the US.

Brazil recently introduced mandatory blending of biodiesel – starting at 2%

	2007 Capacity	Official Guideline for 2008
Large Hydro	144GW	
Small Hydro	1.8GW	+1.1GW
Wind	237MW	+1.4GW
Solar PV	8.6MW	
Solar Water Heating	0.86m m <sup>2</sup>	
Biomass Power	3.7GW	+0.9GW
Biogas	61.6MW	
Biomass Solid Fuel	n/a	
Bioethanol	22 billion litres	25% of all gasoline consumption
Biodiesel	69m litres	2% (2008-2012) then 5%
Geothermal (power & thermal)	n/a	
Marine	n/a	

Source: Brazilian Government (mainly Ministry for Mines & Energy)

in 2008 (3% currently under discussion) and rising to 5% in 2013, with incentives for local family-based production of feedstock. Biodiesel production (95% from soybeans) is currently a fraction of Brazil's ethanol production, but is poised to take off. Biodiesel consumption is expected to reach 1 billion litres in 2008.

Biofuels have thrived in Brazil, thanks to its large areas of arable land, abundant water resources, solid government support, growing working age population and a cost advantage over competitors. However, lack of transport infrastructure, a policy emphasis on social (rather than commercial) goals and increasing awareness of sustainability concerns in export markets such as the EU may hamper the industry's growth.

Wind remains a secondary source of energy in Brazil, in spite of the government's PROINFA programme, which was established in 2002 and designed to encourage wind, biomass and mini-hydro projects by guaranteeing developers power purchase agreements at favourable rates.

Brazil's wind potential is estimated to be 143GW (by the Brazilian Wind Energy Centre (CBEE)), and 1.4GW has been contracted by PROINFA (commissioned, under construction and approved). However, by the end of 2007, only 240MW of capacity had been installed, almost all of it in 2006. A strong pipeline of wind projects has been building up since the government relaxed restrictions on foreign turbine components (60% has to be produced in Brazil, where the only turbine manufacturer, Wobben Windpower, was unable to meet demand), particularly in the country's northeast, which is estimated to have half the country's wind resource. But it is taking time for plans to translate into installed capacity, especially since shipping turbines from Europe pushes installation costs up by as much as 20%. Nearly 100 wind projects have been announced or are in planning, of which just five have been commissioned, with another 11 financed or under construction and 31 permitted.

Activity has picked up in recent months. In February 2008, Spanish developer Fortuny announced plans to develop three wind farm projects, with a total capacity of 223MW, in the cities of Jaguarao (50.2MW), Livramento (74.8MW) and Serra dos Antunes (98.6MW). Brazil's northeastern states of Rio Grande do Norte and Ceara could profit from BRL 10 billion (\$5.8 billion) of wind investment over the next couple of years, according to local reports. Ceara has 17.4MW of wind power already installed and another 500MW planned under PROINFA. Another 800MW of wind capacity could be rolled out in Rio Grande do Norte, costing some BRL 4 billion (\$2.3 billion).

Brazil accounted for almost all renewable energy investment in Latin America in 2007, although renewable energy is expected to gain ground in Ecuador, Argentina, Chile, the Dominican Republic and Mexico under new laws and, in some cases, subsidies for renewable energy.

Ethanol continues to dominate investment in Brazil, with the industry attracting investment from foreign companies such as Infinity Bio-Energy (listed on AIM) and US agribusiness giant Cargill. The number of mills operating in Brazil is expected to increase by a third within four years. Since 2007, there has also been considerable interest in building infrastructure for distributing ethanol (pipelines, storage and ports) – and the Japanese (Mitsui) have announced a joint venture with Petrobras to build a pipeline.

On the back of Brazil's sugar / ethanol industry, there is also growing interest in cogeneration using sugar cane bagasse as a feedstock. Many mills are investing in cogeneration so they can export electricity to the grid. They are already self-sufficient in terms of powering their production process, but more efficient boilers allow them to sell electricity to the grid, with electricity becoming a "third product" of the sugar cane industry. These developments are being driven by talk of an imminent Brazilian electricity blackout, and because electricity from bagasse is very cheap. In early 2008, Marcos Jank, president of sugar and ethanol producer association UNICA, said that by 2020 the burning of bagasse in Brazilian sugar and ethanol mills could generate 15GW of power and account for up to 15% of the country's electricity needs, up from current levels of 2%.

Biodiesel plants are also starting to come on stream. Brazilian agricultural group Agrenco has created a joint venture - Agrenco Bio-Energia - with Japan's Marubeni Corporation to develop biodiesel plants in Brazil. The first, Marialva Biodiesel Plant, a BRL60 million 100 mlpa plant fuelled by animal fats, is due to be commissioned in April 2008. Agrenco also has two other 100 mlpa projects under construction: the Rondonopolis Diesel Plant and the Dourados Diesel Plant. However, biodiesel in Brazil is currently high risk, with producers losing money in spite of the newly mandated 2% blend. The price of soybean, used by 95% of Brazilian producers as feedstock, is very high – while biodiesel prices are low - and biodiesel is sold exclusively by Petrobras-run auctions.

Asset financing in Brazil reached \$6.1 billion, 40% higher than in 2006. This flowed mainly into biofuels projects (biodiesel as well as bioethanol) and mini-hydro. The only disclosed wind asset financing during 2007 was \$69 million raised for the 25.6MW Beberibe wind project in the state of Ceara, being built by US developer Econergy.

VC/PE investment of \$658 million consisted almost entirely of private equity for ethanol production expansion (see Figure 47). Notable deals in 2007 included \$200 million raised by Brenco, a new company investing in Brazilian ethanol production backed by high profile investors including Vinod Khosla, James Wolfensen, Steven Bing and Steve Case. Clean Energy Brazil (a technology fund) paid \$130 million for 49% of ethanol producer Usaciga, and in October 2007, Goldman Sachs invested \$221 million in sugar

Figure 47. Sustainable energy transactions in Brazil, 2004-2007



Note: Grossed-up values based on disclosed deals. The figure includes total transactions for asset classes tracked by the NEF dektop. Numbers in brackets refer to (disclosed/total number of deals) except for public markets were all deals are disclosed and number in brackets refer to (IPOs/Secondaries/Convertibles & other)

Source: SEFI, New Energy Finance,



and ethanol producer Santelisa Vale (the result of a merger between two Brazilian ethanol groups who plan an IPO in 2008).

There was just one pure sustainable energy public market deal in Brazil during 2007. February 2007 saw the \$200 million IPO of Sao Martinho, a sugar and ethanol producer on the Sao Paolo (BOVESPA) stock exchange. More than half its shares were acquired by foreign investors.

Corporate M&A activity in Brazil was also dominated by ethanol, with the exception of Australian wind developer Pacific Hydro's acquisition of SES Ltda, a subsidiary of German wind company renergys (formerly part of ABB).

In January 2008, French nuclear group Areva acquired 70% of Brazilian biomass project designer Koblitz for an undisclosed sum. Koblitz has a particularly strong position in bagasse-burning cogeneration projects, which are currently surging in Brazil. Areva plans to triple the volume of the company within five years.



## 11.4. Investment in Africa

Investment in sustainable energy in Africa remains low, with capacity roll-out highly fragmented. Development continues to focus on North and South Africa, with the vast mass of Sub-Saharan Africa – arguably the region that has the most to gain from renewable energy - largely unexploited. Sub-Saharan Africa remains the only region not on track for achieving the Millennium Development Goals by 2015.

In terms of investment flows, because much renewable energy activity in Africa is at the planning stage – even in the most active regions of North and South Africa – there is little financial deal flow to report on, rather more a series of project and policy announcements. Elsewhere projects tend to be small and dispersed, showing no obvious investment trends. Support from government / development agencies alongside private investment is the norm. Not surprisingly, therefore, there was no recorded VC/PE investment in Africa (see Figure 48), and the only public market activity was the cancellation of Equatorial Biofuels' shares on AIM when the Liberian palm oil developer failed to publish an admission document on its reverse takeover of Liberian Forest Products.

Asset finance, however, was a healthy \$1.3 billion in 2007 (five times as much as in 2006), reversing a gradual decline in investment since 2004 and bearing witness to increasing installed renewable capacity. Investment was mainly in biofuels and geothermal.

### Sub-Saharan Africa

In Sub-Saharan Africa (SSA), excluding South Africa, lack of finance is the principal barrier to sustainable energy roll-out. There is little political support for renewable energy and energy efficiency in these countries, but even if there were, the vast majority of the population could not afford to take it up. Sub-Saharan Africa continues to rely heavily on Official Development Assistance (ODA). While official aid flows to SSA have risen in recent years, additional external financing mechanisms are needed to reduce poverty

and improve lives. According to the World Bank, the region received ODA of more than \$30 billion in 2005, making ODA Africa's largest external funding source, followed by foreign direct investment. Its economists estimate that SSA could raise up to \$30 billion a year by exploring previously overlooked sources of financing such as remittances and diaspora bonds (debt raised from international migrants from Africa), and by strengthening public-private partnerships. CDM take-up in Africa remains very low.<sup>ix</sup>

Perhaps the sustainable energy sector with most near term potential is small hydro. Several mini-hydro projects are in planning, most of them small (up to 20MW). In October 2007, the Hidraluapasso mini-hydro project in northern Angola was announced: a 26MW project being developed jointly by the Angolan Government, Escom Mining Energy and the Angolan National Agency of Private Investment at a cost of \$120 million.

Biofuels was the most active sector, including \$70 million raised by Principle Capital for the first stage of a 295 ml pa bioethanol plant in Mozambique, which will cost an estimated \$290 million. An impressive array of foreign investors came in at this initial fund-raising, including RAB Capital, Tudor, Societe Generale and GLG Partners. In another transaction State-owned Compagnie Sucriere Senegalaise invested \$135 million in a 21.9mlpa bioethanol plant in Senegal.

In geothermal, Kenya Electricity Generating Company (KenGen) raised \$91 million to build

Figure 48. Sustainable energy transactions in Africa, 2004-2007



Note: Grossed-up values based on disclosed deals. The figure includes total transactions for asset classes tracked by the NEF dektop. Numbers in brackets refer to (disclosed/total number of deals) except for public markets where all deals are disclosed and number in brackets refer to (IPOs/Secondaries/Convertibles & other)

Source: SEFI, New Energy Finance,

a 35MW expansion to the existing 70MW Olkaria II geothermal plant. The expansion will be completed by the end of 2009 and produce 276GWh. It will be funded by KenGen, the International Development Association (World Bank) and the EIB. Ormat, the US geothermal developer, is expanding its 13MW plant, Olkaria III, by 35MW. Olkaria III is Africa's first privately funded geothermal plant and is expected to qualify for CDM. The World Bank's Multilateral Investment Guarantee Agency (MIGA) is providing \$88.3 million of political risk insurance for the project. Olkaria IV, a 60MW plant funded by the Kenyan Government and KfW, is in planning. Kenya is Africa's leading source of geothermal power, with about 130MW of installed generation capacity.

Wind capacity in SSA remains very small, although 2007 saw a surge in wind development in Namibia, with five projects entering the planning phase. In March 2007, Aeolus Power Generation Namibia (a joint venture between Dutch investment company Aeolus Associated and investor United Africa Group) announced plans to build three wind farms – Grosse Bucht, Oranjetmund and Walvis Bay – totaling 92MW and costing \$135 million. And in October 2007, Belgian wind developer Electrawinds said it would build two 50MW wind farms in Namibia – Luderitz and Electrawind Walvis Bay. Overall, though, wind capacity in SSA is unlikely to take off in the short term: the Global Wind Energy Council (GWEC) estimates that installed wind capacity will be less than 1GW by 2010.

The outlook for SSA is not entirely bleak, however. According to a recent World Bank Report measuring the quality of government in 212 countries, African nations made the greatest improvements and took the biggest steps in reducing corruption over the past ten years, with Ghana and Kenya standing out. <sup>x</sup> There are also positive signs that domestic wealth may make an increasing contribution in SSA. Driven largely by the global commodity boom, many countries in SSA are seeing their strongest economic growth since the 1970s. Per capital gross national income (GNI) has risen from \$485 in 2000 to \$842 in 2006. <sup>xi</sup>

## South Africa

South Africa remains the focal point for renewable energy in the continent, at least for the time being. The country has been slower than other comparable economies to embrace sustainable energy, in spite of good renewable resources, developed financial markets and a reasonably stable political environment. But 2007 saw a number of positive developments.

With rich coal resources and low electricity prices, South Africa has had little incentive to explore renewable energy and promote energy efficiency, and favours nuclear power to meet capacity shortages. However, rising energy demand and a spiraling supply imbalance is forcing Eskom, South Africa's dominant state-owned electricity company, to consider alternative sources of energy. It is investigating wind generation and concentrating solar power (including carrying out a feasibility study for a 100MW parabolic trough installation in the Northern Cape) and is subsidising solar water heating. It has set a target of 1.5GW of renewable capacity (equivalent to 2% of its energy mix). Eskom's renewable target is less ambitious than those set in other transition countries, such as state-owned Brazilian generator Eletrobras's target of 6%. It is also only half of the South African government's target of 4%, raising the question of whether private investment can bridge the gap.

In January 2008, the Department of Minerals and Energy and Eskom released a new policy document, "National response to South Africa's electricity shortage". The plan includes investment in the country's electricity distribution structure and fast-tracking electricity projects by independent power producers. It includes electricity co-generation projects between Eskom and private industry to produce power that can be used by the industries themselves or sold into the national grid. The new plan also emphasises the importance of reducing demand by pricing electricity correctly, as well as promoting energy efficiency (and penalising inefficiency). Eskom aims to reduce demand by about 3GW by 2012 and a further 5GW by 2025 through an aggressive campaign that will include promoting solar-powered geysers (for water heating), as well as liquid petroleum gas for cooking. The government is also set to introduce a rationing scheme that will reward and penalise customers based on their energy usage.

There are some private initiatives, such as the 5.2MW Darling wind farm and Finavera Renewables' preliminary evaluation of a 20MW wave energy project worth around \$40 million. But attracting private investment on a large enough scale to make a difference needs a significant commitment from Eskom to purchase renewable energy. Meanwhile, the

“managed liberalization” of Eskom (privatising 30% of its assets, delinking transmission and creating a more flexible electricity market) to make more room for other power producers is progressing slowly and is unlikely to be completed in the near future.

Sustainable energy activity in South Africa has accelerated in 2007, which may be a sign that renewable energy in the country is finally taking off. Mirroring this, CDM activity in the country has started to pick up: 13 CDM projects are currently registered, up from five in September 2007, although this accounts for just 1% of global registered CDM projects. Key developments in 2007 include:

- Eskom’s pledge of R2 billion (\$268 million) in July 2007 to encourage roll-out of solar water heating systems
- Commissioning of the country’s first commercial wind farm, the 5.2MW Darling Wind Farm, in October 2007
- Approval of the government’s draft biofuels strategy in December 2007 – which sets a target of 2% of the country’s fuel from biofuels by 2013 (excluding maize as a feedstock because of food security concerns – although subsequent comments from the South African Department of Agriculture suggest that this restriction may be relaxed). Biofuels is expected to play a prominent role in South African renewables, with Ethanol Africa’s 473,000 litres/day Bothaville Bioethanol plant, the first of six planned plants, completed at the end of 2007.

This change of pace seems to be carrying through into 2008. In March 2008, Eskom signed an agreement with French development agency Agence Française de Développement (AFD) for a euro 100 million 20-year loan to help finance a 100MW wind farm project in Koekenaap, on the Western Cape, due to be in operation in early 2010. The Western Cape has also set an energy saving target of 500MW, to be achieved by using 2 million compact fluorescent lights and other efficiency measures. In February 2008, Ebrahim Rasool, premier of the Western Cape, said that the current “national energy emergency is having a severe impact” on both the economy and residents. His 500MW energy saving target will consist of 63MW to be saved by using compact fluorescent lights, 101MW to be saved by an extension of geyser load management systems and incentives, 55MW from the retrofitting of buildings, 20MW from the rollout of solar water geysers (for water heating), and 100MW from “consumer energy saving interventions”.

Rising interest in sustainable energy in South Africa is likely to have a positive effect on neighbouring Sub-Saharan African countries, particularly in biofuels. While South Africa has just 8.7 billion hectares of land suitable for feedstock cultivation, Angola, Zambia and Mozambique have respectively 22.1 billion, 24.1 billion and 31.1 billion hectares of land classified as very suitable or suitable.

## North Africa

Renewable energy in North Africa is focused on Morocco, Tunisia and Egypt, particularly in solar and wind. Morocco’s government aims to increase renewable energies’ contribution to the national energy balance to 10% by 2012 and 20% by 2020, and the country’s Office National d’Electricité (ONE) has pledged to reach 1GW of installed wind by 2012.

According to GWEC, Egypt added 80MW of wind capacity in 2007, taking installed capacity to 310MW, while Morocco doubled its installed wind capacity to 124MW. Several projects are in the pipeline. Iberdrola announced that two 100MW wind farms – Taza and Laayoun - in July 2007. In March 2008, tenders were invited for a 300MW wind farm, the Tarfaya Wind Project (in which French renewable energy company Theolia has expressed interest) and Nareva announced a 40MW project near Casablanca. And in November 2007, in Egypt, Italgas signed a Memorandum of Understanding with the Ministry for Energy and Electricity to explore building a 400MW wind farm in Gabal El Zeit on the country’s Red Sea coast. Feasibility studies are due to be completed by mid-2008. Egypt plans to install 7.2GW of wind capacity by 2020, 12% of the country’s power generation.

The use of solar water heating has been growing quickly in Tunisia, with 62,000m<sup>2</sup> installed in 2007, up 8 times from 2004 and interest now increasing in neighboring countries. North Africa is also attracting interest from large-scale solar developers, particularly for Solar Thermal Electricity Generation (STEG). In January 2007, Abener (the engineering arm of Abengoa, the Spanish infrastructure group that is emerging as a key player in STEG) won the tender to build, own and operate a 25MW parabolic trough solar and 130MW combined



cycle gas power plant in Algeria – Solar Power Plant 1 (SPP1). In June 2007, Abener was contracted to build the Ain-Beni-Mathar project in Morocco, which will consist of 20MW parabolic trough solar and 450MW natural gas capacity, due to be commissioned in December 2012. The contract, worth \$626 million (including around \$68 million for the solar component), has been financed by the African Development Bank (68%), the GEF (8%) and ONE (24%). These developments are promising, but most STEG projects remain at the planning / tendering stage, and there is a certain amount of skepticism as to when (or even whether) construction will begin.

However, recent developments in Egypt have raised hopes of other projects in the region also moving forward. After 15 years in planning, the combined 30MW solar and 120MW gas-fired power station at Kuraymat, Egypt saw engineering, procurement and construction (EPC) contracts signed in October 2007. The winners of the STEG part of the contract are not solar thermal specialists, but multinationals – Iberdrola (Spain), Mitsui (Japan) and General Electric (US). This contract is a major step forward in a region that has huge, but largely unexploited solar potential. According to Mitsui, the project will be completed 30 months after the contract comes into effect and, while many deadlines have been missed already, the involvement of experienced parties is promising.



# Special Focus: Energy Efficiency – Investment Status and Opportunities for Growth

# 12

- Energy efficiency measures could account for more than 65% of energy-related emissions savings up to 2030 (under the IEA's 2006 Alternative Policy Scenario), far more than the 22% saving expected from switching to nuclear and renewable energy.
- Financing energy efficiency capacity / installation can be challenging because of its asymmetrical benefits. Barriers to private investment include the industry's diverse and fragmented nature and the fact that much later-stage (capacity) investment is made internally by the beneficiaries of energy saving. However, ESCOs, white certificates and innovative financing, alongside initiatives from corporates and utilities, are helping to stimulate investment. Regulation and political support also have an important role to play.
- Investment in energy efficiency technology reached a record \$1.8 billion in 2007, an increase of 78% on 2006. Energy efficiency accounted for 18% of new VC/PE money flowing into the sustainable energy sector, second only to solar. Supply-side applications, such as smart metering and energy management technologies, saw a surge in early-stage investment (more than double 2006), although demand side technologies still raised marginally more money, particularly in transport and buildings. The demand side also dominated M&A activity in the sector.

Investment in energy efficiency has to be dealt separately from investment in renewables. True investment in energy efficiency is difficult to capture, since energy efficiency investments are often financed internally through the organisation's balance sheet and are not identified as an investment unless they are of significant scale. Secondly, the most important financial indicators associated with energy efficiency are not the up-front investments, but the costs savings over time from these investments. These demand side savings, and the further supply savings they create<sup>12</sup> are not measurable using New Energy Finance tracking techniques. Consequently, the figures presented in this report represent only a fraction of the real energy efficiency investment picture. However, the strong growth in measured external VC/PE investment in energy efficiency technologies and companies – up 306% between 2004 and 2007 – provides a good overall proxy of investors' expectations of the growth potential of the sector. This positive trend goes counter to the current rate of energy-savings improvements in OECD countries, which according to the IEA has fallen to less than 1% per year since 1990. This is a sharp decline from the rate achieved in the years immediately following the oil price shocks of the early 1970s.<sup>xii</sup>

Energy efficiency improvements since 1990 have nevertheless met 52% of new energy service demands in the world, while new energy supplies have contributed 48%.<sup>xiii</sup> Most analyses expect future efficiency improvements globally to be in the 1.4–2.2% range.

Given the very different nature of EE to renewable energy, this section also differs from the rest of the report in that it provides examples of approaches and vehicles targeted at scaling up investment in EE and highlights the need for public interventions to mobilise the flow of private capital into the sector.

## Corporate Equity Investment

The year 2007 saw record levels of corporate equity investment in energy efficiency technology companies, with venture capital/private equity investors pouring \$1.8 billion into energy efficiency (see Figure 49). Taking into account new investment only, energy efficiency represented 18% of new VC/PE investment, which was second only to solar (30%).

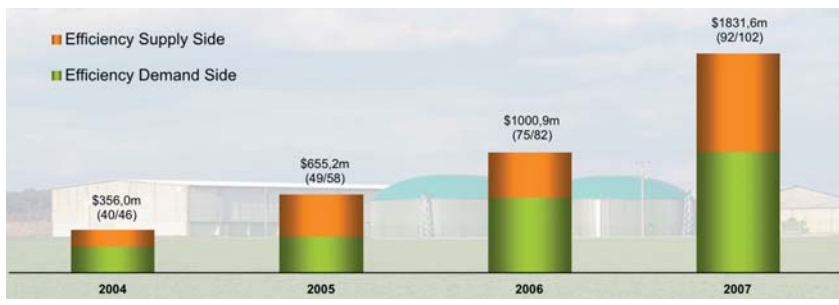
The share of total early-stage investment (including buy-outs) in energy efficiency has significantly increased. Prior to 2005, the amount invested in energy efficiency hovered at around \$400 million a year, increasing marginally during some years, while declining in

<sup>12</sup> According to the International Energy Agency (IEA), "on average, each additional \$1 invested (in energy efficiency) saves more than \$2 on the supply side".

others. Since 2005, however, VC/PE volumes have grown at an average of 75% a year.

Total new investment (VC/PE and Public Markets) in energy efficiency grew 72% in 2007 (compared with 50% in 2006) on the back of strong interest in efficiency technologies

Figure 49. Total VC/PE transactions in Energy Efficiency. 2004-2007



Note: Grossed-up values based on disclosed deals. The figure represents total venture capital and private equity transactions and includes PE buy-outs. OTC & PIPES are included with VC/PE. Numbers in brackets refer to (disclosed deals / total deals).

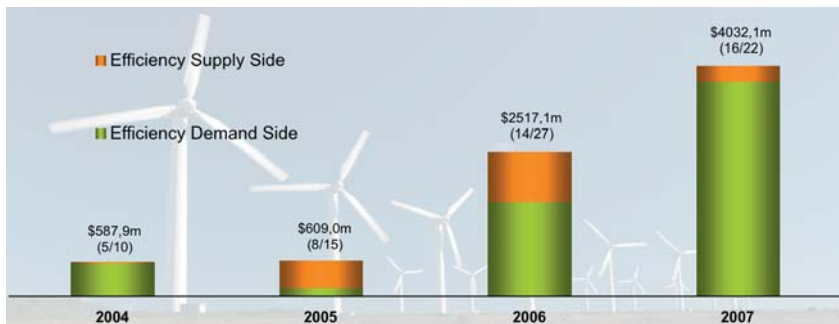
Source: New Energy Finance,

such as smart metering and energy management, including new stock market issues from demand response companies, whose shares have since declined along with the rest of the market. Energy efficiency M&A activity reached a record \$4.3 billion in 2007, putting the sector second only to wind (see Figure 50). Much of this reflected consolidation in the efficient lighting market.

investment during 2007, followed by Europe (although North America lags behind Europe in terms of energy efficiency regulation). Most of the energy efficiency investment that can be tracked is early-stage investment in technology companies. This reflects the sector's relative lack of maturity, with VC/PE investment exceeding public equity market investment.

However, the year 2007 did see a number of exits in the energy efficiency sector, through

Figure 50. Energy Efficiency Corporate M&A. in Energy Efficiency, 2004- 2007



Note: Grossed-up values based on disclosed deals. The figure represents corporate M&A only. Numbers in brackets refer to (disclosed / total deals)

Source: New Energy Finance,

North America attracted most energy efficiency both the public markets and via acquisition. There were two sizable exits from market leaders in demand response, both via secondary public deals: Comverge's offering included more than \$100 million of exits, and EnerNOC's \$380 million. EAGA Partnership went public allowing \$380 million in exits. Three notable M&A deals – all in the lighting segment - also gave investors profitable exits: Cambridge Display Technologies, who had raised \$175 million in VC/PE and \$30 million at IPO,

was acquired for \$285 million by Sumitomo Chemical in September 2007. Color Kinetics, who had raised \$40 million at IPO, was bought in August 2008 for \$732 million by Philips, who also acquired TIR Systems, who had raised \$30 million in VC/PE funding, for \$70.8 million.

### The Energy Efficiency Asset Finance Market

The largest energy efficiency investment needs and opportunities are for installing new energy efficient equipment and systems in end-use sectors: including residential, commercial, industrial, agricultural, transport, and utility applications. On average, only one-third of the world's primary energy consumption is converted to useful energy, and even less to useful services. Energy efficiency improvements -- extracting more useful services, light, heat, mobility, drive power, etc. from primary energy input -- require major capital investment in the full range of capital stock, from buildings, appliances, vehicles, industrial facilities, municipal infrastructure, power distribution, water pumping and more. These types of investments are defined as "Asset Finance" in this report, although as was

stated earlier, only the very small number that are externally financed are included in the data.

The IEA has also estimated in its World Energy Outlook 2006<sup>xiv</sup> that energy efficiency measures could account for more than 65% of energy-related greenhouse gas emissions savings up to 2030 under its Alternative Policy Scenario and in its WEO 2007 estimates that energy efficiency could save \$386 billion between 2006 and 2030 under the Alternative Policy Scenario (relative to the Reference Scenario). Cost-effective energy savings investments in lighting, heating and cooling, pumping, motors, cogeneration, control systems and other technologies can be realised today. Properly financed, they can pay for themselves through energy cost savings. Yet, the story of energy efficiency reveals a big gap between its economic and environmental potential – measured in billions of annual tons carbon and hundreds of billions in investment requirement -- and its commercial realisation.

Causes of the capital market gap for energy efficiency financing have been well-documented. Energy efficiency is not a single market, but constitutes a diverse range of end-user sectors, end-use equipment and technologies and, similarly, consists of very large numbers of small, dispersed projects. High pre-investment development and transaction costs, lack of customer awareness, complicated technical information requirements and long marketing cycles result in a relative paucity of investment-ready EE projects. Because projects can be self-financing from cost savings, financing is important to marketing energy efficiency. But because energy efficiency equipment is installed in the customer facilities and often lacks strong collateral value to serve as security, financing must be based on the creditworthiness of the energy user.

Asset finance requires debt type instruments, which are typically offered by commercial financial institutions, banks, and leasing companies. Opportunities for bond financing via capital markets also exist. While the total potential investment is huge, there is a need for market and project aggregation, grouped by end-use sector or technology. Energy efficiency financing is best approached programmatically, not project-by-project. A number of programmatic approaches have been put in practice, by energy service companies (ESCOs), utilities, development and commercial finance institutions, governments and associations of energy users. These approaches typically combine marketing and project development with innovative finance mechanisms. They can create vehicles for scaled-up investment in energy efficiency.

## **ESCOs**

An Energy Service Company (ESCO) is a business that develops, engineers and installs equipment and processes designed to improve the energy efficiency and maintenance costs for facilities, equipment and infrastructure in a variety of end-user sectors. The ESCO provides operations services, savings monitoring, and assumes certain performance warranties and risks for their projects. Its remuneration is contingent upon the success of the savings. ESCOs operate with a range of business models (guaranteed savings, shared savings, *chauffage*, build-own-operate-transfer). The ESCO sometimes provides or arranges financing for its projects, and when it does, the ESCO and/or its customers need debt financing from commercial financial institutions. ESCOs can form an important bridge between beneficiary and financier, especially in developing countries where finance is less accessible. Specialized ESCO project investment funds have been created, such as those managed by the Fondelec Clean Energy Group, Inc. Commercial banks have created multi-project finance facilities with ESCOs, and newly created infrastructure funds are including specialized sub-funds targeting energy efficiency and seeking ESCO relationships which can aggregate demand for capital.

## **Utility-based programmes**

Energy utilities - electric, gas, heat - can be effective agents and aggregators for marketing and delivering EE equipment, projects and financing. Utilities can contract with ESCOs to implement EE projects and deliver kW and kWh savings. Utilities can act as or establish financial intermediaries to finance EE projects for their customers. Or, utilities can partner with commercial financial institutions to deliver financing, and in some cases perform billing and collections functions to deliver credit cost-effectively and improve collections. All customer sectors can be targeted: large/small, commercial/industrial,



governmental, agricultural and residential. Utilities can benefit in many ways from EE and “demand side management” (DSM) investments on the customer side of the meter. Utilities in developed countries have many resources to bear on EE finance: strong balance sheets, marketing reach to thousands of customers, customer energy use data, billing and collections systems, and engineering and technical resources.

Financial incentives for utilities to essentially sell less energy can be created through regulation, e.g., “decoupling” the sales of electricity from the utility’s profits. California has implemented this approach, and Californian utility PG&E, for example, has 85 residential and commercial energy efficiency programs that have helped its customers save more than 118 million megawatt-hours of electricity and 10.7 billion therms of natural gas, equivalent to a saving of more than \$20 billion in energy costs. After more than two decades of relatively sustained DSM programs, California has per capita power use of 6700 kWh/year, compared to over 12,000 for the US national average.

According to a 2007 utilities global survey by PricewaterhouseCoopers (Energy and efficiency: The changing power climate, 2007) most utilities are investing in energy efficiency, however, only 25% of total respondents felt it was their responsibility, naming end users and governments as those who should take the lead. The survey goes on to say that the propensity to invest is highest in the US, where both the profile of and the scope for energy saving is very high.<sup>xv</sup>

### **Development and Commercial Financial Institution Programmes**

Development Banks are increasingly focusing on energy efficiency. The European Bank for Reconstruction and Development (EBRD) in 2007 channelled 89% of its \$1.21 billion sustainable energy budget into energy efficiency. Much of the money was invested in industrial efficiency, including the restructuring and modernisation of steel plants, cement facilities and glass factories in Russia and Ukraine. The Asian Development Bank (ADB) met its full 2008 energy efficiency financing target of \$1 billion in the first five months of the year. The World Bank Group of institutions has also been scaling up financing for energy efficiency, particularly through the use of credit lines and partial credit guarantees. In China, for example, the World Bank has long supported guarantees on loans to ESCOs, and the International Finance Corporation’s energy efficiency finance programme in China has recently been expanded to over \$350 million in credit enhancement facilities. IFC provides training to participating financial institutions to establish EE finance units, market financial services and source transactions.

### **Governments & Energy User Associations**

Governments and energy user associations can act as market aggregators by organising group procurements for energy efficiency equipment and ESCO services. State and local governments have performed this function for public sector entities and residential and private entities. Such programmes include a plan to organise and aggregate the target market and a finance mechanism that addresses institutional and credit characteristics of the target market.

### **White certificates and carbon finance**

White certificates have been introduced in several European countries, including Italy and France, and in some US states. White certificates, which are granted for specific energy consumption reductions (such as one per MWh), are usually tradable, although very little trading has taken place to date. The lack of a widely accepted measurement standard and verification process has hampered market development.

In India the Ministry of Power is launching a programme to capture the carbon emission reduction (CER) values from replacing incandescent with compact florescent lamps (CFLs) under the Clean Development Mechanism (CDM). CDM methodologies have been developed and the proceeds from sale of CERs will be sufficient to buy down the CFLs to a price equivalent to incandescents. Lighting manufacturers and electric utilities are participating in the program, which targets 400million incandescent bulbs over a five year program period, leading to a potential reduction of 20,000 MW of electricity demand, and a reduction of about 24 million tonnes of CO<sub>2</sub> emissions every year.

## **Need for Market Intervention**

Overall, many successful business models exist for scaling up energy efficiency investment and aggregating demand into a form that is commercially financeable. However, in many cases some level of public intervention and support is needed to correct market failures, organise the market and catalyse investment. Public investment in energy efficiency is justified given the public benefits from improved environment, health, energy development, security and enterprise competitiveness. Many successful models exist for public/private partnerships to promote expanded energy efficiency investment using commercial structures and market processes.

Appropriate regulation can improve the average energy efficiency of energy-consuming products by encouraging the purchase of high-efficiency and discouraging the purchase of low-efficiency products, and by encouraging the development of more efficient products than currently available. Public sector measures that can most effectively foster private investment in energy efficiency include standards and labeling. Standards prescribe the energy performance of manufactured products and prohibit the sale of less efficient ones than the minimum standard. Labels notify and inform consumers of a product's energy performance. Together they facilitate market growth and reduce financing risks by ensuring that new EE technologies have a rapid market impact. International cooperation on standards and labeling would create aggregated demand for energy efficiency products and services.

# References

- i. REN21. Renewables 2007 Global Status Report. Paris: REN21 Secretariat and Washington, D.C.: Worldwatch Institute. 2008.
- ii. UN Framework Convention on Climate Change. Investment and financial flows to address climate change. Bonn: UNFCCC. 2007.
- iii. The Economics of Climate Change: the Stern Review. Nicholas Stern. Cambridge, UK: Cambridge University Press. 2007.
- iv. UNFCCC Secretariat Financial and Technical Support Programme. Energy Subsidies: Their Magnitude, How they Affect Energy Investment and Greenhouse Gas Emissions, and Prospects for Reform. Trevor Morgan. Bonn: UNFCCC. 2007
- v. The World Nuclear Status Report 2007. Schneider, M., Froggatt, A. Brussels, London, Paris: January 2008.
- vi. International Energy Agency. World Energy Outlook 2007. Paris: OECD/IEA. 2007.
- vii. International Energy Agency. Energy Technologies Perspectives 2008. Paris: OECD/IEA. 2008.
- viii. McKinsey Global Institute, Curbing Global Energy Demand Growth: The Energy Productivity Opportunity, May 2007.
- ix. The World Bank. New Ways to Finance Development in Sub-Saharan Africa. World Bank Data & Research. Washington, D.C.: March 2008.
- x. The World Bank. Governance Matters 2007: Worldwide Governance Indicators 1996-2006. Washington, D.C.: The World Bank 2007.
- xi. The World Bank. The World Bank Data & Statistics. Atlas method. <http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf>
- xii. International Energy Agency. Energy Technology Perspectives 2008: scenarios and strategies to 2050. Washington, D.C.: 2008.
- xiii. Realizing the Potential of Energy Efficiency. Washington, D.C.: UN Foundation. 2007.
- xiv. International Energy Agency. World Energy Outlook 2006. Paris: OECD/IEA. 2006.
- xv. PricewaterhouseCoopers. Utilities Global Survey 2007. Energy and efficiency: The changing power climate. 2007.



## 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.

[www.newenergyfinance.com](http://www.newenergyfinance.com)





**Global investment in sustainable energy broke all previous records in 2007, with \$148.4 billion of new money raised, an increase of 60% over 2006. Total transactions in sustainable energy, including acquisition activity, was \$204.9 billion.**

**Asset finance – investment in new renewable energy capacity - was the main driver for this surge in investment, rising 68% to reach \$84.5 billion in 2007, fuelled mainly by the wind sector. Public market investment also raced ahead in 2007, with investment of \$23.4 billion in 2007, more than double the \$10.5 billion raised in 2006.**

**In early 2008, investment growth continues amid the turmoil in the global financial markets.**

**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 developed 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.**

**www.unep.org**

United Nations Environment Programme  
P.O. Box 30552 Nairobi, Kenya  
Tel.: +254-(0)20-762 1234  
Fax: +254-(0)20-762 3927  
E-mail: [unepubb@unep.org](mailto:unepubb@unep.org)



For more information, contact:

**UNEP DTIE  
Energy Branch  
Renewable Energy and Finance Unit  
Sustainable Energy  
Finance Initiative**

15 rue de Milan  
75441 Paris CEDEX 09  
France  
Tel: +33 1 4437 1450  
Fax: +33 1 4437 1474  
E-mail: [sefi@unep.fr](mailto:sefi@unep.fr)  
[www.sefi.unep.org](http://www.sefi.unep.org)  
[www.unep.fr/energy/finance](http://www.unep.fr/energy/finance)

**New Energy Finance Limited**

283-288 New Penderel House  
High Holborn  
London WC1V 7HP  
Tel: +44 20 7092 8800  
Fax: +44 20 7092 8801  
E-mail : [info@newenergyfinance.com](mailto:info@newenergyfinance.com)  
[www.newenergyfinance.com](http://www.newenergyfinance.com)

**ISBN:978-92-807-2939-9  
DTI/1066/PA**