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GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2010

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



UNITED NATIONS ENVIRONMENT PROGRAMME

Endorsed by



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FOREWORD

The sustainable energy investment story of 2009 was one of resilience, frustration and determination.

Resilience to the financial downturn that was hitting all sectors of the global economy and frustration that, while the UN climate convention meeting in Copenhagen was not the big breakdown that might have occurred, neither was it the big breakthrough so many had hoped for.

Yet also determination on the part of many industry actors and governments, especially in rapidly developing economies, to transform the financial and economic crisis into an opportunity for greener growth.

Let's look at the numbers: new investment in sustainable energy was \$162 billion in 2009, or some 7% down from 2008 figure of \$173 billion - an estimate revised up from the original \$155 billion made at the time.

Nevertheless 2009's figure was still the second highest annual investment total ever (and four times that seen in 2004) and spending on new capacity (including large hydro as well as other renewable) was for the second year running bigger than the investment in new fossil fuel capacity. This underlines that sustainable energy was not a bubble by-product of the ill-fated credit boom, but a global investment transition that is likely to strengthen over time.

In 2009, governments stepped in as never before - some \$188 billion of 'green stimulus' commitments began to be spent - and public banks like the European Investment Bank and Germany's KfW helped bridge the financing gap.

Supportive policies for clean energy expanded. According to REN21's Renewables 2010 Global Status Report the companion report to SEFI's Global Trends also launched today, over 100 countries had some type of policy target or promotion policy for renewable energy by early 2010. This represents more than half the countries in the world.

China for the first time took the top spot globally for overall sustainable energy investment in 2009, pushing the United States to second place: in 1999 China made 1% of the world's solar panels; by 2008 it was the world's leading producer with a 32% market share.

Last year, as export markets faltered, domestic demand surged, especially in the wind sector. The close-to-14GW of new wind capacity built in China during 2009 was nearly 15% of the total new generating capacity added to the grid.

The Copenhagen Accord, to which over 100 countries have now associated themselves, has brought developed and developing economies together for the first time on decoupling economic and emissions growth.

But there is a gap between the ambition and the science in terms of where the world needs to be in 2020 to avoid dangerous climate change by mid-century. Sustainable energy, from wind to geothermal and photovoltaic to solar thermal, can assist in bridging that gap if the right kind of green economy policies are accelerated and embedded internationally and nationally.

Achim Steiner

UN Under-Secretary General and UN Environment Programme (UNEP) Executive Director

TABLE OF CONTENTS

Foreword	5
List of Figures	7
Methodology and Definitions	8
Key Findings	10
Executive Summary	11
1. Overview of Investment Trends	15
1.1 Global Investment in Sustainable Energy	15
1.2 Investment in Technology	16
1.3 Investment by Geographical Region	18
2. Putting Sustainable Energy into Perspective	22
3. Research and Development	25
4. Venture Capital and Private Equity	27
5. Public Markets	30
6. Asset Financings	33
7. Corporate Mergers & Acquisitions	36
8. Investment Funds	39
9. Carbon Report	42
10. Investment in Developing Countries – China, India and Brazil	45
11. Investment in Developing Countries – Outside the “Big Three”	49
11.1. Other Asia	49
11.2 Other Latin America	50
11.3 Africa	51
12. Special Focus Chapter: Sustainable Energy and the Green Economy	53
Glossary	57
References	58

FIGURES

1 & 7. Global new investment in sustainable energy 2004-2009 (\$ billion)	11 & 16
2. Global transactions in sustainable energy, 2009 (\$ billion)	12
3 & 16. Renewable power generation and capacity as a proportion of global power, 2004-2009, %	12 & 22
4. SEFI global trends in sustainable energy investment 2009 data table (\$ billion)	13
5. Global financial new investment quarterly trend, Q1 2004-Q1 2010 (\$ billion)	15
6. Global acquisition transactions quarterly trend, Q1 2004-Q1 2010 (\$ billion)	16
8. Financial new investment by technology, 2009, and growth on 2008 (\$ billion)	17
9. Acquisition transactions by technology, 2009, and growth on 2008 (\$ billion)	17
10. VC/PE new investment by technology, 2009 (\$ billion)	18
11. Public markets new investment by technology, 2009 (\$ billion)	18
12. Asset finance new build by technology, 2009 (\$ billion)	18
13. Financial new investment by region, 2009 (\$ billion)	19
14. Financial new investment by region, 2004-2009 (\$ billion)	21
15. Acquisition transactions by region, 2004-2009 (\$ billion)	21
17. Adding up the climate pledges (global emissions in billion tons CO2-equivalent)	24
18. Change in power generation required in 2030 (GW)	24
19. R&D investment in sustainable energy, 2004-2009 (\$ billion)	25
20. Corporate and Government R&D investment by technology, 2009, and total growth on 2008 (\$ billion)	25
21. Corporate and Government R&D investment by region, 2009, and growth on 2008 (\$ billion)	26
22. VC/PE new investment by stage, 2004 - 2009 (\$ billion)	27
23. VC/PE new investment by stage, 2009, and growth on 2008 (\$ billion)	27
24. VC/PE new investment by sector, 2004-2009 (\$ billion)	28
25. VC/PE new investment by sector, 2009, and growth on 2008 (\$ billion)	28
26. VC/PE new investment by region, 2004-2009 (\$ millions)	28
27. VC/PE new investment by region, 2009, and growth on 2008 (\$ billion)	29
28. Public market new investment by stage, 2004-2009 (\$ billion)	30
29. NEX vs selected indices	30
30. Public market new investment by sector, 2004-2009 (\$ billion)	31
31. Public market new investment by sector, 2009, and growth on 2008 (\$ billion)	31
32. Public market new investment by region of exchange, 2004-2009 (\$ billion)	31
33. Public market new investment by exchange, 2009, and growth on 2008 (\$ billion)	32
34. Public market new investment by company nationality, 2009, and growth on 2008 (\$ billion)	32
35. Asset financing new investment by type of security, 2004-2009 (\$ billion)	33
36. Asset financing new investment by sector, 2004-2009 (\$ billion)	33
37. Asset financing new investment by region, 2004-2009 (\$ billion)	34
38. Acquisition transactions by type, 2004-2009 (\$ billion)	36
39. Acquisition transactions by sector, 2004-2010 (\$ billion)	36
40. Acquisition transactions by region 2009, and growth on 2008 (\$ billion)	37
41. Sustainable energy funds by focus and asset class, as at March 2010 (\$ billion)	39
42. Sustainable energy funds by asset class, as at March 2010, %	39
43. Sustainable energy public equity funds launched, 2004-2009, units	40
44. Value of carbon market 2005 - 2009 (\$ billion)	42
45. Forecasted value of carbon markets to 2010 (\$ billion)	42
46. Project submission to the CER pipeline, monthly number of projects and volume 2012, MtCO2e	43
47. CER project pipeline, number of projects at each stage, 2005-2010	43
48. CER credit issuances, volume by technology, 2005 - March 2010, MtCO2e/yr	43
49. New financial sector investment by country, 2009, and growth on 2008 (\$ billion)	45
50. Financial new investment in China by sector and asset class, 2009 (\$ billion)	46
51. Financial new investment in Brazil by sector and asset class, 2009 (\$ billion)	47
52. Financial new investment in India by sector and asset class, 2009 (\$ billion)	48
53. Financial new investment in non-OECD Asia (excluding China and India) by country, 2009 (\$ billion)	49
54. Financial new investment in South America (excluding Brazil) by country, 2009 (\$ billion)	50
55. Financial new investment in Africa by country, 2009 (\$ billion)	51
56. Annual profile of spending on clean energy stimuli (\$ billion)	54
57. Green stimuli by country (\$ billion)	54
58. Sector breakdown of global green stimuli (\$ billion)	54
59. Estimated world jobs under Greenpeace Reference Scenario (millions)	56
60. Estimated world jobs under Greenpeace [R]evolution Scenario (millions)	56
61. Cost estimates for seven oil spills 1967 - April 2010	56

METHODOLOGY & DEFINITIONS

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

The Bloomberg New Energy Finance Desktop collates all organisations, projects and investments according to transaction type, sector, geography and timing. It covers 32,500 organisations (including start-ups, corporates, venture capital and private equity providers, banks and other investors), 21,500 projects and 17,000 transactions.

METHODOLOGY

The following renewable energy projects are included: 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 0.5MW, all marine energy projects, and all biofuel projects with a capacity of 1m litres or more per year.

Energy efficiency investment includes financial investment in technology, plus corporate and government R&D. It excludes investment in energy efficiency projects by governments, companies and public financing institutions.

Where deal values are not disclosed, Bloomberg 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 statistics used are historic figures, based on confirmed and disclosed investment.

Annual investment in small-scale and residential projects, such as micro wind turbines and rooftop solar is estimated. These figures are based on annual installation data, provided by industry associations and REN21. In Chapter 1, we have also stated estimates for solar water heaters, which do not generate power and are therefore excluded from the main small-scale projects figure.

The figures on investment in small-scale projects in this report also do not include balance-of-plant spending such as the cost of putting solar panels on a roof. For these reasons, the statistics on small-scale projects may appear lower than those in other reports.

Bloomberg 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.

This 2010 report contains revisions to investment figures published in the 2009 UNEP Global Trends In Sustainable Energy Investment report. In particular, the total new investment figure for 2008 has been revised up from \$155 billion to \$173 billion. This, and changes to earlier years' figures, reflect improvements made by Bloomberg New Energy Finance to its calculations – including deep analysis of corporate and government research and development, and the inclusion for the first time of bridging loans and construction debt for renewable energy projects.



DEFINITIONS

Bloomberg New Energy Finance tracks deals across the financing continuum, from R&D funding and venture capital for technology and early-stage companies, through to debt and equity financing for renewable energy projects. Investment categories are defined as follows:

Venture capital and private equity (VC/PE): all money invested by venture capital and private equity funds in the equity of companies developing renewable energy and efficiency technology. Similar investment in companies setting up generating capacity through special purpose vehicles is counted in the asset financing figure.

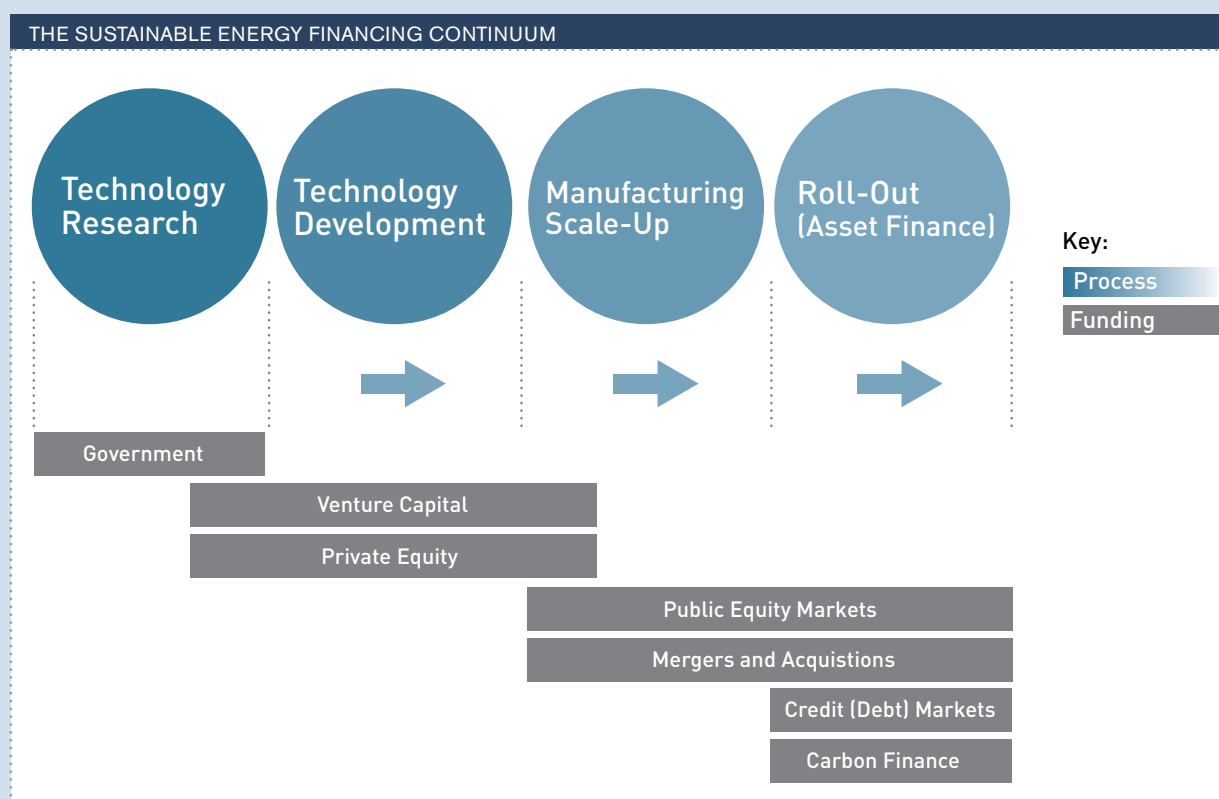
Public markets: all money invested in the equity of publicly quoted companies developing renewable energy technology, efficiency and clean power generation. Investment in companies setting up generating capacity is included in the asset financing figure.

Asset financing: all money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. This excludes re-financings.

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

To make it clear to which point in the financing continuum each of the investment sections refers, 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:





KEY FINDINGS

- **New investment in sustainable energy in 2009 was \$162 billion, down from a revised \$173 billion in 2008.** The 7% fall reflected the impact of the recession on investment in Europe and North America in particular, with renewable energy projects and companies finding it harder to access finance.
- **China saw a surge in investment. Out of \$119 billion invested worldwide by the financial sector in clean energy companies and utility-scale projects, \$33.7 billion took place in China, up 53% on 2008.** Financial investment in Europe was down 10% at \$43.7 billion, while that in Asia and Oceania, at \$40.8 billion, exceeded that in the Americas, at \$32.3 billion, for the first time.
- **Clean energy share prices rose almost 40% in 2009, reversing around a third of the losses they experienced in 2008.** The WilderHill New Energy Global Innovation Index, or NEX, which tracks the performance of 88 sustainable energy stocks worldwide nearly doubled to 248.68 from its low of 132.03 reached on 9 March 2009.
- **Major economies began to spend some of the estimated \$188 billion in “green stimulus” programmes they announced in the months after the collapse of Lehman Brothers in September 2008.** However the wheels of administration take time to turn, and even at the end of 2009, only some 9% of the money had been spent. Larger proportions of the stimulus funds are likely to be spent in 2010 and 2011.
- **Total investment in clean energy companies by venture capital funds was \$2.7 billion in 2009, down 36% on 2008.** VC players found it harder to raise new money, because of general investor caution and because exits were hard to achieve given the weakness of stock markets.
- **Research, development and deployment spending by governments and corporations totalled \$24.6 billion in 2009, with government R&D up 49% at \$9.7 billion and corporate RD&D down 16% at \$14.9 billion.** The shifts reflected greater willingness by governments to invest in research on sustainable energy technologies – to help generate economic activity – and also caution on the part of some big corporate players at a time when their profits were under pressure.
- **Private equity expansion capital of \$4.1 billion went into clean energy companies in 2009, down 45% on 2008 levels. The reasons for the fall, as with venture capital, were a shrinkage in available funds to invest, and a reduced risk appetite among some PE players.**
- **Public market investment in sustainable energy companies was \$14.1 billion, up slightly on the 2008 figure but a long way short of the record of \$24.6 billion achieved in 2007.** After a very slow start to the year in public markets, there were several large secondary issues by established wind and solar players, the restart of IPO activity in the late summer, and an IPO of \$2.6 billion by a Chinese wind project developer in December.
- **Asset finance of utility-scale renewable energy projects totalled \$100.9 billion in 2009, just slightly down from \$108.4 billion the previous year.** The highlights included a boom in Chinese wind project financings and the busiest year to date for offshore wind in the North Sea. Small-scale projects excluding solar water heaters, meanwhile, totalled \$18.1 billion, with a surge in German solar PV activity right at the end of the year the strongest feature.

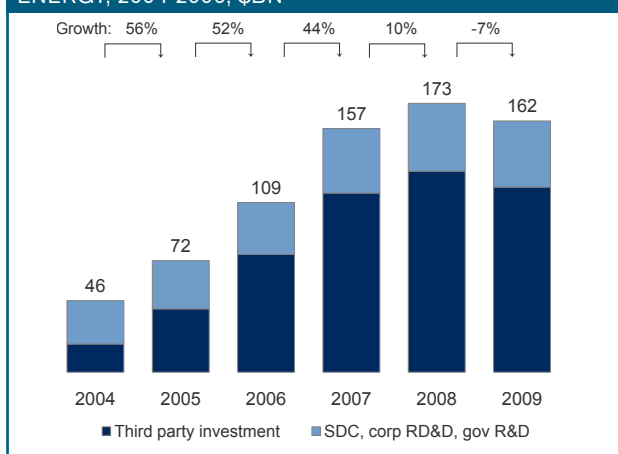
An overview of investment trends in sustainable energy in the early months of 2010 is shown in the box on page 14.

EXECUTIVE SUMMARY

Clean energy survived the first phase of the world economic downturn, in late 2008 and the whole of 2009, better than many had expected. After a slowing in investment activity in the final months of 2008 in the face of the banking crisis, and then a weak first quarter of 2009, sustainable energy enjoyed a rebound in investment during the final three quarters of last year.

“New investment reached \$162 billion in 2009, down from \$173 billion in 2008 but still the second highest annual figure ever and nearly four times 2004's total.”

FIGURE 1: GLOBAL NEW INVESTMENT IN SUSTAINABLE ENERGY, 2004-2009, \$BN



SDC = small distributed capacity. New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance

The end-result was that total new investment in sustainable energy worldwide reached \$162 billion in 2009, down from a revised \$173 billion for 2008 but still the second highest annual figure ever and nearly four times 2004's total (see Figure 1). This resilient performance showed that clean energy was not a bubble created by the late stages of the credit boom, but is an investment theme that will remain important for the years ahead.

With policy-makers increasing their focus during 2009 on encouraging the growth of the low-carbon economy, partly to create jobs and counter the forces of recession and partly to curb carbon emissions, the sector received plenty of fresh support. From the financial crisis of autumn 2008 until the spring of last year, major economies announced an estimated \$188 billion of "green stimulus" programmes, and that money started - gradually - to be spent. The US announced a grant

scheme to support renewable energy projects, and other places around the world – including Finland, Ontario, New South Wales, Ukraine, Serbia and the UK (for small-scale generation) - followed the examples of Germany, Spain and others in Europe by announcing feed-in tariff programmes to encourage investment in technologies such as wind and solar. The major development banks, led by Germany's KfW and the European Investment Bank, also became important actors in helping the sector to weather the storm and expand into new markets.

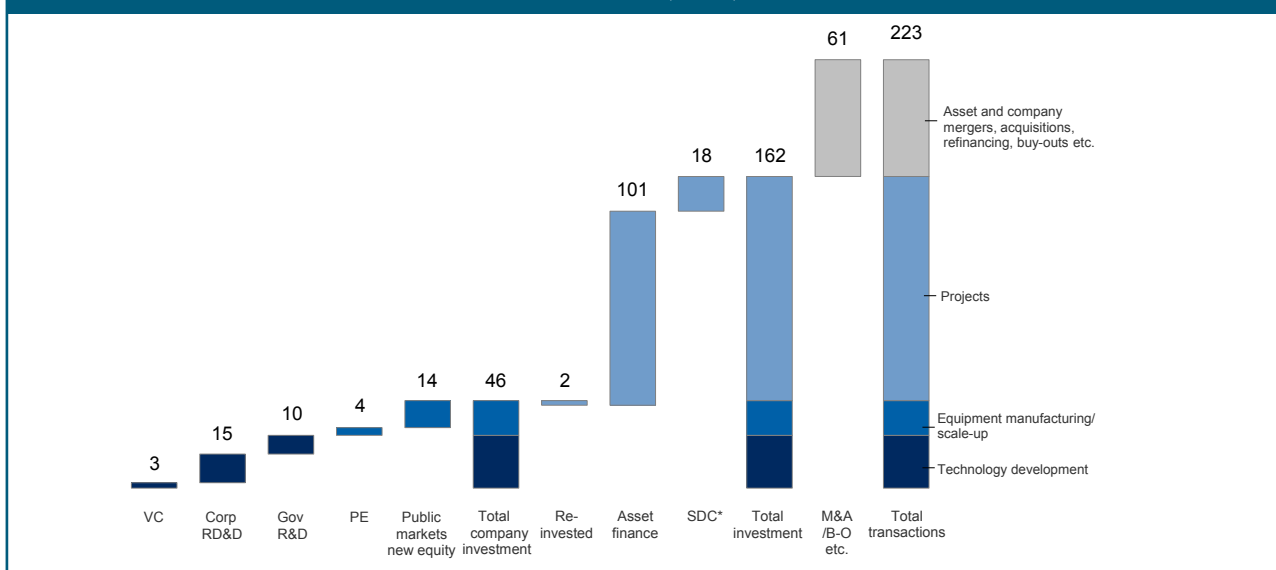
However, sustainable energy has often to cope with a bumpy path. The year closed with a mixed result at the Copenhagen climate change conference. Meanwhile, hopes of early passage for carbon cap-and-trade legislation in the US and Australia were not realised in 2009 – although progress remains possible in 2010 or 2011. Public support for sustainable energy remained intact in most countries, but action to curb emissions moved a few places down the list of priorities for some voters as a result of the recession, the controversies over climate science during the winter of 2009-10 and the cold weather that hit the most populated parts of the Northern Hemisphere around the same time. By the spring of 2010, as the box on page 14 explains, the sector was facing fresh challenges as a second phase of the economic downturn developed, with governments running into pressure to cut their deficits and volatility returning to markets.

The story of 2009, however, was one of resilience for sustainable energy. While there were areas of weakness such as project development in the US and finance for biofuel plants, there was also a decisive shift in the balance of investment towards developing countries and particularly China. Wind farm development in China was the strongest feature of the year by far, although there were other areas of strength in the world in 2009 such as offshore wind investment in the North Sea and the financing of power storage and electric vehicle technology companies. There was also a marked improvement in the cost competitiveness of renewable power generation compared to fossil-fuel electricity generation.

“By the spring of 2010, the sector was facing fresh challenges as a second phase of the economic downturn developed, with governments running into pressure to cut their deficits and volatility returning to markets.”

Figure 2 shows the breakdown of clean energy investment activity in 2009. New investment totalled \$162 billion, in addition to which there was \$61 billion worth of project

FIGURE 2: GLOBAL TRANSACTIONS IN SUSTAINABLE ENERGY, 2009, \$BN



SDC = small distributed capacity. Total values include estimates for undisclosed deals. * data based on estimates from various industry sources

Source: Bloomberg New Energy Finance, UNEP SEFI

acquisitions, buy-outs, refinancings and corporate M&A, all of which represent assets changing hands rather than new money coming into the sector.

Within the \$162 billion figure for new investment, there are several categories measuring money going into the development of sustainable energy technology, and into the building of new capacity including wind farms, solar parks and biofuel refineries.

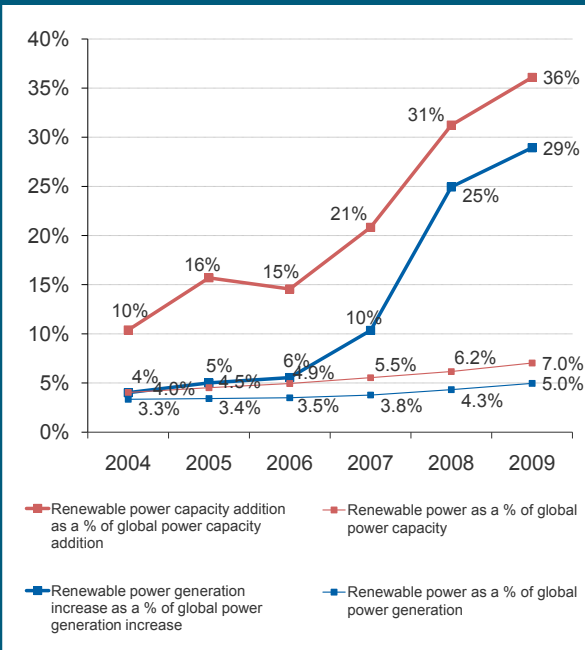
Starting at the left side of the Figure 2, some \$28 billion of investment went into the development of new technology for sustainable energy. This consisted of \$3 billion in the form of venture capital finance for young clean energy companies, and research, development and deployment, which attracted an estimated \$15 billion from established corporations and \$10 billion from governments.

The next category is equity investment in growing clean energy companies. This consisted of some \$4 billion of expansion capital injected by private equity funds, and \$14 billion committed to quoted sustainable energy companies by stock market investors.

That took the amount invested in technology and expanding companies combined to \$46 billion. Moving along the chart, the next items, after an adjustment of \$2 billion for reinvested capital, represent new investment in renewable power generation and biofuel production. Of this, asset finance of utility-scale projects totalled \$101 billion, and there was an estimated \$18 billion of capacity added in small-scale generation sources such as rooftop solar.

In 2009, this investment is estimated to have added some 50GW of renewable energy generation capacity worldwide, excluding hydro-electric. This was up from 40GW in 2008, and closing in on the figure of 83GW of fossil-fuel, thermal capacity installed in the same year.¹ If some 28GW of large hydro-electric capacity is added, the gap between renewable and conventional fossil-fuel capacity added shrinks to only 5GW or so. If the trend continues, then 2010 or 2011 could be the first year that new capacity added in low-carbon power exceeds that in fossil-fuel stations. Given the greater upfront capital cost of renewable energy per GW, it is likely that the value of investment in renewable energy capacity (excluding large hydro) in 2009 was comparable to that in fossil-fuel generation, at around \$100 billion each. If investment in some

FIGURE 3: RENEWABLE POWER* GENERATION & CAPACITY AS A PROPORTION OF GLOBAL POWER, 2004-2009, %



*Excluding large hydro. Renewable capacity figures based on known commissioned projects logged on the Bloomberg New Energy Finance desktop.

EIA, IEA, Bloomberg New Energy Finance

FIGURE 4. SEFI GLOBAL TRENDS IN SUSTAINABLE ENERGY INVESTMENT 2009 DATA TABLE, \$BN

Category	Year	2004 \$bn	2005 \$bn	2006 \$bn	2007 \$bn	2008 \$bn	2009 \$bn	2008-09 Growth %	2004-09 CAGR %
1 Total Investment									
1.1 New Investment		46	72	109	157	174	162	-7%	29%
1.2 Total Transactions		57	102	149	220	239	223	-7%	32%
2 New Investment by Value Chain									
2.1 Technology Development									
2.1.1 Venture capital		1.2	1.4	2.2	3.9	4.3	2.7	-37%	19%
2.1.2 Government R&D		4.3	4.6	5.1	5.9	6.5	9.7	49%	18%
2.1.3 Corporate RD&D		15.4	15.0	15.8	16.7	17.7	14.9	-16%	-1%
2.2 Equipment Manufacturing									
2.2.1 Private equity expansion capital		0.3	1.0	3.3	3.7	7.6	4.1	-46%	65%
2.2.2 Public markets		0.9	5.0	12.9	24.6	14.0	14.1	0%	74%
2.3 Projects									
2.3.1 Asset finance		15.8	33.4	58.7	89.2	108.4	100.9	-7%	45%
Of which re-invested equity		0.0	0.0	1.1	5.7	4.5	2.4		
2.3.3 Small distributed capacity		8.2	11.6	12.5	19.0	19.5	18.1	-7%	17%
Total Financial Investment		18	41	76	116	130	119	-8%	46%
Gov'n R&D, Corporate RD&D, Small projects		28	31	33	42	44	43	-2%	9%
Total New Investment		46	72	109	157	174	162	-7%	29%
3 M&A Transactions									
3.1 Private equity buy-outs		0.9	3.6	2.0	3.6	5.8	3.5	-39%	30%
3.2 Public markets investor exits		0.0	1.5	2.0	5.0	1.0	1.9	93%	167%
3.3 Corporate M&A		4.0	13.2	16.9	23.8	20.2	18.7	-7%	36%
3.4 Project acquisition & refinancing		5.4	11.8	18.5	30.3	38.7	36.6	-5%	47%
4 Financial Sector New Investment by Technology									
4.1 Wind		11.0	20.6	29.9	51.9	58.8	67.3	14%	44%
4.2 Solar		0.6	3.2	10.3	21.9	33.0	24.3	-27%	107%
4.3 Biofuels		1.5	6.0	19.7	19.7	18.4	6.9	-62%	36%
4.4 Biomass & Waste		2.4	6.2	9.0	11.5	9.4	10.8	14%	35%
4.5 Energy smart technologies		1.3	1.8	2.9	3.9	3.2	4.4	34%	28%
4.6 Small Hydro		0.5	1.9	2.0	3.5	4.2	3.8	-9%	48%
4.7 Geothermal		0.8	0.4	1.2	1.6	2.2	1.5		
4.8 Low carbon services & support		0.0	0.6	0.7	1.3	0.4	0.3	-41%	46%
4.9 Marine		0.0	0.0	0.5	0.4	0.1	0.2	110%	66%
Total		18	41	76	116	130	119	-8%	46%
5 Financial Sector New Investment by Geography									
5.1 Global									
5.1.1 Europe		9.2	18.7	28.1	48.4	48.4	43.7	-10%	37%
5.1.2 North America		4.6	11.3	27.1	32.9	33.3	20.7	-38%	35%
5.1.3 South America		0.5	2.8	4.5	8.0	14.6	11.6	-21%	91%
5.1.4 Asia & Oceania		3.7	7.9	14.9	24.4	31.3	40.8	30%	61%
5.1.5 Middle East & Africa		0.2	0.2	1.5	2.0	2.1	2.5	20%	61%
Total		18	41	76	116	130	119	-8%	46%
5.2 Selected Developing Countries/Regions									
5.2.1 Brazil		0.4	1.8	4.0	6.7	12.8	7.8	-39%	85%
5.2.2 China		0.9	2.6	7.2	13.3	22.1	33.7	53%	105%
5.2.3 India		1.1	2.8	3.7	4.7	3.4	2.7	-21%	19%
5.2.5 Africa		0.2	0.1	0.6	1.2	1.0	0.9	-12%	34%

New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Source: Bloomberg New Energy Finance, UNEP SEFI

28GW of large hydro-electric is included, then total investment in renewables exceeded that in fossil-fuel generation for the second successive year, and the gap in favour of renewables was greater than in 2008.

New investment in sustainable energy did not quite match 2008's revised figure of \$173 billion, and ended up falling \$11 billion short. However, the drop was much smaller than appeared likely in the early part of 2009, when the stricken condition of banks in Europe and the US was threatening to stem the flow of debt finance to renewable energy projects and stock markets remained effectively closed to fundraising by companies, including those in clean energy. Fortunately for the sector, investors and lenders started to recover their nerve from the second quarter of 2009 onwards and the vanguard

of major economies' \$188 billion of "green stimulus" spending started to arrive in the sector later in the year.

As Figure 4 shows, the 7% drop in total new investment in sustainable energy disguised a variety of changes for different types of transaction. Venture capital investment fell 36% in 2009 as fund managers found themselves running short of money to invest because of a shortage of exits and difficulty in raising fresh money from investors. VC players were also cautious about committing equity to new firms when there was an increased likelihood that existing portfolio companies might need to raise additional rounds from their shareholders rather than carrying out an initial public offering. Private equity expansion capital also saw a reduction in its commitment to the sector last year, of 45% - for many of the same reasons. The

fierce competition in some renewable energy technologies, such as solar, wave and tidal, made VC/PE investors hesitate, although there was increased interest in other areas, including energy efficiency and power storage.

Government research, development and deployment expenditure increased by an estimated 49% in 2009. Administrations made efforts to boost promising technologies in their countries at a time when other sources of finance were in short supply for the companies concerned. However, research, development and deployment (RD&D) spending by large corporates fell by an estimated 16%, in response to the squeeze on their profits during the recession.

Public market investment in clean energy companies held steady in 2009 at the same level as 2008, although this was still down 43% on the 2007 peak. Some technologies, such as biofuels, were squarely out of favour for stock market investors last year, but there was a readiness to support secondary issues by established players in wind and solar, including a \$1.1 billion rights issue by Vestas Wind Systems. The \$2.6 billion IPO by Chinese wind project developer Longyuan Power in December showed the confidence of investors in that country. There was also strong interest in power storage, with US firm A123 Systems executing a successful \$371 million IPO and Hong Kong listed electric car and battery firm BYD seeing its shares gain 427% in the year.

Asset finance of renewable energy projects fell 7% in 2009. However, there was a wide geographical variation, with China seeing a spectacular increase in wind project financing, while US project development stalled in the face of a shortage of capital. Utilities spearheaded a take-off in the financing of offshore wind schemes in the North Sea in 2009, enabling the UK - previously a laggard in the renewable power stakes - to claim third spot in the world for clean energy investment behind China and the US.

The figures for overall new investment in clean energy, at the bottom of Figure 4, show that China increased its commitment in 2009 by 53% to \$33.7 billion. This reflected not just the dynamism of investors and the effectiveness of feed-in tariff and auction mechanisms in that country. There was also a deliberate strategy by Beijing to encourage clean energy deployment as a way of creating jobs and building world-leading manufacturing capability.

Energy-smart technologies such as power storage and efficiency were another notably strong feature of 2009, accounting for \$2.3 billion of public markets investment and \$2.1 billion of venture capital and private equity investment. For the first time, energy-smart technologies attracted more VC/PE investment than any other clean energy sector.

INVESTMENT IN 2010

The early months of 2010 were a mixed period for sustainable energy investment. The sector found itself out of the limelight, following the inconclusive Copenhagen conference at the end of the previous year. Clean energy share prices underperformed wider stock markets by around 10% in the first four months of the new year. Although oil prices were buoyant, prices of electricity and natural gas stayed low, cramping returns for project developers.

As the year wore on, many governments in developed countries were under pressure to cut back on deficits exacerbated by the recession and by emergency fiscal programmes to support their economies. The squeeze was particularly apparent in euro area countries such as Greece, Portugal and Spain, and it put a question mark over the ability of some administrations to maintain the same level of support for renewable power. Meanwhile, continuing volatility in financial markets was affecting the ability of clean energy companies to raise equity finance, and several initial public offerings had to be postponed in the spring of 2010. However, overall investment levels in H1 2010 showed once again the clean energy sector's resilience.

Nevertheless, new financial investment in clean energy totalled \$65 billion in the first half of 2010, some 22% up on the same six months of 2009. The Q1 and Q2 totals, at \$33 billion and \$32 billion, were very similar to the figures for the final three quarters of 2009 and well up on the Q1 2009 low.

China was again the leading country for investment, but there was also an uptick in asset finance in the US. It rose to \$8.4 billion in H1 2010, from \$5.9 billion in the first half of 2009. Europe however showed a sharp fall, reflecting the fact that, whereas there were several large offshore wind financings in the first six months of 2009, large deals were few and far between in January-June 2010.

Investment in clean energy companies via the public markets and from venture capital and private equity players also rose in the first half of 2010. VC/PE investment was up 65% at \$5.2 billion in H1. Among the bigger deals was a \$350 million Series B round for US electric vehicle infrastructure firm Better Place and a \$219 million expansion capital round for Brazilian wind firm Energimp. Public market investment came in at \$4.7 billion in the first half of this year, up from the dismal \$3.5 billion recorded in H1 2009.



OVERVIEW OF INVESTMENT TRENDS

- Global investment in clean energy was \$162 billion in 2009, down 6% from a revised \$173 billion in 2008. The setback reflected the impact of the financial crisis and world recession.
- However the overall figure for last year disguises a gradual recovery from a low-point in investment activity in the first quarter of 2009.
- The highlight of the 2009 figure was a spectacular performance from China, which saw a 53% rise in financial investment in clean energy, helping to offset weaker numbers from Europe and particularly North America.

1.1 GLOBAL INVESTMENT IN SUSTAINABLE ENERGY

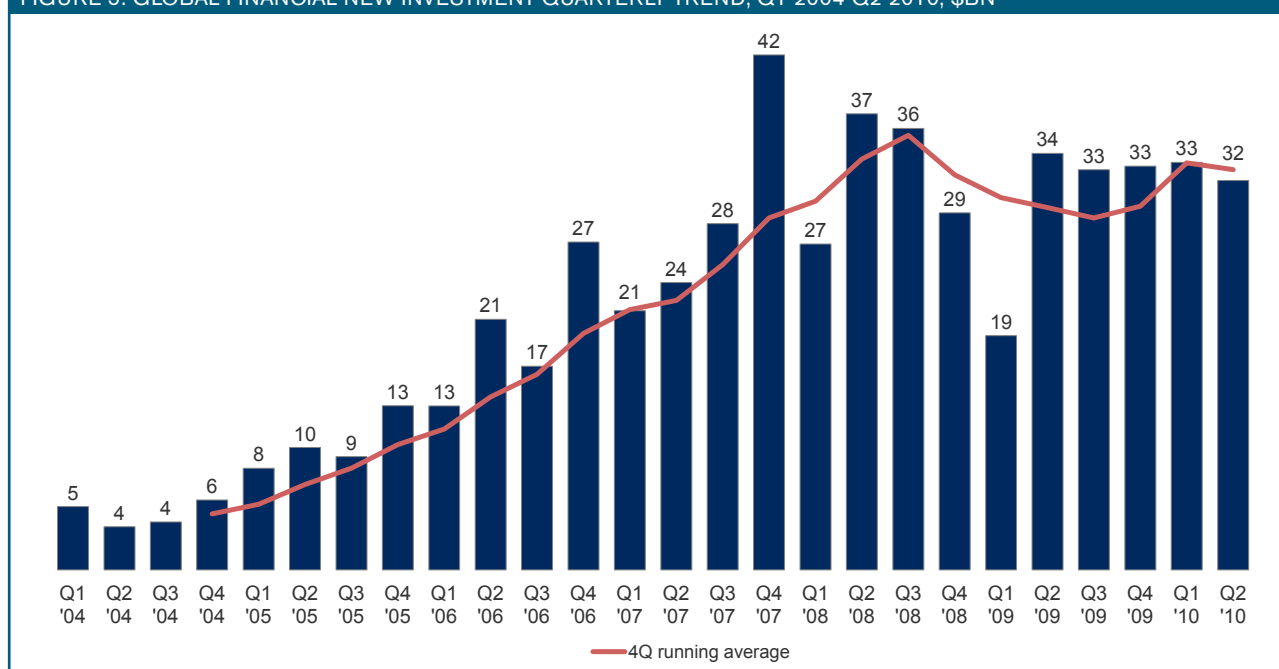
Global new investment in sustainable energy reached \$162 billion in the year 2009, the second highest figure ever, after 2008's revised \$173 billion (see Figure 7). Although the 2009 figure was down by 7%, it was higher than the \$157 billion achieved in 2007, at the height of the world economic boom, and it was nearly four times the 2004 total of \$46 billion.

The setback in sustainable energy investment was relatively mild given the severity of the world economic downturn and the caution that the banking crisis and stock market fall created among many types of investors. The quarterly pattern for new financial investment in clean energy (defined as total investment minus corporate and government research and development and small-scale projects) shows that the first quarter of 2009 marked the bottom for the clean energy sector.

Figure 5 shows that financial investment in Q1 2009 was \$20 billion, down from \$29 billion in Q4 2008 and \$28 billion in the same quarter a year earlier. However the second and third quarters of 2009 showed increased activity, with financial investment at \$34 billion each, down just \$2 billion or so from the equivalent quarters in 2008. The Q4 2009 number, at \$31 billion, was a modest \$2 billion higher than that a year earlier, and the first three months of 2010 showed a year-on-year rise of around 70%.

The gradual recovery of investment since the darkest days of the financial crisis in the autumn and winter of 2008-09 has reflected the sustainable energy sector's strong fundamental growth trend, support from world governments via incentive programmes and "green stimulus" packages, and a partial return of confidence for investors and lenders. However both of the latter remain more cautious than before the crisis - share prices for clean energy companies in the second quarter

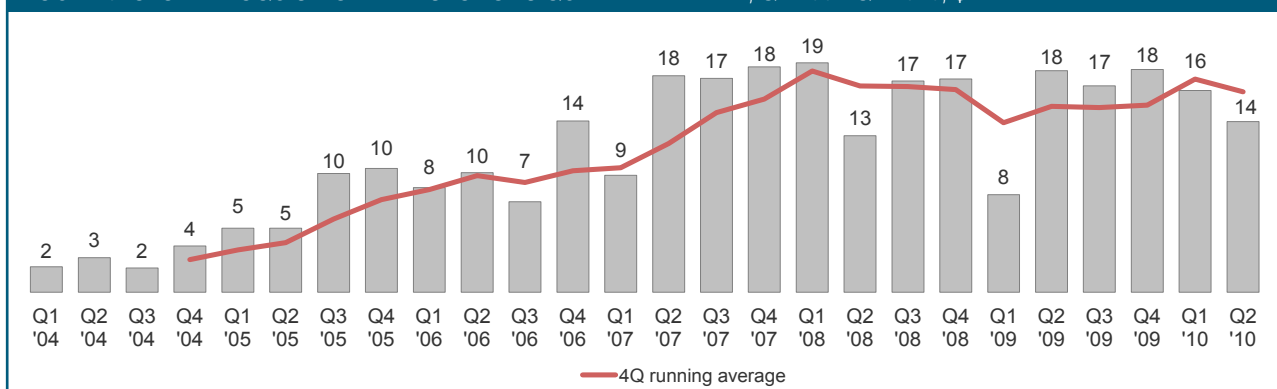
FIGURE 5: GLOBAL FINANCIAL NEW INVESTMENT QUARTERLY TREND, Q1 2004-Q2 2010, \$BN



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

Source: Bloomberg New Energy Finance

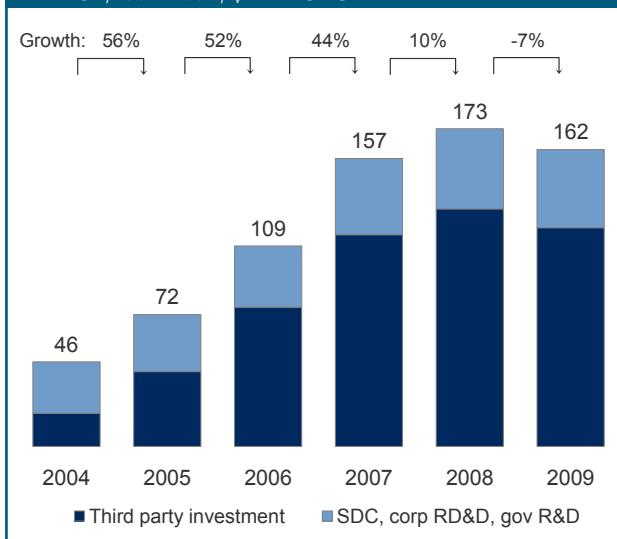
FIGURE 6: GLOBAL ACQUISITION TRANSACTIONS QUARTERLY TREND, Q1 2004-Q2 2010, \$BN



Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance

FIGURE 7: GLOBAL NEW INVESTMENT IN SUSTAINABLE ENERGY, 2004-2009, \$ BILLIONS



Source: Bloomberg New Energy Finance

of 2010 were, on average, only about half their peak levels of late 2007, and bankers in Europe and North America have been taking longer to approve loans to renewable energy projects. China (see section 1.3 below) has been the biggest single contributor to sustainable energy investment in the last year.

Acquisition activity is an important element in sustainable energy, although since it represents money changing hands rather than net new money coming into the sector, it is not included in the new investment totals above. Figure 6 shows that acquisition transactions, including corporate mergers and takeovers of clean energy companies and the purchase of projects, were also at a low level in the first quarter of 2009. However acquisition transactions picked up from \$8 billion in that quarter to \$17 to \$18 billion in each of the three succeeding quarters, as buyers took advantage of lower valuations than had prevailed before the recession. Acquisition activity in Q1 2010 was \$16 billion, some \$8 billion higher than in the same quarter a year earlier although below Q1 2008's record of \$19 billion.

1.2 INVESTMENT BY TECHNOLOGY

Wind was even more dominant as a destination for investment in 2009 than in the previous year. In 2008, it accounted for \$59 billion or 45% of all financial investment in sustainable energy, but in 2009, its share rose to 56%. Total financial investment in wind last year was \$67 billion, compared with \$119 billion for all sustainable energy technologies.

The strength of wind reflected several developments. One was the financial go-ahead for a number of large offshore wind farms in the North Sea, notably the 1GW London Array, the 317MW Sheringham Shoal project and the first, 165MW phase of Belwind. Another was that, in uncertain economic and financial circumstances, wind was seen as a relatively mature, and therefore lower risk, sub-sector of clean energy than some others. The biggest initial public offering of the year in clean energy was the \$2.6 billion flotation of wind project developer Longyuan Power. The fact that such a large IPO was for a project specialist is a hint that the biggest contributor of all to wind's performance in 2009 was exceptional growth in the financing of new generation capacity in China (see section 1.3).

The year was very different for solar. Previously seen as the most dynamic sub-sector in clean energy, and one with huge long-term potential, solar suffered a 27% fall in financial investment in 2009, to \$24 billion, just 20% of the total for all sub-sectors compared to 25% in 2008. There was more to the setback for solar than meets the eye, because one of



the main reasons was the behaviour of prices along the PV module value chain.

Between the third quarter of 2008 and the end of 2009, PV module prices fell by some 50%, as the whole industry from the production of solar-grade silicon to the fabrication of wafers, from the making of cells to the assembly of panels, shifted suddenly from excess demand to excess supply. Additional production capacity came on stream at the same time as demand weakened in the recession. With PV prices falling so sharply, it was no surprise to see the dollar value of financial investment in solar also falling. The good news was that with module prices dropping, more MW of solar PV could be installed for each dollar of investment.

However this was not the only reason for the weakness of the solar investment figure in 2009. Another was a new caution on the part of venture capital and public market investors towards buying equity in young solar companies. A third was a shortage of bank debt finance for projects in both Europe and North America – a problem that also affected progress with wind farms. A final reason was that Spain, the most active solar market in 2008, saw a slump in PV project investment as lower tariffs and a temporary freeze on permits for new capacity kept developers at bay. On the other hand, there was activity in Spanish solar thermal electricity generation projects, with financings for several 50MW installations, from Acciona, Iberdrola and others.

The third and fourth largest sub-sectors of sustainable investment are biofuels, and biomass and waste-to-energy. The notable feature of 2009 for these two was that they swapped positions in terms of financial investment volumes. Biofuels, which ranked third after wind and solar in 2008 with \$18 billion of financial investment, ended up fourth last year with just \$7 billion. Biomass and waste-to-energy, which was fourth in 2008 with \$9 billion, moved up to third in 2009 with \$11 billion.

The biomass sector's resilience, like that of wind, owed much to being a relatively mature technology at a time of investor nervousness. There were some large financings such as for American Renewables' 100MW Nacogdoches biomass incineration plant in Texas, but the majority of this sub-sector's financial investment was spread between a multiplicity of small projects.

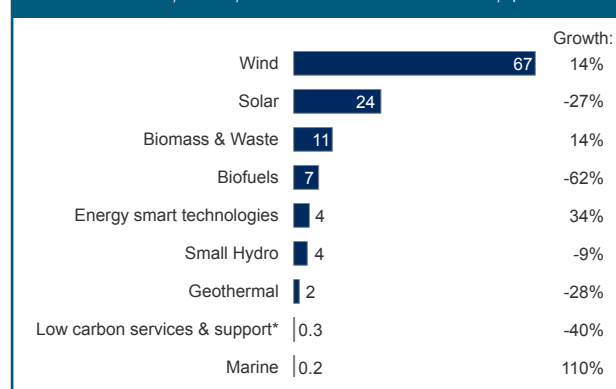
Biofuels found itself hitting bottom in 2009, after its dramatic fall from grace in 2007-08. The problems that emerged in those years from high feedstock prices and over-capacity gave way to balance sheet difficulties last year. The biggest investment by far of 2009 in biofuels was Neste's EUR 670 million biodiesel plant near Rotterdam in the Netherlands. Other would-be biofuel project developers found it hard to find banks able and willing to lend to them, and in Brazil, several existing biofuel companies found themselves struggling with dollar-denominated debts that had risen in local currency terms. Meanwhile investors were even more loath to buy equity in young biofuel companies than in 2008, even those involved in developing cellulosic technologies.

Among the smaller sub-sectors of sustainable energy, small hydro (plants of 50MW or less) saw a 9% fall in financial investment to \$4 billion, while energy-smart technologies enjoyed a 34% rise to the same figure. Geothermal suffered a 28% drop in financial investment in 2009, to \$2 billion, while marine saw a doubling in investment but only to a relatively insignificant \$246 million (see Figure 8).

The financial crisis left its mark on all the smaller renewable generation sub-sectors. In marine, the main problem was a shortage of venture capital finance for young wave and tidal technology companies. In small hydro, projects in India, China, Brazil and other parts of the developing world went ahead but investors were more cautious than in 2008 in the face of financial market weakness. Energy-smart technologies bucked the trend, benefitting from intense investor interest in electric cars and the smart grid. The IPO of US energy storage company A123 Systems, raising \$371 million, was one of the highlights.

Figures 10 and 11 show that energy-smart technologies outweighed all the renewable energy sectors in terms of

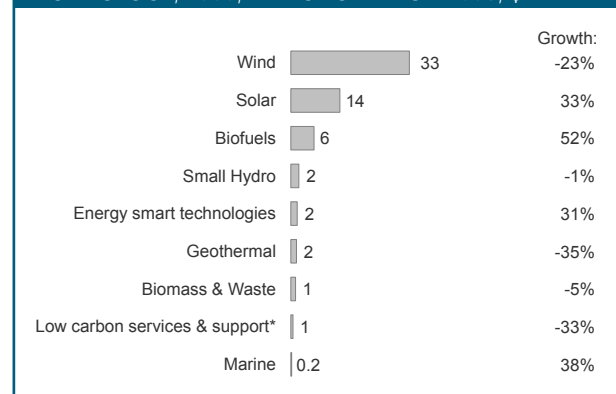
FIGURE 8: FINANCIAL NEW INVESTMENT BY TECHNOLOGY, 2009, AND GROWTH ON 2008, \$BN



New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. * Includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

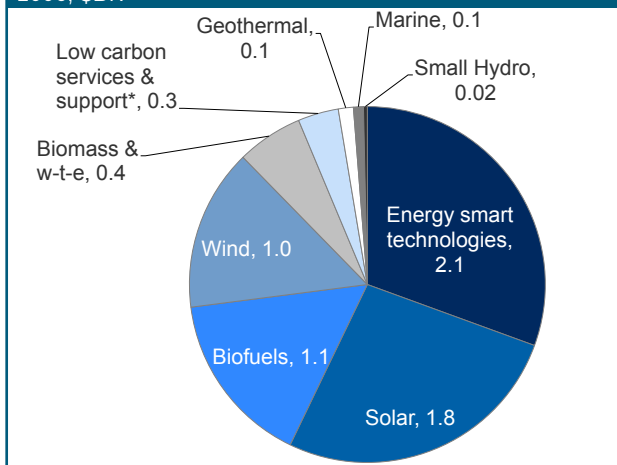
FIGURE 9: ACQUISITION TRANSACTIONS BY TECHNOLOGY, 2009, AND GROWTH ON 2008, \$BN



Total values include estimates for undisclosed deals. * Includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

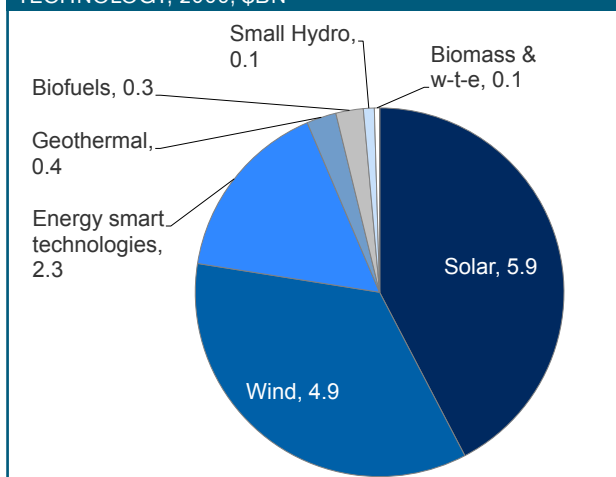
FIGURE 10: VC/PE NEW INVESTMENT BY TECHNOLOGY, 2009, \$BN



VC/PE new investment excludes PE buy-outs. Total values include estimates for undisclosed deals. * Includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

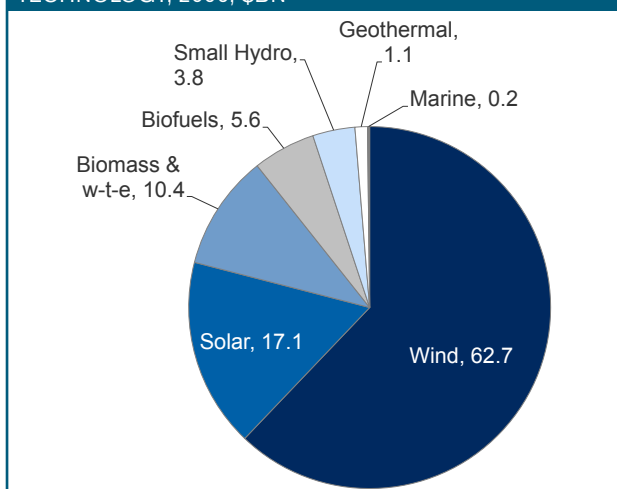
FIGURE 11: PUBLIC MARKETS NEW INVESTMENT BY TECHNOLOGY, 2009, \$BN



* Includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

FIGURE 12: ASSET FINANCE NEW BUILD BY TECHNOLOGY, 2009, \$BN



Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP SEFI

venture capital and private equity investment in 2009, and came third behind solar and wind in terms of public markets investment. Figure 12 shows the largest component of financial investment in clean energy - asset finance. Wind was by far the leading sector, with \$62.7 billion worth of projects clinching finance.

1.3 INVESTMENT BY GEOGRAPHICAL REGION

The most intriguing aspect of sustainable energy in 2009 was, arguably, the shift in the focus of this up-and-coming industry from Europe and North America, to Asia. Last year, Europe maintained its position as the region with the largest share of world financial investment in clean energy - but only just. Its total came in at \$43.7 billion, down from \$48.4 billion in 2008.

It was challenged hard for the top spot, but not by North America. Instead Asia and Oceania produced a sharp increase in financial investment in 2009, to \$40.8 billion from \$31.3 billion. Meanwhile, North America suffered a fall in investment, to \$20.7 billion from \$33.3 billion (see Figure 13). South America saw investment slip to \$11.6 billion from \$14.6 billion, while the Middle East and Africa enjoyed a modest increase to \$2.5 billion in 2009, from \$2.1 billion.

The shift in regional power reflected to a large extent the varied severity of the impact of the recession on different parts of the world. Asian GDP held up better in the face of the financial crisis and the contraction in world trade in the fourth quarter of 2008 and first quarter of 2009 than did output in the Western Hemisphere. In both Europe and North America, the availability of finance for renewable energy projects shrunk significantly during the winter of 2008-09, and its cost relative to official interest rates increased. Banks found themselves with less long-term finance to deploy on renewable energy, and their credit committees became more cautious. In the US, the supply of tax credit finance for wind and solar projects dried up.

"Green stimulus" programmes were announced by most of the leading economies, including the US, China, Japan and the big European Union members. However in most nations, the money took time to get through government administrative machinery and by the end of 2009, the bulk of the funds remained unspent. Instead in Europe, utilities, established energy groups and public sector banks such as the European Investment Bank increased in importance last year, and were particularly active in large-scale projects in areas such as offshore wind and solar thermal electricity generation.

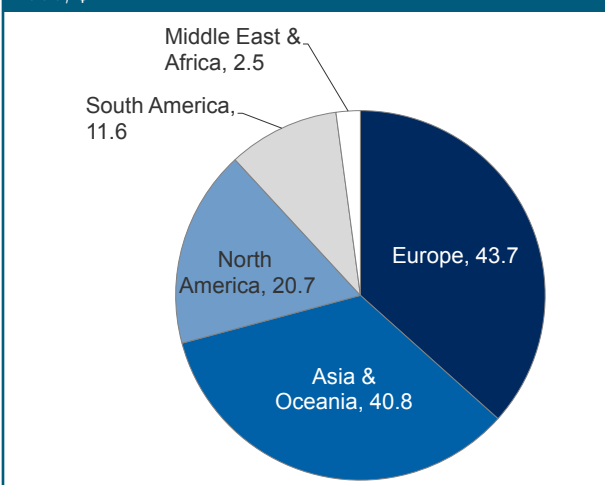
In the US, there was hope that the Obama administration's grant programme for renewable energy projects would fill the void left by the disappearance of tax equity, but the new money started to come through only gradually. Meanwhile natural gas prices at only a third of their 2008 peak made utilities drive a hard bargain on power purchase agreements, and this made

some renewable energy developers hesitate before committing themselves to new projects.

The landscape was very different in Asia and Oceania. The banks there sustained less damage from the crisis than they did in the US or Europe. In some countries such as Australia, this was thanks to effective regulation, in others it reflected the fact that local banks were not exposed to a property crash. However the main reason for Asia-Oceania's investment growth was China, where an expansionary economic policy spurred bank lending and government measures encouraged the development of large renewable energy projects, such as wind "mega-bases". There was official backing for the building of wind and solar generating capacity as a way of bolstering the domestic manufacturing industry, as well as adding to energy security and the availability of power. The Hong Kong and Chinese stock exchanges were also more fertile ground than those in the US and Europe for renewable energy companies wanting to raise fresh equity finance. The largest initial public offering of the year, by far, was Longyan Power's \$2.6 billion flotation in December 2009. Overall, new financial investment in sustainable energy rose 53% to \$33.7 billion.

South America saw no such boom, although there was evidence of increased interest in wind in particular, in Brazil and many other countries. Investment in ethanol in Brazil and biodiesel in Argentina had been buoyant in 2007-08 but suffered in 2009 as a result of the balance sheet problems of some producers, and the effect of weaker oil prices and recession on export demand.

FIGURE 13: FINANCIAL NEW INVESTMENT BY REGION, 2009, \$BN



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

Source: Bloomberg New Energy Finance, UNEP SEFI



SUSTAINABLE ENERGY IN THE US

US clean energy investment in 2009 was \$17 billion, down 45% from 2008 levels. The US lost the top spot among the G-20 for the first time in the past five years. Further declines were avoided as long-term extension of production and investment tax credits, and initial funding from the stimulus bill spurred financing.

Investors continued to look to Congress for passage of climate/energy legislation that would provide long-term certainty for investment, although as of early summer 2010, the chances of that happening in the near future looked uncertain.

The US performance in sustainable energy investment in 2009 was mixed. It continued to dominate world venture capital and private equity financing of new technologies, its figure of \$3.7 billion vastly outweighing everyone else including second-placed Brazil, at \$0.9 billion. Public market investment in clean energy companies in the US totalled \$3.6 billion, the second highest in the world after China. But the area where the US fell short, in particular, was asset finance of wind farms, solar parks and other projects, where its total of \$10.7 billion was far behind China's \$29.2 billion.

The weak showing in asset finance reflected the shortage of bank and tax equity finance, noted above. By the end of 2009, the US was still the world's leading country in terms of installed renewable energy capacity, excluding large hydro. Its total stood at more than 53GW, but China was fast catching up, only around 1GW behind. Germany stood third with around 36GW and Spain fourth with 22GW.

Some of the US' largest proposed schemes ran into delays in 2009, including T Boone Pickens' planned 4GW Pampas wind project in Texas. Instead, there were a large number of medium-sized projects financed including the first phase of the 500MW Whispering Willow wind farm in Iowa and the 16MW solar PV project at Davidson County, North Carolina.

SUSTAINABLE ENERGY IN THE UK

The UK has a well-established position as a laggard within Europe in the building of sustainable energy capacity. Its slow progress contrasts with that of countries such as Germany, Spain and Denmark, and comes despite enviable natural resources, particularly in wind and wave and tidal energy. With 6.8% of total electricity coming from renewables including large hydro in 2009, the UK was well behind the European average of around 18%.

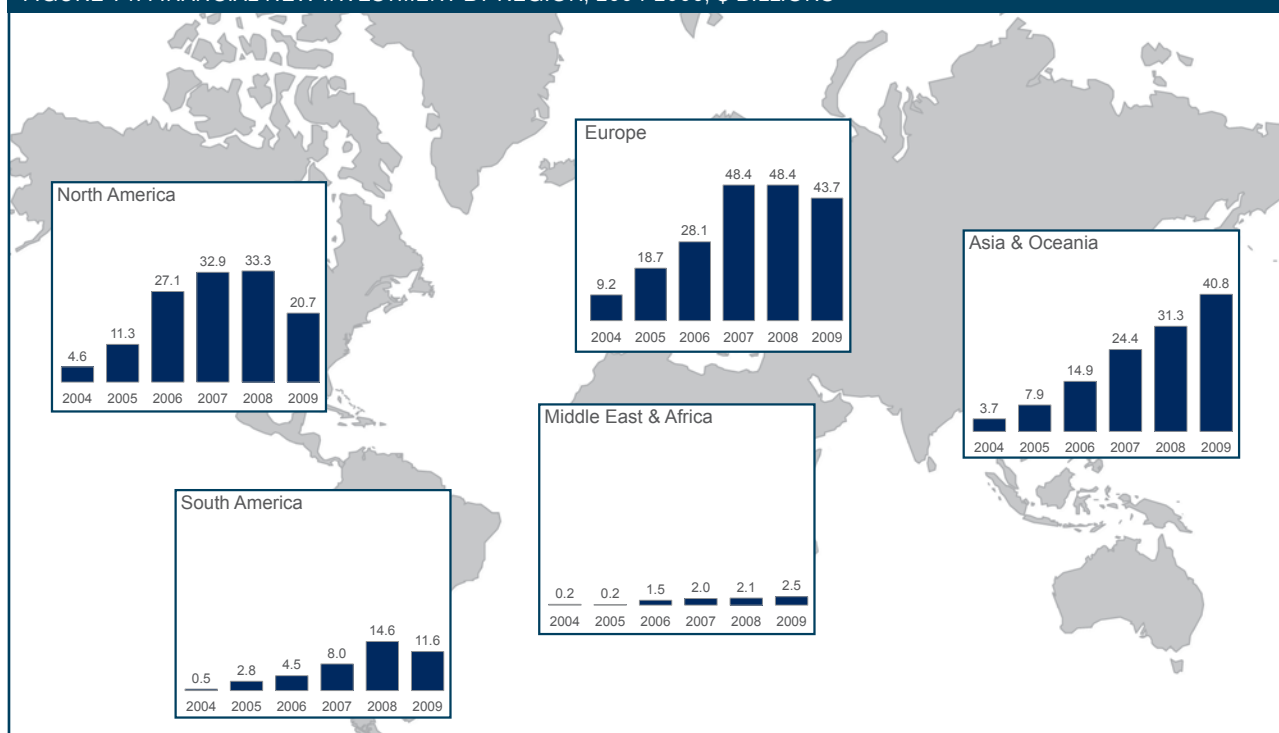
However all is not gloom. In fact, last year suggested that the UK is finally starting to catch up in terms of sustainable energy deployment. Among the steps forward was approval for a 130MW extension to Europe's biggest onshore wind plant, the 322MW Whitelee scheme in Scotland. 2009 also saw progress in offshore wind, with the financial go-ahead achieved for several projects including the 1GW London Array, the 317MW Sheringham Shoal and the 367.2MW Walney Island. The biomass and waste-to-energy sector was also active, with the financing of the 100MW Ineos Runcorn plant and the 500MW biomass co-firing facility at Drax.

Also encouraging were the developments on policy. The UK government introduced banding to its Renewable Obligation Certificate scheme in April 2009, offering bigger incentives to offshore wind and marine energy than to more mature technologies such as onshore wind and landfill gas-to-energy. The 2009 UK Budget earmarked GBP 405 million to help manufacturers of low-carbon products, further boosted the ROC incentive for offshore wind in the next few years, and additional cash help for carbon capture and storage projects selected as a result of the government's carbon capture and storage (CCS) competition.

Legislation was passed for the start of a feed-in tariff in April 2010 for small-scale renewable energy generation by homes and businesses, and this regime is expected to result in a sharp increase in deployment, particularly of rooftop solar panels. All three of the main political parties backed pro-sustainable energy policies in the May 2010 election, with the establishment of a Green Investment Bank one of the key proposals.



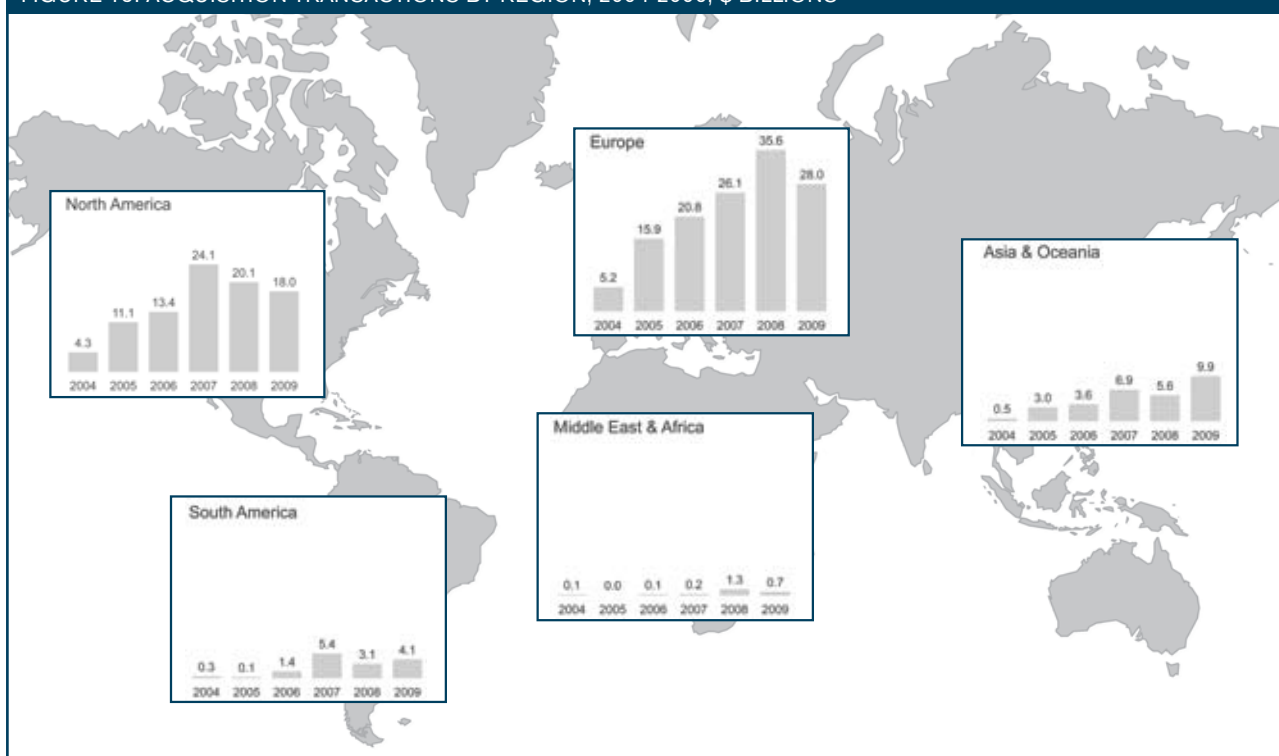
FIGURE 14: FINANCIAL NEW INVESTMENT BY REGION, 2004-2009, \$ BILLIONS



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

Source: Bloomberg New Energy Finance, UNEP SEFI

FIGURE 15: ACQUISITION TRANSACTIONS BY REGION, 2004-2009, \$ BILLIONS



Note: Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP SEFI

PUTTING SUSTAINABLE ENERGY INVESTMENT INTO PERSPECTIVE

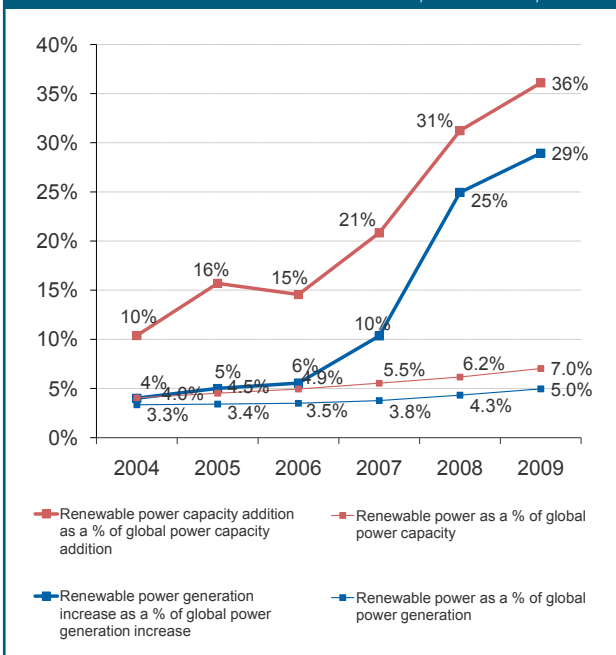
- The \$162 billion of new sustainable energy investment in 2009 is significant compared with levels of investment in other energy sectors, but it is still modest in relation to the broader economy and the overall long-term challenge of addressing climate change.
- This investment helped increase the amount of installed renewable energy power capacity globally to 1230GW (with hydro) and 245GW (without), equivalent to 25% and 7%, respectively, of total installed generation capacity.
- In the EU and the US, wind accounted for 39% of newly installed power capacity, while China again doubled its wind capacity with an addition of 13.8GW in 2009.
- Although the size of the clean energy industry is now similar in Europe, North America and Asia, the rate of growth is far higher in emerging markets and this has been reflected in investor sentiment in the last two years.
- In 2009 China moved ahead of the US as the country with the highest financial investment in clean energy, and Brazil moved into second spot, behind the US, in venture capital and private equity investment.

During 2009 renewable technologies continued to strengthen their leadership position amongst energy options, both in terms of dollars invested and GWs installed. This is particularly the case for the power sector, where renewables, including hydro, now attract more investment than new fossil-fuelled generation. Energy efficiency has also been an increasing area of interest, with energy smart technologies for the first time in 2009 attracting more VC and private equity investment than any of the renewable energy technologies.

In OECD countries, however, the leadership that the finance sector had shown previously in building out the sector waned somewhat as a result of the credit crunch. This was shown in the depressed state of clean energy stocks compared with their 2007 peaks, and by the shift from non-recourse project finance led by banks to on-balance-sheet finance by utilities. While the developed world remains bogged down by broader economic instabilities, the emerging markets and particularly China have forged ahead, the latter country taking top spot in overall clean energy investment in 2009 for the first time. And yet, within the context of climate change, the response to the challenge of shifting globally to a low-carbon path is still in early stages of development.

Installed non-hydro renewable energy power generation capacity increased in 2009 to 245GW, enough to power an estimated 75 million households and equivalent to 7% of global power capacity (see Figure 16). In the EU, new renewables (small hydro, modern biomass, wind, solar and geothermal), accounted for more than 60% of new capacity installed. It is estimated that approximately 78GW of renewable power generation was installed globally in 2009, of which 50GW was new renewables, and 28GW was large hydro. Low-carbon options are closing the gap with conventional thermal generation, which saw about 83GW added globally in 2009. Several countries now meet a significant share of their

FIGURE 16: RENEWABLE POWER* GENERATION & CAPACITY AS A PROPORTION OF GLOBAL POWER, 2004-2009, %



*Excluding large hydro. Renewable capacity figures based on known commissioned projects logged on the Bloomberg New Energy Finance desktop.

EIA, IEA, Bloomberg New Energy Finance

electricity demand with wind, including Denmark (20%); Spain (14%), where wind overtook coal for the first time in 2009; and Germany (6%).ⁱⁱ The wind sector on its own accounted for 39% of new power generation in both the EU and the US, making it the largest newly added source of capacity in both regions. Solar PV accounted for 16% of all new power capacity additions in Europe last year and an estimated two million German households now have PV systems generating power on their rooftops.

If the trend continues, then 2010 or 2011 could be the first year that new capacity added in low-carbon power exceeds that in added fossil-fuel stations. Given the greater upfront capital cost of renewable energy per GW, it is likely that the value of investment in renewable energy capacity (excluding large hydro but including small-scale projects), at some \$112 billion, was some 20% below investment in fossil fuel generation. However, if some \$39 billion of large hydro investment is included, then for the second year running, total investment in renewable energy exceeded that in fossil fuel capacity.

Including large hydro, renewable power capacity (1230GW) comprises about one-quarter of global generating capacity (estimated at 4800GW) and supplies about 18% of global electricity production. But even as renewables start to take a significant share of the energy mix, their position within the economy as a whole remains modest. It is striking how poorly clean energy companies are represented among the world's largest stocks by market capitalisation. The \$162 billion of new clean energy investment in 2009 was significant, but small when compared with some other aggregates: it was 7% of the size of the UK economy, for example, and only a quarter of a percentage point of the world economy at market exchange rates. On the other hand, \$162 billion is equivalent to 37% of the investment made by the oil and gas industry last year, or 52% of IEA projected annual power generation investment needs out to 2030.ⁱⁱⁱ

In terms of profitability, clean energy companies are also pretty small fish. Vestas made net income of EUR 579 million in 2009, a small fraction of the profits achieved by market leaders in other sectors such as Exxon (\$19.3 billion), Microsoft (\$14.6 billion) or Roche (\$7.8 billion). So while the clean energy sector may look quite big to those inside it, it is in a different, and lower, league than some of the large global industries. On the other hand, it is growing rapidly while many of the other sectors are expanding much more slowly, and one would expect that differential to be reflected in market capitalisations. Annualised growth in investment in sustainable energy since 2004, despite the modest setback in 2009, has been more than 30%, while overall gross capital formation

in the US economy, for example, has only increased at an annualised rate of 2.5% during that time.

Yet that pace of growth in clean energy is not particularly obvious from the stock market ratings of many of its largest companies. In the second quarter of 2010, Vestas shares were on a historic price-earnings ratio of 19, and First Solar, champion of a particularly fast-growing segment within the PV industry, was on a historic multiple of 17. The average multiple for the US S&P 500 index was also around 17 times historic earnings.

The message appears to be that investors do not expect leading clean energy companies to grow at the same rate that the sector as a whole did between 2004 and 2009 or suspect that overall sector growth will slow sharply compared with the average in previous years. Certainly, in 2008 growth in investment slowed to just 5% and in 2009 went into reverse. Those years, however, saw the deepest world recession in more than 50 years, and other sectors were hit at least as hard, if not harder. For example, oil and gas investment fell 16% in 2009 according to IEA estimates.

Although sustainable energy companies still battle for recognition (and valuations) in developed countries, their role within the developing world seems clearer. Since 2004 developing country investment in sustainable energy has increased from \$3.2 billion to \$50.7 billion, rising from 18% to 42%, respectively, of global investment. China, Brazil and India ranked first, fifth and eighth in the world, together attracting \$44.2 billion in 2009, which represented 37% of global financial investment in clean energy.

Asia, and more specifically China, has been leading the charge. China for the first time took the top spot globally for overall clean energy investment in 2009, pushing the US to second place. In 2009, Chinese financial investment in clean energy reached nearly \$33.7 billion, almost double America's \$17 billion, primarily due to domestic policy support. The top 10 wind turbine manufacturers globally in 2009 included three Chinese firms, Sinovel (third), Goldwind (fifth) and Dongfang (seventh). With the exception of GE Wind (US) and Suzlon (India), European and Chinese firms dominate the turbine manufacturing sector. In the solar PV industry, manufacturers from mainland China also figure prominently, with 45% of global production and three firms in the top 10. In 1999 China made 1% of the world's solar panels; by 2008 it was the world's leading producer with a 32% market share, and its solar-panel exports were valued at \$15 billion. To put that in perspective, in 2009 America's number one export product by far was civilian aircraft, with exports of \$35 billion.

The US is also on the verge of losing its leadership position in installed renewable energy capacity, with China surging in the last several years to a virtual tie. According to the Global Wind Energy Council, China added some 13.8GW of wind in 2009. This was nearly 15% of the total capacity added from all sources in 2009 and lifted installed Chinese wind capacity



to second top position in the world, at 25.8GW on Global Wind Energy Council figures.^{iv}

Beyond China, other emerging markets were also advancing, particularly Brazil and India. Although Brazil is mostly known for biofuels, a sector that has seen difficult times, investment in the wind sector took off in 2009, more than trebling to \$2.2 billion. Brazil was the second largest market, after the US, for VC/PE activity and the country intends to become a major source of financing for renewable energy projects across the developing world. The national development bank BNDES is already one of the largest providers of project finance to the renewable energy industry globally.

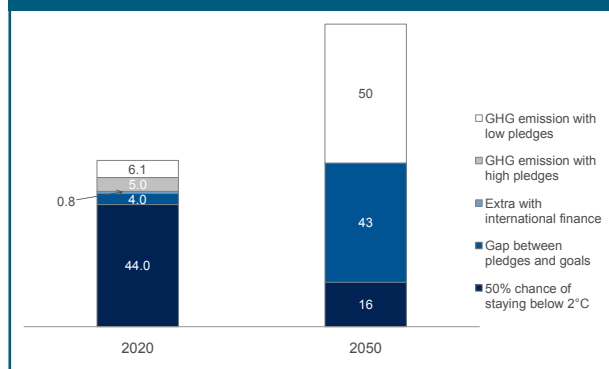
Aggressive policy targets are part of the reason for the overall shift southwards, with developing countries continuing to enact an increasing number of targets. China aims for 21% of electricity from renewables (up from 17% in 2008) and 17% of final energy from renewables (up from 10% in 2008), even as total energy demand continues to grow at nearly double digit annual rates. China also greatly increased its previous existing target of 1.8GW solar PV by 2020, to 10GW by 2020, and also plans to achieve 100GW of wind power by 2020.^v

India's current five-year plan targets 14GW of added renewables by 2012, and Brazil aims to maintain or increase its existing shares of energy and electricity from renewables through 2030. Thailand increased its renewable energy target to 20% by 2022 and the Philippines national plan calls for 4.5GW of new renewable power capacity during the period 2003–13. Kenya plans for 4GW of geothermal by 2030.^{vi}

This growing policy momentum for upscaling low carbon energy options in the developing world lends some cause for optimism within the climate negotiations. Going into the COP15 negotiations in Copenhagen developed country governments were pledging to reduce emissions in absolute terms and developing countries were pledging to reduce their emissions growth. As shown in Figure 17, when these combined pledges are added up, and if they can actually be met, then the gap to achieving a 2C maximum increase goal is only 4Gt (gigatonnes) in 2020, although the gap is more than 10 times as big as that in 2050.

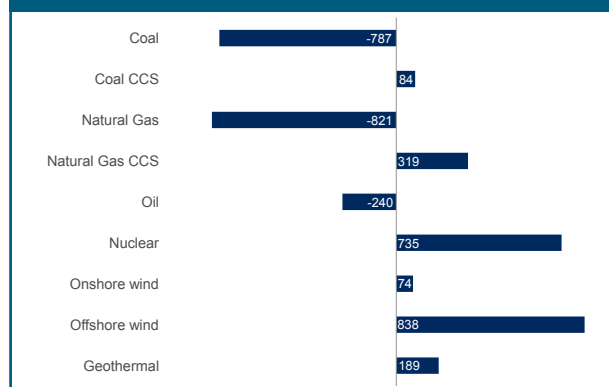
Analysis by Bloomberg New Energy Finance, using its Global Energy and Emissions Model, suggests that to reduce world CO₂ emissions from currently around 42 gigatonnes (Gt) a year to 39Gt by 2030, would mean that global investment in renewable energy assets would have to rise from just over \$100 billion in 2009 to \$500 billion by 2030. Heavy investment would be required in technologies such as offshore wind, where some 838GW might be added by 2030, and geothermal, contributing an extra 189GW (see Figure 18). The estimates in the chart come from a simulation based purely on current economic considerations. In reality, given strong policy support and improving economics, solar would also be an important beneficiary of this switch. A carbon price of \$100-a-tonne might also be needed by 2030 to provide incentives for electricity generators and utilities to increase efficiency and

FIGURE 17. ADDING UP THE CLIMATE PLEDGES (GLOBAL EMISSIONS IN BILLION TONS CO₂-EQUIVALENT)



Source: UNEP Climate Pledge

FIGURE 18. CHANGE IN POWER GENERATION REQUIRED IN 2030 (GW)



Source: Bloomberg New Energy Finance GE2M analysis

move from inefficient, fossil-fuel plant to low-carbon capacity, especially based on renewables.

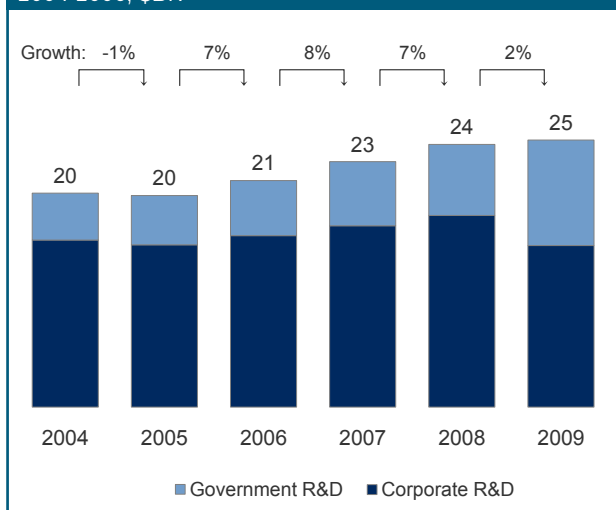
In contrast to the sums required, the Copenhagen Accord, agreed to at COP15 in December 2009, committed developed countries to provide developing countries with \$30 billion of fast-start public funding for the period 2010–12, and to work towards mobilising \$100 billion per year by 2020 from public and private sources. This climate finance is intended to cover just the incremental costs of carbon abatement actions.

Even these pledges would be a significant increase from today. The World Bank estimates that climate finance to developing countries, including both public funding and the Clean Development Mechanism, at present totals less than \$10 billion annually.

RESEARCH & DEVELOPMENT

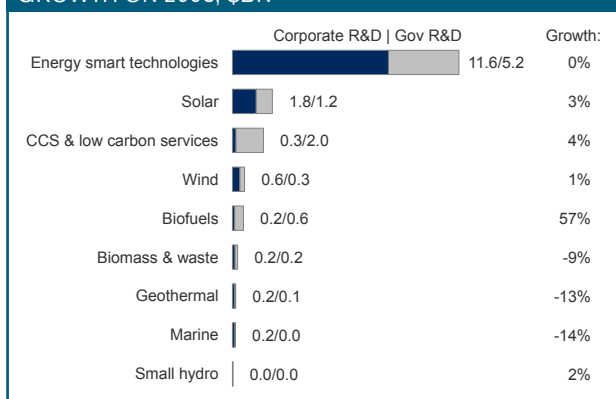
- Global research, development and deployment spending on clean energy technology grew to \$24.6 billion in 2009, up by \$0.4 billion (2%) on the previous year. The global recession restricted the contribution of private sector RD&D investment, which fell to \$14.9 billion in 2009, down from \$17.7 billion in 2008.
- Increased public sector spend on RD&D more than compensated for the fall in private sector investment, increasing from \$6.5 billion in 2008 to \$9.7 billion in 2009 as governments increasingly acknowledged the role technology will play in helping them to meet emission reduction commitments.
- Investment in RD&D was heavily weighted towards energy-smart technology, which accounted for \$16.8 billion (68%). Solar received the second highest level of funding with \$3 billion.
- Europe was the largest player in clean energy RD&D with \$11.7 billion of investment in 2009, followed by the US with \$7.4 billion.

FIGURE 19. R&D INVESTMENT IN SUSTAINABLE ENERGY, 2004-2009, \$BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

FIGURE 20: CORPORATE AND GOVERNMENT R&D INVESTMENT BY TECHNOLOGY, 2009, AND TOTAL GROWTH ON 2008, \$BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

In spite of the reduced overall investment in sustainable energy by the private sector in 2009 compared with the previous year, total global spending on clean energy research and development grew to \$24.6 billion in 2009, up by \$0.4 billion (2%) on 2008 (see Figure 19). Private sector RD&D investment fell by \$2.8 billion during 2009, largely due to corporate caution and funding constraints during the global recession, but this was more than offset by the increase in public sector spend.

Combined state spending on clean energy RD&D rose from \$6.5 billion in 2008 to \$9.7 billion in 2009, an increase of 49%. This increased public sector expenditure coincided with a number of governments making emission reduction commitments immediately prior to the COP 15 meeting in Copenhagen in December 2009. Technology will undoubtedly play a major role in helping governments to deliver on these commitments and their activity in research has increased correspondingly. There has also been a realisation by many governments that clean energy is an important growth sector for the future, and that RD&D effort may assist their countries in establishing industries on home soil.

The major economies' "green stimulus" programmes, announced from the collapse of Lehman Brothers onwards and amounting to some \$188 billion, played a crucial part in the increase in government RD&D spending. Research and development accounted for 14% of this "green stimulus" total, or \$27.1 billion – although only a small part of this was actually spent during 2009.

Energy-smart technologies attracted the bulk of RD&D funding with \$16.8 billion invested during the year, accounting for 68% of total RD&D (see Figure 20). This was split \$11.6 billion and \$5.2 billion between the private and public sectors, respectively. Energy-smart technologies improve the efficiency of existing processes rather than bringing additional capacity to the market. They encompass conventional energy efficiency programmes from lighting to insulation, digital energy, power storage, hydrogen and fuel cells and advanced transportation.

Large corporate players such as Bosch, Panasonic and Sharp, plus car makers such as Honda and Nissan, warmed to the energy-smart technology theme in 2009, seeing research in this area as a key building block for future sales growth.

As a result of RD&D spending, smart grid products are developing rapidly, from intelligent home appliances through wireless networking to data analytics and back-end utility software. With smart metering technology beginning to roll out, further focus is turning to leveraging communications infrastructure for in-home energy management systems and automation of distribution grids.

Options for energy storage, both at the grid scale and for distributed power and transportation, are beginning to fall in cost as a result of RD&D spending. Demonstration projects are proving the viability of storage for high value ancillary service applications. Lithium-based battery technology is attracting substantial RD&D investment dollars, primarily due to its transportation applications, though alternative battery technologies also continue to receive funding.

Energy-saving technologies have also seen continued development, with LED lighting projects demonstrating improvements in efficiency and also, in the important area of thermal management. Other technologies such as high temperature superconductors are making the transition from laboratory to pilot projects, with a steady stream of real-world projects beginning to demonstrate technical viability.

Solar was the second largest technology with \$3 billion of RD&D expenditure in 2009. The majority of this spend was undertaken by the private sector with \$1.8 billion of the total coming from private sources. Among the areas receiving significant research effort are process technologies for improving wafer slicing and recycling, and improving thin-film consistency, and new materials such as cadmium sulphide and copper indium gallium selenide. RD&D is contributing to the falling cost of solar equipment. The decline in prices along the value chain, caused partly by enhanced technology, but also more recently by a swing from excess demand to excess supply, is boosting the economic viability of solar PV projects.

Biofuels saw the biggest increase in RD&D funding, of 57% from 2008 levels. Government funding in this sector was up by 88% on the previous year, standing at \$0.6 billion. The focus of this investment was on second-generation biofuels that do not compete with the food supply and also measure well in terms of full life-cycle carbon emissions. Examples of such technologies are cellulosic biofuels, which turn complex starch molecules from plant waste into transport fuel, and algae-based biodiesel.

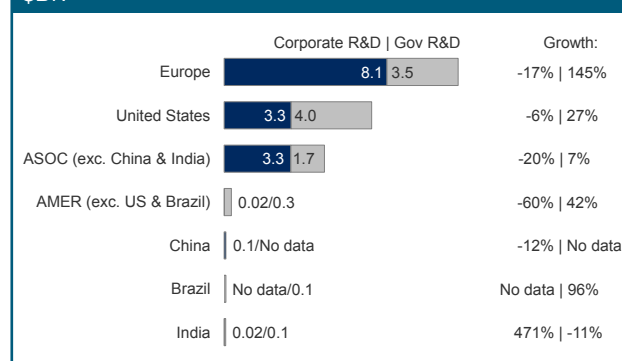
Marine and geothermal saw the greatest drop-off in RD&D funding in the year, falling by 14% and 13%, respectively. Many of the companies operating in this space are venture capital and private equity backed and access to finance for them was particularly restricted in 2009, because VC/PE players were short of cash and in a risk-averse

mood in the face of the financial market crisis. This in turn impacted on their firms' ability to invest in technology.

Carbon capture and storage (CCS) accounted for \$2.3 billion of total investment in clean energy RD&D in 2009, though was heavily dependent upon governments, with \$2 billion coming from the public sector. Government support is required at this stage as the projects tend to be large-scale. While the technology remains unproven and the carbon price outlook uncertain, they are unlikely to be fully funded by the market.

Both private and public sector investment in CCS RD&D is flowing to a broad range of capture and storage technologies. In terms of scale, however, funding is relatively focused: around 90% of the money (governments globally have pledged nearly \$24 billion) is destined for demonstration projects. While post-combustion, pre-combustion and oxy-combustion capture projects are all receiving both public and private support, the greatest share has gone to post-combustion projects so far. This may be as a result of lower capex forecasts for the technology or it could be simply due to its wider range of applications, such as industrial CCS and retrofit. Private funds have been largely limited to balance sheet investments in pilot-scale projects to date. The majority of banks and utilities appear to be waiting for public grant money before committing to the big investment decisions required for demonstration projects. This will need to change if the technology is to make the big leap to scale.

FIGURE 21: CORPORATE AND GOVERNMENT R&D INVESTMENT BY REGION, 2009, AND GROWTH ON 2008, \$BN



Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies

Europe and the US are the largest investors in clean energy technology, with \$11.7 billion and \$7.4 billion respectively being invested in RD&D in 2009 (see Figure 21), up 3% and 9% respectively on the previous year. The private sector accounted for the majority of European RD&D spending, at \$8.1 billion of the \$11.7 billion total. In contrast, public sector funding accounted for the majority of the US total, with \$4 billion out of a total of \$7.4 billion coming from the federal government or states.

VENTURE CAPITAL & PRIVATE EQUITY

- In 2009, venture capital and private equity investment fell 42% to \$6.8 billion. By the third quarter, however, investment activity had started to increase and this recovery continued into the first quarter of 2010.
- Investment fell across the board, from seed capital to private equity, reflecting a lack of new money flowing into early-stage funds and existing money not being recycled via exits as quickly as expected.
- Energy-smart technologies for the first time attracted more VC/PE investment than any other sector. This reflects a focus on energy efficiency by governments disbursing stimulus money, and also a surge in support for electric vehicles.
- The US continued to dominate VC/PE activity, accounting for 54% of new investment in 2009. This was particularly noticeable at earlier-stage venture capital funding, where the US has a better-established tradition than Europe of supporting young companies.

Venture capital and private equity investment fell 42% in 2009 (see Figure 22). However, investment patterns were uneven throughout the year, with a slow first half as quarterly investment fell to levels not seen since 2007, followed by a surge in the third quarter. The last three months of 2009 saw a return to the lower levels – around \$1.5 billion per quarter – seen earlier in the year. This does not necessarily reflect a decline in investor confidence; it is likely that deals that had been deferred due to market conditions in late 2008 and early 2009 were resurrected and completed in the third quarter, leading to higher deal flow. Q1 2010 saw a return to investment levels comparable to Q3 2009.

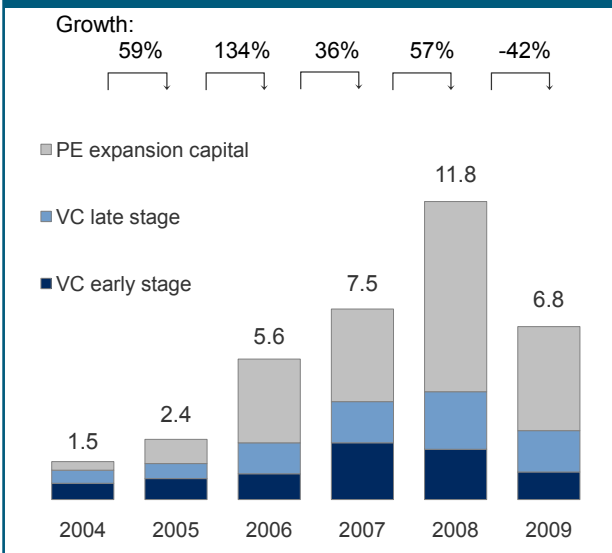
In 2009, there was a decline not only in investment value, but also in the number of deals, so the fall in activity cannot be explained away by smaller deal size and lower valuations. The year was not a good one for young companies seeking venture funding or expansion capital.

Investment activity fell across the entire VC/PE spectrum between 2008 and 2009, from seed capital through to private equity for expansion or buy-outs (see Figure 23). Admittedly, 2008 marked a record high for VC/PE investment, peaking at \$11.8 billion. However, new VC/PE investment in 2009 was also lower than in 2007.

This lacklustre performance is partly a reflection of slower early-stage funding in general, regardless of industry, as wary investors looked for the comfort of established names, proven technologies and track record.

In addition, capital continues to be in short supply. In 2009, global private equity fundraising across all industries fell to its lowest level since 2004, according to research company Prequin. In Europe, many clean tech venture capital funds have invested the bulk of their money. Even though there is no shortage of good investment opportunities, there seems to be little appetite for further fundraising: in 2009, venture capital raised in the US totalled \$15.2 billion from 120 funds, a 47%

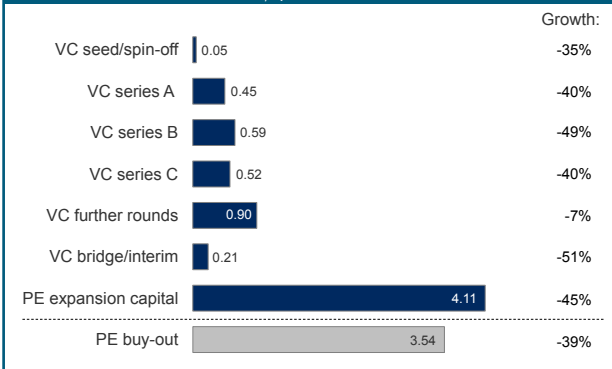
FIGURE 22. VC/PE NEW INVESTMENT BY STAGE, 2004 - 2009, \$BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance

FIGURE 23. VC/PE NEW INVESTMENT BY STAGE, 2009, AND GROWTH ON 2008, \$BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance

decline in terms of value and the slowest year for fundraising since 2003. In terms of number of funds, 2009 was also the slowest year since 1993, according to data from Thomson Reuters and the National Venture Capital Association.

Private equity is also suffering as pension funds have all but stopped committing new capital to PE funds, a consequence of the stock market crash in 2008-09 that left them over-allocated to unquoted alternative assets, including private equity investments. And a lack of exit opportunities, with the IPO market closed for the first half of 2009 and lower corporate valuations, means that money tied up in portfolios is not being recycled as quickly as managers would like.

Early-stage companies suffered from more intense competition from more established companies for the limited amount of equity funding available last year. And though they are mostly reliant on equity, early-stage companies have nevertheless been affected somewhat by the decreasing availability of debt funding.

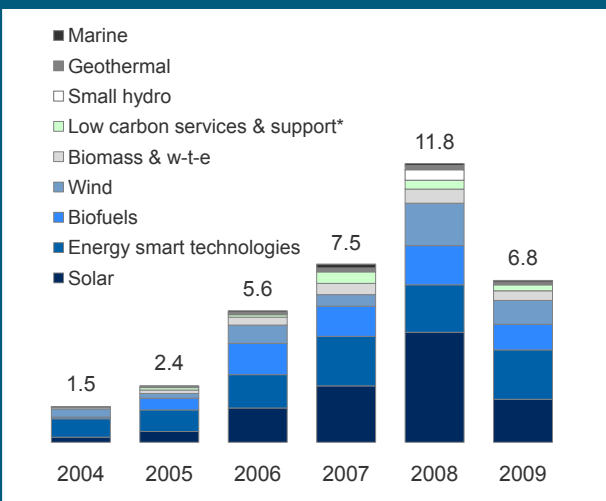
Late-stage venture capital funding proved the most resilient investment stage over the year, attracting \$1.6 billion in 2009, level with 2007 and only 28% lower than in 2008. Early-stage venture capital and private equity were worst hit, each falling well over 40% in 2009 from 2008 levels. Early-stage investment in 2009 was also lower than in 2007, with less than half of 2007's \$2.2 billion invested in 2009.

In terms of sector, energy-smart technologies attracted most VC/PE funding in 2009, overtaking solar, which received well under half what it had raised in 2008 (see Figure 24). The energy-smart / efficiency sector covers a broad range of technologies, from digital energy applications, to efficient lighting through to electric vehicles.

In 2008, VC/PE investment in energy-smart technologies was behind that in solar, biofuels and wind, but "green stimulus" money, much of which has been earmarked for efficiency measures, along with a focus on cutting costs in austere economic times, have propelled the sector into first place (see Figure 25). Furthermore, energy efficiency technologies are typically less capital-intensive than renewable technologies, and the sector tends to be less volatile than the solar industry, where many competing technologies are jostling for position. Energy efficiency technologies do not rely on the sort of incentive programmes or subsidies that may be lowered or withdrawn at short notice.

A number of energy efficiency firms completed large private equity deals, including Better Place Norway, an electric vehicle charging infrastructure company, which raised \$133 million; Landis+Gyr, a Swiss manufacturer of meters and demand-side management systems, \$100 million; and Silver Spring Networks, a US smart grid technology developer, \$100 million.

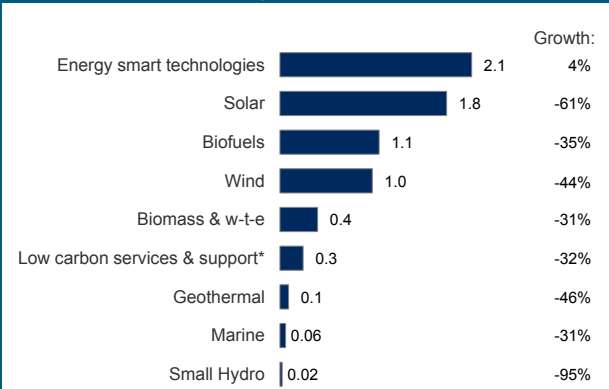
FIGURE 24. VC/PE NEW INVESTMENT BY SECTOR, 2004-2009, \$BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals * includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

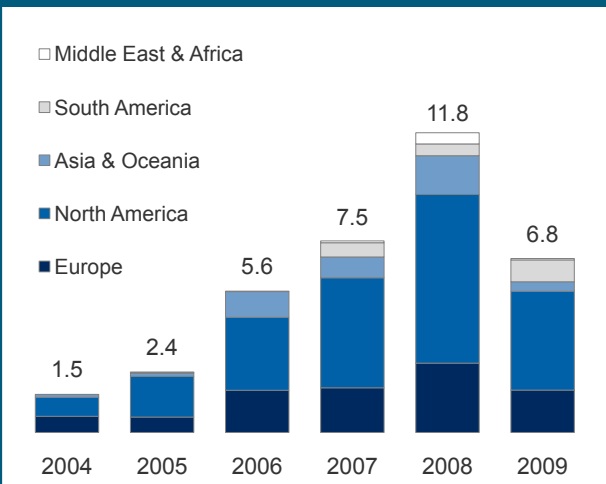
FIGURE 25. VC/PE NEW INVESTMENT BY SECTOR, 2009, AND GROWTH ON 2008, \$BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP SEFI

FIGURE 26. VC/PE NEW INVESTMENT BY REGION, 2004-2009, \$M



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP SEFI

Silver Spring Networks, whose backers include Google Ventures, Foundation Capital, Kleiner Perkins and Northgate Capital, is poised to benefit from the US government's sudden interest in - and funding support for - the grid. The economic stimulus package set aside \$4.5 billion specifically for smart grid projects and technologies; most of these funds have now been allocated to projects, several of which plan to use Silver Spring technology. The company has said it plans to carry out an IPO in 2010.

Solar also continues to attract early-stage funding, albeit less than in recent years. The largest solar deal of the year was \$286 million of pre-IPO venture capital raised by Solyndra, a US thin film PV module maker. The company was required to raise the money as a condition of a \$535 million US loan guarantee, the first offered under the Energy Policy Act of 2005. This will fund the 250MW first phase of construction at a 500MW manufacturing plant. There were several other large deals, both in the US and beyond, but most VC investments in solar were on a much smaller scale and directed at small technology companies, such as Circadian Solar, the UK gallium arsenide PV cell developer which raised \$3.3 million.

Wind, just behind biofuels, dominated large private equity deals, as one would expect of a mature technology. 2009's largest PE deal was in the wind sector, with Terra Firma, a UK private equity firm, buying US project developer Everpower Wind, for \$350m. Another large wind deal saw Axa Private Equity acquiring Kallista Energies Renouvelables and Kallista France from Babcock & Brown for \$314 million.

As in the years before, VC/PE activity was dominated by the US, where there is a long tradition of supporting young companies (see Figure 26). A total of \$3.9 billion, almost 60% of VC/PE new investment in 2009, was in North America (see Figure 27).

Asia, on the other hand, which unlike the US and Europe experienced overall higher investment in 2009, saw very little early-stage activity, accounting for just 5% of worldwide VC/PE funding during the year. Investment activity in South America was dominated by private equity for expansion directed to Brazil's well-established biofuels industry.

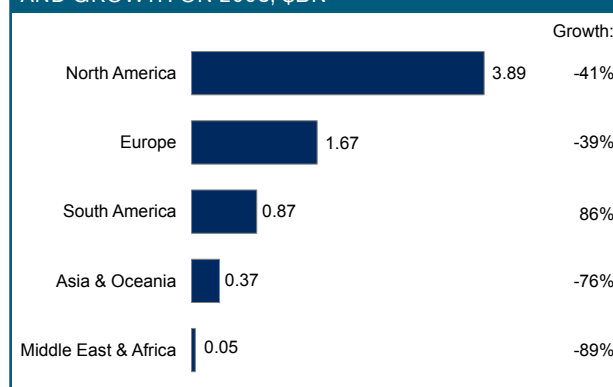
Europe was somewhere in the middle between the Americas and Asia, seeing \$1.7 billion (24%) of VC/PE investment in 2009. Given that Europe is a frontrunner in clean energy, with broadly supportive regulation such as widespread feed-in tariffs, and is home to many of the world's leading clean energy manufacturers and developers, its apparent reluctance to finance and support early-stage technologies through to market is surprising.

This is partly due to the fact that European investors tend to be more conservative and generalist, with mainstream venture capitalists preferring to stick to technologies and business models they are familiar with, but also because there is a fundamental difference in government attitude to early-

stage companies. In the US, some of the challenges facing venture capitalists are alleviated by support for early-stage VC managers from public bodies such as CalPERS, the Californian Public Employees' Retirement System, which has to invest a percentage of its funds in venture capital funds. Furthermore, there are government procurement programmes supporting small and medium-sized enterprises, as well as the large US green stimulus package.

European companies and investors do not benefit from this level of support. An EU-backed stimulus package and more specialist venture capital firms would help close the gap.

FIGURE 27. VC/PE NEW INVESTMENT BY REGION, 2009, AND GROWTH ON 2008, \$BN



Buy-outs are not included as new investment. Total values include estimates for undisclosed deals

Source: Bloomberg New Energy Finance, UNEP SEFI



PUBLIC MARKETS

- In 2009, new investment in clean energy via global stock markets amounted to \$14.1 billion, almost level with 2008.
- Public market activity was patchy during the year, with the markets effectively closed in the final quarter of 2008 and the first quarter of 2009. After that, investment volumes increased steadily, peaking in the fourth quarter of 2009.
- Since the beginning of 2010, investment activity has held up well, slightly lower than in previous quarters, but well above volumes a year earlier.
- In 2009, solar continued to dominate public market activity, with wind in second place, buoyed by the largest public market deal of the past two years: Longyuan's \$2.6 billion IPO on the Hong Kong Stock Exchange.
- Asia saw the most public market activity in terms of both company nationality and stock exchange. Public market fundraising on Asian stock exchanges, and by Asian companies, grew in 2009 compared to 2008, in contrast to that in more mature markets such as Europe and North America, both of which saw investment activity declining.

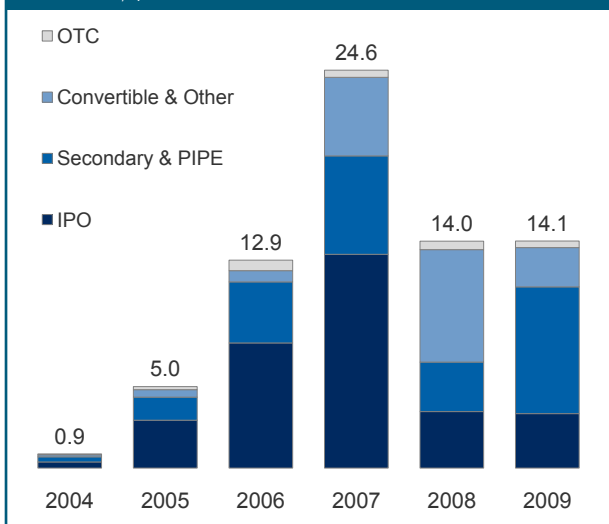
The volume of clean energy investment on the public markets, which had come to a complete standstill by the beginning of 2009, finished the year at a similar level to 2008 at \$14.1 billion (see Figure 28). In particular, the initial public offering market reopened in the second half of the year, having been effectively closed for nearly a year.

The mix of deals was very different between the two years. 2009 saw far higher secondary issuance and private investment in public equity (PIPE), and far lower convertible issuance than in 2008. Convertible bonds are typically used to attract investors in difficult times, as they provide a stable, bond-like return with equity upside should the underlying share price rise above a certain level. The fact that convertible issuance has largely been replaced by secondary issuance marks a return of investor confidence in the clean energy sector, as does higher private investment in the public markets.

The volume of IPOs remained similar to 2008, although fewer deals were completed during 2009. Uncertainty on the world's stock markets meant that many companies were choosing to defer their debuts, or find an alternative exit route. The public markets have now re-opened, but investors are favouring larger, established companies – hence the surge in secondary issuance during 2009 – and unproven newcomers still have to tread cautiously. Issue size is also a consideration: big issues on major exchanges from larger companies offer much better liquidity and a more transparent after-market than smaller, lower-profile deals.

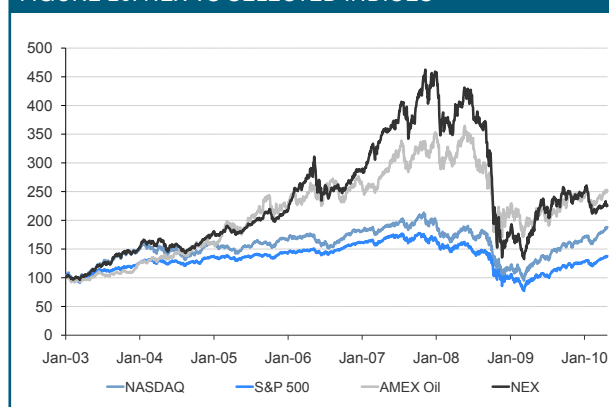
When looking at historic trends in public market investment, it is worth remembering that the 2007 public market total was flattered by the \$6.6 billion IPO of Iberdrola Renovables, the wind power subsidiary of the Spanish power utility, in December of that year. Stripping this out reduces the 2007 total to \$18 billion, and would produce a far less dramatic decline in investment over the past couple of years than Figure 28 suggests.

FIGURE 28. PUBLIC MARKET NEW INVESTMENT BY STAGE, 2004-2009, \$BN



Source: Bloomberg New Energy Finance

FIGURE 29. NEX VS SELECTED INDICES



Index Values as of 31 March 2010; AMEX Oil, NASDAQ and S&P 500 rebased to 100 on 30 December 2002

Source: Bloomberg New Energy Finance

Deals completed during 2009 included the largest public market deal of the last two years: Chinese wind developer Longyuan Power Group's \$2.6 billion IPO on the Hong Kong Stock Exchange. Shares sold at the top end of the indicative range and rose 10% following the launch. Other IPOs were far smaller; the next largest came from A123Systems, a US developer of new-generation lithium-ion batteries, whose IPO raised \$371 million on Nasdaq in September.

Several established companies completed secondary offerings during 2009, including Norwegian solar group REC (\$719 million), Spanish wind turbine manufacturer Gamesa (\$556 million) and Japanese silicon manufacturer Tokuyama (\$532 million). REC raised a further \$467 million via a convertible issue later in the year.

In line with higher public market investment, the quoted clean energy sector recovered since its low point in the first quarter of 2009. Sharp rises in clean energy share prices during 2009 reflected recovering investor confidence.

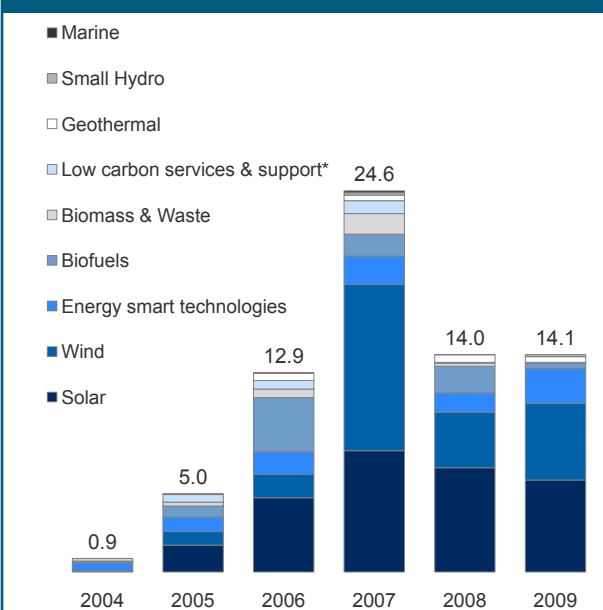
The WilderHill New Energy Global Innovation Index (ticker symbol "NEX") tracks 88 clean energy companies listed on 25 exchanges worldwide. Indexed to 100 at the start of 2003, it traded as high as 468 in November 2007 (see Figure 29) and stayed resilient for the first half of 2008. When investment bank Lehman Brothers collapsed however, the NEX fell sharply, reaching 178 at the end of 2008, and 132 by March 2009. Since then, the NEX recovered to close 2009 at just under 250 – up 39% during the year and up 87% up from its lowest point in March.

Towards the end of 2009, clean energy share prices faced a fresh challenge in the shape of "Climategate", the scandal over emails between climate scientists. The Climatic Research Unit of the University of East Anglia has since been cleared of any "deliberate scientific malpractice". The inconclusive Copenhagen climate talks also disappointed investors in the clean energy sector. In the early months of 2010, clean energy shares drifted without strong direction, under-performing wider stock markets.

In spite of falls during 2008 and early 2009, the NEX delivered compound annual capital appreciation of 13.8% over the seven years from the beginning of 2003 to the end of 2009 – a respectable return when compared with almost any major asset class.

The best performing clean energy sectors within the NEX in 2009 were energy conversion, power storage and energy efficiency. This reflected two key influences: rising interest in electric cars and the arrival of stimulus money, much of which has been earmarked for increasing energy efficiency. This performance contrasts with the figures for new public market investment, which show that last year the mature sectors – wind and solar – continue to dominate (see Figures 30 and 31).

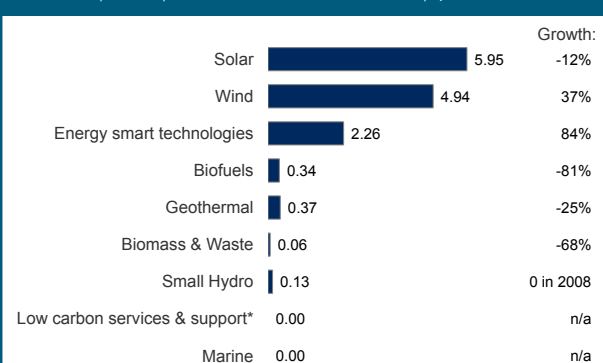
FIGURE 30. PUBLIC MARKET NEW INVESTMENT BY SECTOR, 2004-2009, \$BN



*includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

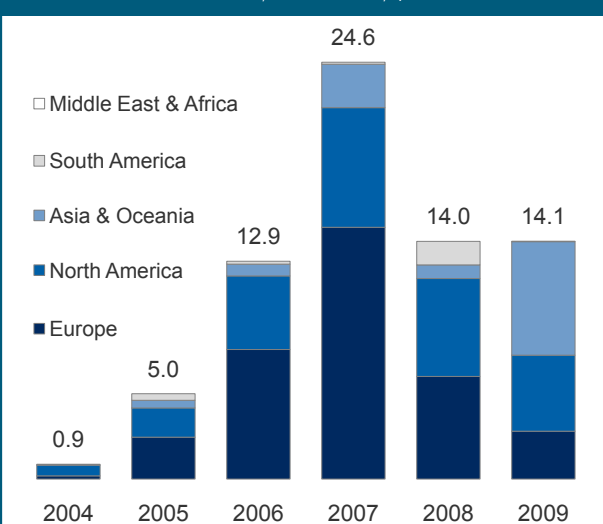
FIGURE 31. PUBLIC MARKET NEW INVESTMENT BY SECTOR, 2009, AND GROWTH ON 2008, \$BN



*includes CCS

Source: Bloomberg New Energy Finance, UNEP SEFI

FIGURE 32. PUBLIC MARKET NEW INVESTMENT BY REGION OF EXCHANGE, 2004-2009, \$BN



Source: Bloomberg New Energy Finance, UNEP SEFI

Solar companies led the way, raising nearly \$6 billion on the public markets in 2009, slightly lower than 2008's \$6.7 billion (see Figure 31). This total included six solar IPOs, all launched between September and December 2009, which collectively raised \$289 million of new investment. Three of these IPOs were from Chinese solar companies, including the sector's largest IPO, from PV equipment maker Tianlong, raising \$133 million. Secondary or convertible issues accounted for most of the money raised by solar companies on the public markets, by established players such as REC, GCL-Poly Energy, Tokuyama, Q-Cells, Suntech, Yingli Green Energy and SunPower.

The wind sector followed closely behind, raising \$4.9 billion, 37% more than in 2008. However, more than half of this was accounted for by Longyuan's \$2.6 billion IPO on the Hong Kong Stock Exchange. The sector's underlying performance, stripping out this deal, showed a decline of more than a third from 2008. There was only one other wind sector IPO during the year, from Indian Energy, a UK-based wind farm developer, which raised \$15.8 million on London's Alternative Investment Market (AIM). Other large deals included a \$1.1 billion PIPE from Danish turbine manufacturer Vestas, and a series of secondary issues and one convertible issue from India's Suzlon, raising a total of \$537 million between May and November 2009.

Perhaps predictably in a cautiously reopening market, established wind and solar companies dominated new public market investment. In terms of growth, though, energy-smart technologies led the way, enjoying a near-doubling in the value of new investment raised on the public markets between 2008 and 2009. Lithium-ion battery manufacturer A123 Systems raised \$371 million in its IPO, while two LED makers from opposite ends of the world completed large secondary offerings within a week of each other in September 2009: in the US, Cree raised \$449 million, and Epistar Corporation raised \$351 million in Taiwan.

Geographically, Asia dominated public market activity in 2009 (see Figures 32, 33 and 34). This was partly because of Longyuan's IPO, which accounted for 18% of new clean energy investment on the global stock markets during the year; but it also reflected the competitiveness of Asian manufacturers in overseas markets and the fact that in 2009, Asia became the world's number two location for building clean energy, overtaking the Americas. It was also the only one of the three main regions to show growth in total new investment in 2009: an increase of 33% compared with a drop of 10% in Europe and 12% in the Americas.

In the public markets, lower activity in Europe and the US was offset by fund raisings in Asia, particularly China and Taiwan (Province of China). If Longyuan's IPO is stripped out, the Hong Kong Stock Exchange was level with Nasdaq, with \$1.4 billion of new investment, but the US took the lead in terms of company nationality (\$2.5 billion raised by US companies, compared with \$1.6 billion raised by Chinese companies, excluding Longyuan), and also in terms of stock exchange region (\$4.5 billion raised on American exchanges compared with \$4 billion raised on Asian ones).

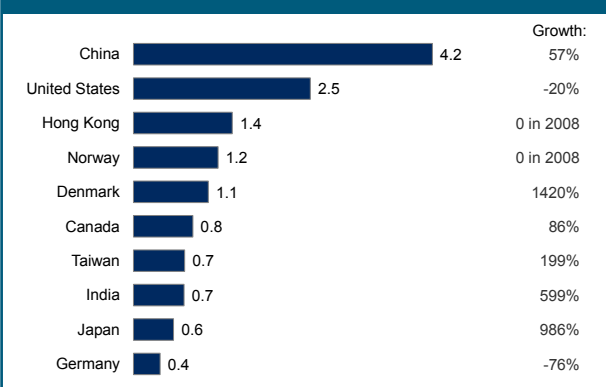
FIGURE 33. PUBLIC MARKET NEW INVESTMENT BY EXCHANGE, 2009, AND GROWTH ON 2008, \$BN



Top 10 exchanges

Source: Bloomberg New Energy Finance

FIGURE 34. PUBLIC MARKET NEW INVESTMENT BY COMPANY NATIONALITY, 2009 & GROWTH ON 2008, \$BN



Top 10 countries

Source: Bloomberg New Energy Finance

More telling, though, are the market growth rates, which clearly show activity in Asia growing (even without Longyuan), while activity in most other countries slowed (see Figure 34).

The Hong Kong Stock Exchange was boosted by Longyuan's IPO, as well as by a \$710 million private investment in public equity deal from GCL-Poly Energy. But Asian stock exchanges beyond Hong Kong also saw good growth; Taiwan (Province of China) benefited from Epistar's \$351 million secondary offering, and activity on the Tokyo Stock Exchange was dominated by Tokuyama's \$532 million secondary offering.

Elsewhere, Scandinavian markets were lifted by Vestas's \$1.1 billion issue on the Copenhagen Stock Exchange, and by \$1.2 billion raised by REC in two deals on the Oslo Stock Exchange.

Public market activity by clean energy companies in the US was much more evenly spread, as one would expect from a mature market. Deals were spread between IPOs, secondary offerings and private investment in public equity deals, with several raising up to \$500 million but no transactions larger than that.

CHAPTER 6

ASSET FINANCING

- Asset finance of new, utility-scale renewable energy projects fell to \$100.9 billion in 2009, from \$108.4 billion.
- In addition, there was an estimated \$18.1 billion invested in small, distributed capacity such as domestic rooftop solar and farm biogas projects. This was down from \$19.5 billion in 2008.
- Behind the fall in asset finance last year was the impact of the recession on the availability of debt and, in the US of tax equity, for projects.
- That shortage has begun to ease, but margins on project finance debt remain much wider than before the credit crunch, and with commercial banks in a more cautious mood, a key role is being played by public sector development banks.
- Wind dominated renewable energy asset finance in 2009, accounting for \$63 billion of investment, up 13% on the previous year. Asset finance in solar and biofuels fell.

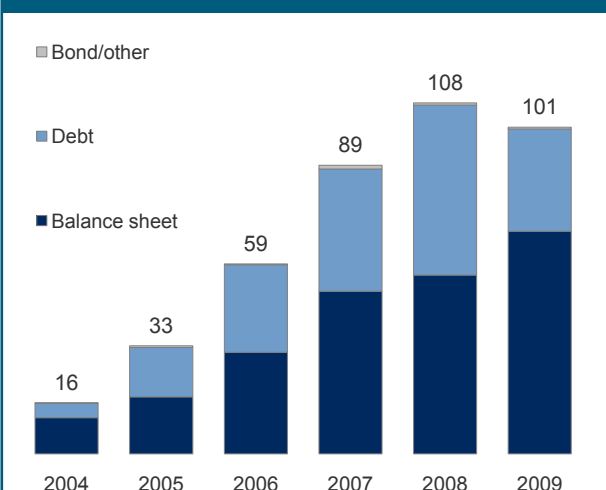
Investment in renewable energy capacity breaks down into three main pieces - the asset finance of utility-scale projects, the refinancing and acquisition of such projects, and the financing of small-scale projects such as rooftop solar for households and small businesses and biogas plants for individual farms. Refinancing and acquisition of projects totalled \$36.6 billion in 2009, down slightly from 2008's \$38.7 billion, while small-scale projects saw an estimated \$18.1 billion invested last year, down from \$19.5 billion in 2008 (see note on page 8).

The dominant type of new investment however is asset finance of new utility-scale renewable energy projects such as wind farms, solar parks and biofuel refineries. This totalled \$100.9 billion in 2009, down 7% from the previous year but 13% above 2007's \$89.2 billion.

The figure splits into two main categories - asset finance by utilities and energy groups from their own balance sheets, and debt and equity provided directly to projects rather than to the company developing them. It was this latter category, known as non-recourse project finance, that sustained the biggest impact from the financial crisis. Figure 35 shows that while on-balance-sheet finance of renewable energy rose to \$68.8 billion in 2009 from \$55.2 billion in 2008, project finance fell to \$31.6 billion from \$52.5 billion.

This contrast reflected the fact that large energy groups continued to be able to finance their own projects from balance sheets sometimes strengthened by raising money on bond markets. Several large offshore wind projects in Europe, sponsored by utilities, got the go-ahead in 2009, as did "mega wind bases" developed by energy majors in China. However developers hoping to raise debt and equity specifically for their projects in many countries found the going tough - many commercial banks suffered damage to their balance sheets in the crisis of late 2008 and early 2009 and became cautious about lending long term. Project finance loans became more expensive relative to central bank interest rates, and deals took much longer to agree than before because the syndication market was closed and large projects therefore needed to be

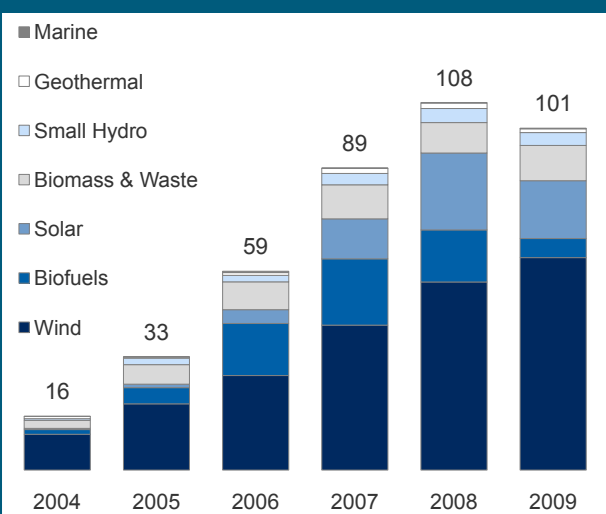
FIGURE 35. ASSET FINANCING NEW INVESTMENT BY TYPE OF SECURITY, 2004-2009, \$BN



Total values include estimates for undisclosed deals.

Source: Bloomberg New Energy Finance

FIGURE 36. ASSET FINANCING NEW INVESTMENT BY SECTOR, 2004-2009, \$BN



Total values include estimates for undisclosed deals.

Source: Bloomberg New Energy Finance

backed by a “club” of banks, each providing their agreement before the whole package could be agreed.

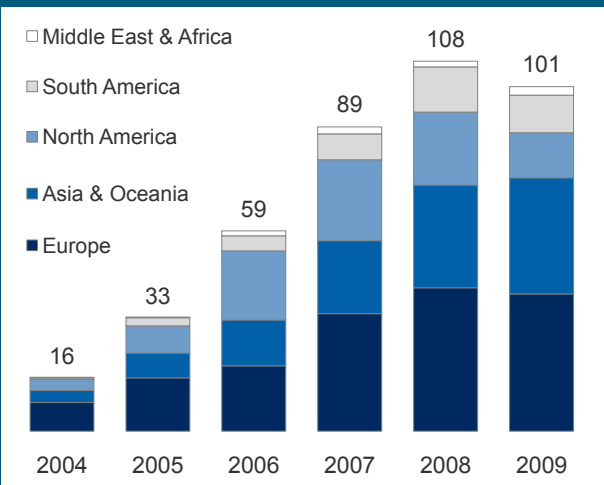
While project finance debt was in short supply in Europe, tax equity finance for renewable energy was even harder to find in the US. Incentive schemes such as the Production Tax Credit enabled US financial institutions to shelter taxable profits by investing in tax equity in wind farms and solar parks, but the 2008-09 crisis knocked some players, such as Lehman Brothers, out of this market and made others more cautious about providing tax equity. This is one reason why asset financing of renewable energy projects in the US was particularly depressed in 2009.

Although the financial crisis and recession continued to have an impact throughout 2009, there were more positive developments as the year went on. First, the shortage of bank finance in Europe and elsewhere started to ease from the summer onwards. Second, the US administration’s “green stimulus” started to release grants to help pay for the construction of projects in that country, offsetting the shortage of tax equity. Third, development banks played a more important role than ever before in financing renewable energy. The European Investment Bank, for instance, raised its lending to the sector from EUR 2.2 billion in 2008 to EUR 4.2 billion in 2009, and lent a further EUR 1.5 billion to energy efficiency projects. One of the EIB’s largest loans was a EUR 300 million contribution to the July 2009 financing of the first, 165MW phase of the Belwind offshore wind project in Belgian waters. In Brazil, the public sector bank BNDES was once again the dominant lender to domestic biofuel projects.

Figure 36 shows that the trend in new asset financing worldwide varied greatly between renewable energy sectors. Asset finance of wind projects rose 13% to a record \$62.7 billion in 2009, while that of solar projects dropped 25% to \$17.1 billion. The rise for wind reflected the ability of large energy players to go ahead with projects on the basis of on-balance-sheet finance, and a surge in wind project development in China was a particular feature.

The setback for solar was due in part to a sharp fall in PV panel prices - of some 50% - between the third quarter of 2008 and the fourth quarter of 2009, as the excess demand that had previously kept prices high suddenly turned into excess supply as more manufacturing capacity came on stream for everything from silicon to finished cells and modules. In addition, there was a sharp turnaround in one big market, Spain. The Spanish PV market boomed in the run-up to the expiry of the former feed-in tariff offer in September 2008, but in 2009, with a government cap in place on the amount of new capacity that could be built, investment in utility-scale PV in that country fell spectacularly. Expansion of other markets, notably France, the Czech Republic and Germany (where there was a frantic close to 2009 as developers rushed to take advantage of an expiring tariff there) partly offset the contraction in Spain, but projects in most countries found project finance harder, and slower, to obtain than in 2008.

FIGURE 37. ASSET FINANCING NEW INVESTMENT BY REGION, 2004-2009, \$BN



Total values include estimates for undisclosed deals.

Source: Bloomberg New Energy Finance

The next largest sectors in renewable energy after wind and solar are biofuels, and biomass-to-power. Biofuels endured another difficult year. In 2009, asset finance of new ethanol and biodiesel plants was just \$5.6 billion worldwide, down 63% on 2008 and far below the record figure of \$20 billion reached in 2007, when corn-based ethanol in the US, biodiesel in Europe and sugar-based ethanol in Brazil were all attracting huge interest from investors. The 2009 decline in asset finance for biofuels reflected the same shortage of bank debt that afflicted other sectors, compounded by the fact that banks were especially cautious towards biofuels because some leading producers had run into severe difficulties, or gone insolvent. However there were signs by the latter part of 2009, that the dark clouds over biofuels might be starting to lift - there was a more comfortable conjunction of feedstock prices and crude oil prices than for some time, and some demanding government mandates for a rising percentage use of biofuel in the transport fuel system lay ahead for the next few years.

Biomass and waste-to-energy overtook biofuels in 2009 to become the third largest renewable energy sector in terms of asset finance. It enjoyed investment in new capacity of \$10.4 billion, up 16% on 2008 and roughly level with the 2007 figure. The fact that many of the technologies in this sector are relatively mature, especially those in waste-to-energy and in the co-firing of biomass in coal power stations, helped to reassure investors and bankers in nervous times.

Another mature sector is hydro-electric. This report includes any project of 50MW or less. These small hydro schemes attracted asset finance of \$3.8 billion in 2009, down 8% from 2008. Small hydro has grown steadily in recent years, particularly in emerging economies such as China, India, Brazil and eastern Europe. However activity last year did feel an impact from the banking crisis, and the fact that quoted hydro-electric developers found it much more difficult to raise equity finance on stock markets.

Among the smaller renewable energy sectors, geothermal saw a fall in asset finance investment of around a third to \$1.1 billion, while marine enjoyed a spectacular 408% increase but only to the modest level of \$0.2 billion. For geothermal, the level of interest from investors remains buoyant everywhere from the “hot rocks” developments of Australia, to Indonesia and the western states of the US. However actual spending on projects in 2009 suffered - probably temporarily - in the face of economic influences such as the slump in Iceland and the shortage of debt and tax equity finance in the US.

For marine, the problems in 2009 were of a different nature. Most technologies, except for large tidal barrages, remain immature and unproven. Most of the investment in recent years has taken the form of venture capital finance of dozens of young technology developers in wave and tidal stream power, but VC investors became more risk-averse as a result of the recession and loath to commit more funds to marine. There were however some positive developments on projects, notably the generation of power from Marine Current Turbines' 1.2MW tidal device in Northern Ireland.

Figure 37 shows that trends in the asset finance of new-build projects differed greatly between regions of the world, just as it did between technologies in 2009. Europe saw a modest decline in asset finance, to \$40.2 billion from \$42 billion in 2008, but the downturn was much sharper in North America, where the 2009 total of \$13.2 billion was 38% lower than the previous year's \$21.4 billion. As noted above, the US was hit by particular problems over the availability of tax equity finance for wind and solar. The downturn in the corn ethanol sector that started during 2007 continued, and several leading players, including VeraSun and Aventine, embarked on insolvency procedures.

In South America, new-build asset finance fell to \$11 billion from \$13.3 billion. The recession, balance sheet problems and a weaker oil price than in 2008 caused investors to scale back their development of new ethanol plants in Brazil, although activity there remained high compared with the US or Europe. BNDES lending to renewable energy fell in 2009, reflecting the caution of developers rather than its own reluctance. However there was increased interest in the wind sector in Brazil, and in other Latin American countries such as Argentina, Uruguay and Peru, all of which have conducted renewable energy tenders.

The Middle East and Africa saw a rise in new-build asset finance to \$2.5 billion from \$1.7 billion in 2008. The increase in interest was greater than the figures reveal, with African countries such as Egypt and Kenya embarking on ambitious wind projects, and South Africa belatedly fine-tuning its policies to encourage wind and solar project development – with the introduction of a feed-in tariff last year and a target of 1.2GW of renewable power capacity by 2013.

The most dynamic developments however were in China. Overall, the Asia and Oceania region saw a rise in clean energy asset finance to \$34.1 billion in 2009 from \$30.1 billion in 2008, further increasing its lead over North America and narrowing the gap on Europe. China saw asset finance of \$29.2 billion in 2009, up from \$22 billion in 2008, on the back of a surge in wind investment, some of it going into the country's “mega bases” such as the planned 3.8GW development at Jiuquan in Gansu province. China opened up a big lead in terms of asset finance over the US, which managed just \$10.7 billion last year.



MERGER & ACQUISITION ACTIVITY

- Clean energy mergers and acquisition activity valued at \$60.7 billion took place in 2009, a decline of 7.6% from the previous year's \$65.7 billion.
- Towards the end of the year, activity started to improve as the world's major economies gradually began to recover from the financial crisis.
- The wind sector stood head and shoulders above all other renewable sectors in 2009, with the majority of the acquirers targeting either wind projects or companies that develop projects.
- In response to the falling silicon price, solar equipment manufacturers have been consolidating and moving into different business areas.
- Consolidation has long been inevitable in Brazil's fragmented biofuel market, but in Q4 2009 activity really began to accelerate.

In 2009, the value of clean energy mergers and acquisition activity, including buy-outs, corporate takeovers and asset purchases and refinancing, amounted to \$60.7 billion, a 7.6% decline from the previous year's \$65.7 billion. Two opposing forces acted on investors throughout the year: on the one hand, investment activity was driven forward by the lure of falling asset values, but on the other, it was stifled by a lack of credit.

As in previous years, more money was spent acquiring renewable energy projects than any other type of RE asset (see Figure 38). In all, \$36.6 billion was poured into either buying or refinancing power generating infrastructure in 2009, a decrease of 5.5% from the all-time high of \$38.7 billion recorded in 2008.

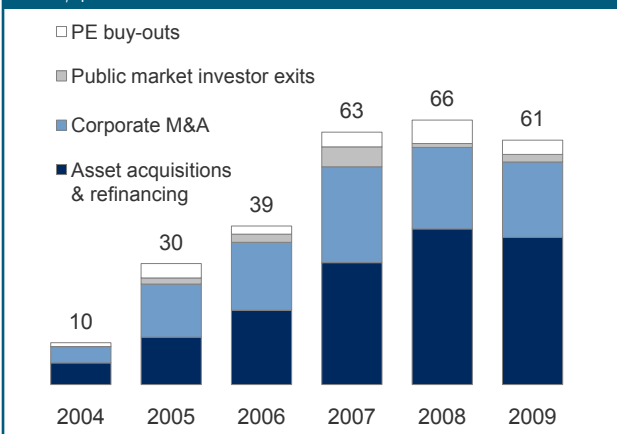
Corporate M&A fell for the second successive year. The \$18.7 billion paid by new corporate buyers for existing equity in renewable energy or energy efficiency companies was 7.4% less than the \$20.2 billion recorded for the previous year.

Of all the acquisition types, private equity buy-outs fell by the biggest margin as financing for deals of this sort all but dried up. In 2009, the volume spent on buy-outs sank to \$3.5 billion, a drop of 39% compared with the \$5.8 billion that changed hands in the previous year.

The sale of equity stakes in listed companies was the only area of M&A to resist the downward trend in 2009. As the markets started to open up towards the end of the year, investors managed to sell equity worth \$1.9 billion, up from \$1.0 billion in 2008.

The decline in investment volume took place against the backdrop of the worst financial crisis in decades. Banks reined in lending, share prices plummeted and economic uncertainty weighed heavily on CEO confidence, forcing many entities to review their investment strategies and to prioritise some deals and shelve others.

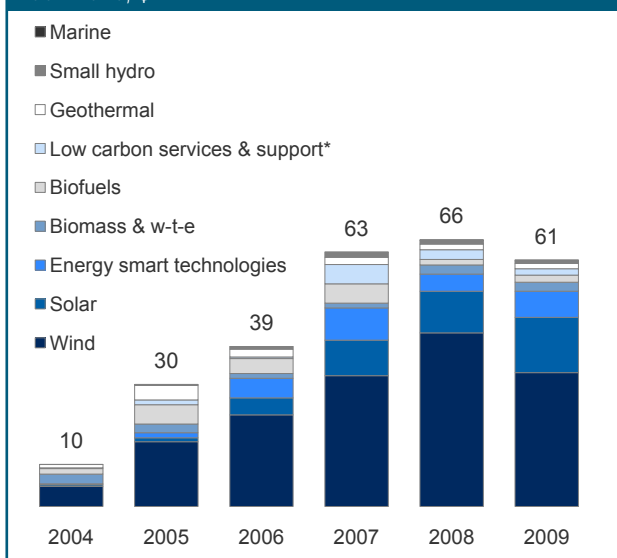
FIGURE 38. ACQUISITION TRANSACTIONS BY TYPE, 2004-2009, \$BN



Total values include estimates for undisclosed deals.

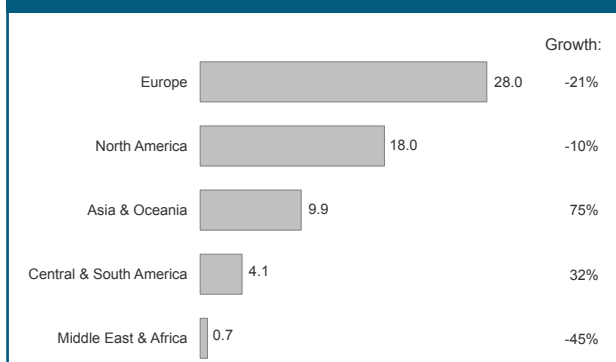
Source: Bloomberg New Energy Finance

FIGURE 39. ACQUISITION TRANSACTIONS BY SECTOR, 2004-2010, \$BN



Total values include estimates for undisclosed deals. * Includes CCS

Source: Bloomberg New Energy Finance

FIGURE 40. ACQUISITION TRANSACTIONS BY REGION 2009, AND GROWTH ON 2008, \$BN

Total values include estimates for undisclosed deals.

Source: Bloomberg New Energy Finance

Risk thresholds among investors were severely lowered with the result that deals needed to be much stronger than during the boom years if they were to get done. Industry sources reported that all transactions were subject to very extensive due diligence and analysis. One major consequence of this was that deals took considerably longer to complete.

M&A deal volumes fell across all industries, not just clean energy. According to data from Thomson Reuters, the value of global M&A fell by 32% in 2009 compared with 2008, which was already a quieter year than 2007.

Towards the end of the year, however, acquisition activity started to recover along with output in the world's major economies. Investors and corporate buyers had seen asset values fall during the recession, and the beginnings of an economic recovery gave them more confidence to seek opportunities. However, even in late 2009, acquisition activity remained relatively muted compared with the period prior to the financial crisis.

The wind sector stood head and shoulders above all others in 2009 in value terms (see Figure 39). The bulk of the \$33.0 billion was spent buying either wind projects or companies that develop projects, but a not inconsiderable amount was channelled into wind equipment makers.

Utilities made most of the running in the more mature European markets. Denmark's Dong Energy, Italy's Enel and Scottish and Southern Energy were just a few of the many that made acquisitions over the course of the year. Certain US utilities also showed some interest: Pacific Gas & Electric Company, for example, made its first foray into the wind sector in 2009, paying Iberdrola an estimated \$393 million for its 246MW Manzana project in California.

The emerging markets also fielded a handful of deals. In South America, Brazilian utility CPFL Energia bought a 180MW portfolio in its home country, while in China, Inner Mongolia Mengdian acquired the announced but-not-yet-permitted 49MW Baiyun project. The volume of activity in these markets is expected to increase as more players become involved.

There were also a few large refinancings of existing wind projects. Some of the larger examples included two UK offshore projects: the EIB approved a \$1.6 billion loan for the first phase of the 1GW London Array, and Centrica received \$556 million from a consortium of banks to refinance its 221MW Boreas portfolio.

By the end of 2009 investors and utilities started snapping up development companies as a way of acquiring large swathes of installed capacity and project pipelines. International Power bought a Canadian developer, while Irish gas supplier Bord Gais bagged SWS Energy, beating off competition from rival ESB. Even UK private equity firm Terra Firma threw its hat into the ring, buying 90% of US project developer EverPower Wind for \$350 million.

Given the problems that many developers face trying to secure portfolio financing, a utility investor provides a much-needed source of capital. For its part, SWS Energy needs to embark on a prolonged period of construction and Bord Gais has the option to tap the capital markets at lower cost.

Although wind is a relatively mature clean energy technology, there are still companies developing important technologies for improving performance and reliability of turbines. Those enterprises continued to excite acquisitive interest from larger industrial players. Among the more notable deals were GE's purchase of advanced drive train developer Scanwind and XEMC's acquisition of direct drive turbine manufacturer Darwind.

In early 2010, the most eye-catching deal saw US helicopter-to-air-conditioning giant United Technologies Corporation take a 49.5% stake in turbine maker Clipper Windpower for \$270 million. The deal brings another large industrial corporation right into the heart of the biggest market in renewable energy, wind turbines.

In the solar sector the prices of solar-grade silicon and PV modules fell precipitously. In response, manufacturers sought to protect their margins by consolidation and by moving into different business areas. Many switched their attention from upstream activities (the supply of raw materials) to downstream activities - the development, installation and engineering of PV systems, those businesses at the end of the line where the sun falls on the modules. Companies made strategic acquisitions downstream in the hope that they would reap larger margins from installation and distribution of solar systems as the price of modules continued to fall.

Energy Conversion Devices, for example, moved downstream with the acquisition of one of its customers, building-integrated PV systems manufacturer Solar Integrated Technologies, which had been struggling for several quarters.

The need to scale up also drove consolidation, particularly in the thin-film sector, where there are numerous small companies competing with one another. The best way to reduce production costs is to build large integrated factories with on-

site glass and gas, and yet most thin-film companies have small manufacturing operations producing small volumes.

These considerations may have been behind the merger of California-based thin-film PV equipment maker DayStar and British Columbia-based project developer and PV equipment maker EPOD Solar. The latter also needed manufacturing expertise so that it could begin making modules quickly to capitalise on its portfolio of projects approved for the Ontario feed-in tariff.

A number of large industrial groups also sought to establish a foothold in the solar sector. Glass manufacturer Saint-Gobain, for instance, snapped up the remaining 50% stake in copper indium selenide developer Avancis, formerly a joint venture with oil company Shell.

Bosch was also busy. It acquired German silicon PV manufacturer Aleo Solar for EUR 130 million (\$190 million) in cash, and the remaining stake in ErSol Solar, an integrated manufacturer of PV equipment.

Deals were also driven by downstream players looking to expand their market share. In the fragmented US market, GroSolar acquired the residential division of California-based PV systems integrator Borrego Solar Systems; and roofing and PV systems specialist Petersen-Dean bought competitor OCR Solar and Roofing.

Given the fall in the price of polysilicon, it was inevitable that there would be some distressed sales. Chinese PV cell and module manufacturer Tianwei New Energy, for instance, took a 60% stake in troubled polysilicon manufacturer Hoku Scientific.

The solar thermal electricity generation sector has also seen some movement in recent months. German corporate giant Siemens bought Solel, an Israel-based pioneer in the sector, for \$418 million, while France's Areva purchased linear Fresnel solar company Ausra. The deal offers Areva an almost implementation ready entry into the sector.

In the biofuels sector much of the M&A activity in 2009 was centred on the US, where numerous distressed biofuels plants were put on the block. Former VeraSun refineries found new owners in the shape of carbon credit project developer Carbon Green BioEnergy, NTR-backed US ethanol producer Green Plains Renewable Energy, and most importantly, oil firm Valero Energy.

Valero's foray into the ethanol market marked the first such move by an oil company but it was not alone for long. Pennsylvania-based Sunoco, a Suncor Energy subsidiary, soon joined it with the purchase of Northeast Biofuels' 100 million-gallon (379 million-litre) per year ethanol plant in Oswego County, New York. These oil companies acted to lock in a supply of ethanol in anticipation of a hike in blending mandates.

There was also activity in the highly fragmented Brazilian ethanol market. Consolidation had long been inevitable, but in Q4 2009 activity really began to accelerate. Almost overnight, major vertically integrated sugar cane groups began to emerge. See Figure 40 for a breakdown of deals by region.

The rush of M&A activity has brought several major players from outside the sector further into the picture, most notably oil major Shell and agribusiness giant Bunge. Moves from these firms and others demonstrate growing confidence that the Brazilian market will rebound and the country stands to be a major fuel exporter in this decade.

As if to underline that point, the US Environmental Protection Agency has mandated that sugarcane ethanol meet its "advanced biofuel" requirements, presenting Brazilian producers a major opportunity to help the US fulfil a major quota calling for 79 billion litres (21 billion gallons) of such fuel by 2022.

There were five important acquisitions in the final few months of 2009, and the first few months of 2010 have seen the announcement of three others.

French agribusiness Louis Dreyfus started the ball rolling in March 2009, when it began negotiating to acquire Santelisa Vale, a key player in the sugar and ethanol industry in Brazil. In October, the two parties finally closed the deal.

In November, Vale do Ivaí was acquired by the Indian sugar and ethanol player Shree Renuka Sugars, and Bunge agreed to acquire Grupo Moema giving it complete ownership of five sugarcane crushing plants. The following month, Brazil's state owned oil and gas company Petrobras acquired a 40.4% stake in Total Agroindustria Canavieira.

More recently, in April 2010, ETH Bioenergia – owned by industrial conglomerate Odebrecht and Japanese trading house Sojitz – acquired Brenco, to create one of the biggest ethanol-producing entities in the world.



INVESTMENT FUNDS

- Appetite for new funds remained muted in 2009. In all, just four new public equity funds were created, although there were other launches in areas such as venture capital and projects.
- Private equity funds enjoyed greater success at reaching financial close in 2009, although in some cases these were funds launched before the crisis and the amount raised did not reach initial targets.
- There has been an increase in the role of public sector banks and pension funds in supporting specialist clean energy and clean technology funds.
- The uncertain performance of clean energy share prices in recent months has restricted the ability of venture capital funds to realise cash via exits, and public equity fund managers to market their strategies more effectively to potential investors.

Over the last 10 years, as the clean energy sector has gone from niche to mainstream, the type of investors it attracts has changed. At the start of the decade, the sector was the preserve of small, boutique venture capital funds, but as time went on they were joined by larger Silicon Valley VC firms.

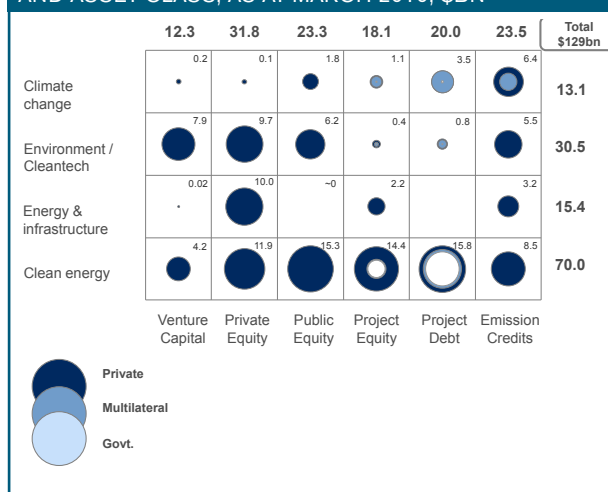
In more recent years, investment banks and large private equity and mutual funds have shown increasing interest in the sector, with hedge funds also devoting some portion of their portfolios to clean energy. Big private equity firms such as Blackstone, CVC Capital Partners and Terra Firma have all made forays into the sector.

In 2007, fuelled by cheap and easily available credit, enthusiasm for the sector reached new heights. The WilderHill New Energy Global Innovation Index, or NEX, which tracks the performance of around 88 clean energy stocks worldwide, reached an all-time high in November of that year, and new clean energy-focused public equity funds sprang up at a rate of almost one a week to keep pace with demand.

In 2008, the situation changed radically. Worries of a credit crunch grew more acute and with the near-collapse of the global banking system, clean energy share prices plummeted and not surprisingly new fund creation fell sharply. By mid-2009 there were the first signs of recovery but appetite for new funds remained muted. In all, just four new public equity funds were created in 2009.

Fundraising became more difficult. For much of 2008 it was still possible to raise funds from limited partners; however institutional investors became progressively more reluctant to make commitments as the crisis turned into world recession. The fact that clean energy shares had taken such a sharp fall in 2008, and that there were plenty of other investments trading far below their 2007 peaks made it difficult for managers to raise new funds specialising in the sector. With the NEX performing fitfully since the middle of 2009, the level of interest from the wider investment community has yet to make a full recovery.

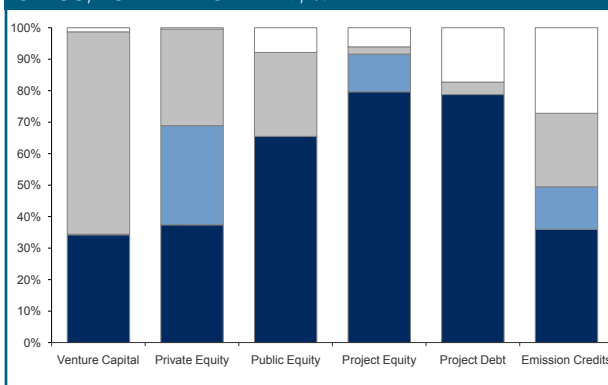
FIGURE 41. SUSTAINABLE ENERGY FUNDS BY FOCUS AND ASSET CLASS, AS AT MARCH 2010, \$BN



Excludes SRI funds

Source: Bloomberg New Energy Finance

FIGURE 42. SUSTAINABLE ENERGY FUNDS BY ASSET CLASS, AS AT MARCH 2010, %



Source: Bloomberg New Energy Finance

The asset value of funds investing in clean energy has grown over the last year despite the difficulties. One reason has simply been the rebound in sector share prices since the spring of 2009 and the impact of that on public equity funds. Another has been successful fundraising by a number of specialist vehicles, in some cases helped by money coming from public sector development banks and government pension funds. To take one example, DB Masdar's \$265m Clean Tech Fund reached a first close in January 2010, with contributions from Japan Bank for International Cooperation and Development Bank of Japan, as well as from private sector investors such as General Electric.

There was also growth in the volume of uncommitted funds from March 2009 to March 2010, reflecting a general reluctance to make investments in an uncertain environment. Now that most major economies are on the road to recovery the rate of investment is likely to pick up.

As of March 2010, there was \$70 billion of private and public money under management in core clean energy funds (those that invest more than 50% of their money in clean energy or energy efficiency companies and projects). This represented an increase of 37% from the previous year. Figure 42 shows a snapshot of the volume and focus of funds targeting the sector as at March 2009.

Environmental funds – those with a significant, but less than 50%, exposure to clean energy and energy efficiency – had \$30.5 billion under management by the end of March 2010, an increase of 43.9% on March 2009. Meanwhile, climate change funds, for which clean energy is a smaller but still important portion of the total portfolio, had \$13.1 billion in their coffers, a rise of just 3.1% on the previous year.

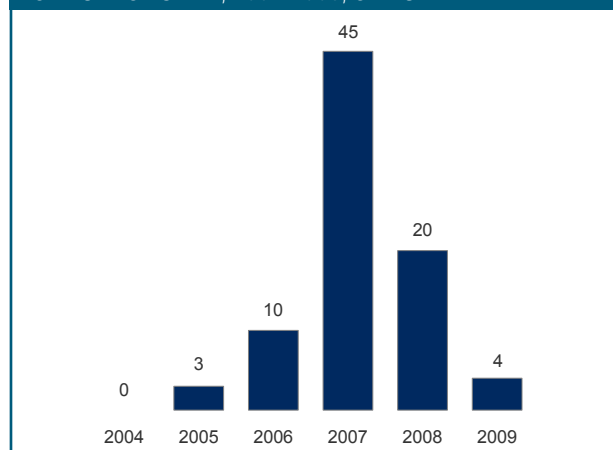
Finally, a further \$15.4 billion was held in energy and infrastructure funds (those that comprise large funds with at least 10% marked for renewable energy infrastructure investment). This was 49.5% higher year-on-year.

In all, the value of funds under management by March 2009 in the universe of clean energy and energy efficiency funds totalled \$129 billion, a 35.2% increase on the \$95.4 billion one year earlier.

Not only has the volume of money under management grown over the last year, the focus of investment type has also changed.

Within 'clean energy' funds – the largest group by volume of funds and that most directly focused on the sector – the snapshot taken in March 2009 showing the size and type of funds revealed that the biggest share of the money was directed towards project equity and project debt, via private equity, and occasionally debt, funds. It is clear that renewable power projects, shored up by state subsidies for renewable

FIGURE 43. SUSTAINABLE ENERGY PUBLIC EQUITY FUNDS LAUNCHED, 2004-2009, UNITS



Source: Bloomberg New Energy Finance

power projects and power purchase agreements, held considerable appeal for investors when they were looking for relatively low-risk opportunities after the shocking events of the financial crisis.

By March 2010, the picture within clean energy funds had changed somewhat (see Figure 41). The value of disclosed funds investing in project debt and project equity had inched ahead over the year to \$20 billion and \$18.1 billion respectively, but the biggest shift was the growth in the volume of money available for investment in public equity. This reached \$23.3 billion, up from \$14.5 billion a year earlier – reflecting a combination of recovering valuations of the stocks already held by funds, and a modest amount of fund raising during the 12 months, particularly by specialist clean energy vehicles, including exchange-traded funds. There was a strong, general recovery in equities, with the WilderHill New Energy Global Innovation Index up 68% between its low at the beginning of March 2009 and the end of March 2010.

There are distinct trends in the type of investment made within the four categories of clean energy-focused funds (see Figure 41). Venture capital and private equity investments, for example, tend to be made by investment funds that are broad-ranging in scope. By contrast, project equity and project debt investment remains a niche area and so is mainly made by more tightly focused 'clean energy' funds – those that invest 50% or more in the sector.

Looking to the year ahead, a number of issues are expected to prevail. The first is a potential shortage of capital for the sector. At present, there is an overhang of uncommitted funds from 2007 and 2008; however, the combination of lower fundraising and the pace at which some funds are deploying capital – taking advantage of more modest valuations for cleantech and renewable energy companies and projects – means that much of this overhang is likely to be committed over the next year to 15 months.

There are concerns among some investors that fund managers with unspent commitments will be drawn to higher-risk markets. Where there is a shortage of assets, certain fund managers are looking afield – to Latin America for wind, particularly Brazil, and to India for solar given the recent feed-in tariffs announced there.

The challenge of replenishing depleted coffers will also be a prominent feature of the coming year. Even established firms with long track records are finding it difficult to reach first close. CVC Capital Partners launched its first infrastructure fund more than a year ago, but still has not reached a close, neither has Blackstone's Cleantech Venture Partners Fund.

Investors are not rushing back into private equity as a number of them had their fingers burnt in the wake of the financial crisis. Many private equity and infrastructure investors who overpaid for, and over-gear, assets are nursing their wounds and are understandably wary of a repeat performance.

Nevertheless, some firms have raised funding. Earth Capital Partners, a management company planning to raise EUR 750 million (\$1 billion) to invest in solar and waste energy infrastructure projects, reached first close of a fund it launched at the end of November 2009. As well as pension funds, ECP is seeking investment from companies, sovereign wealth funds and high net-worth individuals.

Fortis Investments, now owned by BNP Paribas, managed to close its debut fund. The Fortis Clean Energy Fund, which invests in infrastructure projects, was launched in September 2008 during the most virulent phase of the world financial crisis and was initially expected to close in Q1 2009 but was delayed by about six months. It eventually closed at EUR 158 million (\$233 million) and managers are confident it will reach its target of EUR 450 million in 2010.

A number of other large clean energy technology-oriented funds have also raised money recently. The DB Masdar Clean Tech Fund, for instance, expects to invest at least half of its \$265 million in renewable power technologies.

More recently, Massachusetts-based Battery Ventures closed its ninth fund at \$750 million and said a portion of the proceeds will go to "clean technology" investments, while a UK government-backed "low-carbon and clean technology" fund managed by Hermes Private Equity reached a first close at GBP 125 million (\$202 million), thanks to an injection of GBP 75 million from a key Hermes client, the British Telecom Pension Scheme.

The contribution of pension funds to the sector is growing and may help plug the looming funding gap. Danish pension fund ATP, for instance, made a \$400 million commitment to US private equity investor Hudson Clean Energy Partners' first fund, which closed at just above the targeted \$1 billion in December 2009. Other pension funds investing in the sector include Norway's government pension fund, which has a

mandate to invest \$3.1 billion in the space by 2015, and AP7, a Swedish state pension fund that manages about SEK 100 billion (\$14 billion). The latter has plans to triple its investment in renewable energy to about SEK 3 billion (\$410 million) over the next two years from SEK 1 billion today.

In the UK, the Universities Superannuation Scheme says it is investing approximately \$250 million in cleantech and renewable energy assets through listed and unlisted asset ownership.

While these pension funds will not invest in projects and companies directly, others are keen to tap them for funding. Rabobank, the Dutch institution that is one of Europe's leading lenders to wind and solar projects, said that despite the gradual market recovery from the financial crisis, there was still a shortage of debt for wind and solar projects in Europe. It recently announced that it is looking to raise between EUR 1 billion (\$1.3 billion) and EUR 1.5 billion (\$2 billion), and is in discussions with investors, including pension funds, in the Benelux countries, the UK, Ireland, Germany and the Nordic countries.

European pension funds are starting to take an increasing interest outside the EU and North America with for instance ATP announcing at COP15 in Copenhagen its intention to invest EUR 1 billion in low-carbon sectors in emerging markets.

Funds in emerging markets were raising capital in 2009, although more slowly than in recent years. For example the Renewable Energy Asia Fund managed by Berkeley Energy achieved a first closing of \$74 million, while the South African Evolution One Fund managed a final closing for a total of \$93 million. These private equity funds are principally financing project equity in the wind and small hydro sectors.

Project development capital remains hard to source in the emerging markets and therefore in 2009 UNEP, the Asian Development Bank and the African Development Bank jointly launched a Seed Capital Assistance Facility that is backing seven private equity funds to provide early-stage financing to clean energy projects. The Evolution One Fund was the first to sign a SCAF Cooperating Fund Agreement for the development of 300MW of wind farm assets in the Eastern Cape province of South Africa.

CARBON REPORT

- The value of the global traded carbon market increased by 4% in 2009 to stand at \$128 billion, though growth was much weaker than in previous years. New investment flows into carbon projects via the CDM, JI and other mechanisms are estimated to have fallen by around half in 2009.
- Ongoing regulatory uncertainty and the continued absence of binding carbon reduction targets, as well as the global economic climate, constrained new investment flows. Investment in carbon funds slowed to a near halt and fewer new Certified Emission Reduction (CER) projects were added to the pipeline in 2009.
- By 2020, the global carbon market is projected to be worth \$875 billion. The US, Japan and Australia have set the wheels in motion towards enacting their own emission reduction schemes from 2012, but there have been many setbacks along the way already. Such schemes in those countries would provide greater surety of demand for CDM project developers.

The impact of the global recession and ongoing lack of clarity on a global emissions policy framework weighed heavily on investment activity in carbon finance markets in 2009. Though the overall value of the global traded market in carbon grew marginally on the previous year, up by 4%, it was at a far slower rate than previous years. Furthermore, CER project development slowed and new investments in carbon funds shrunk to almost zero.

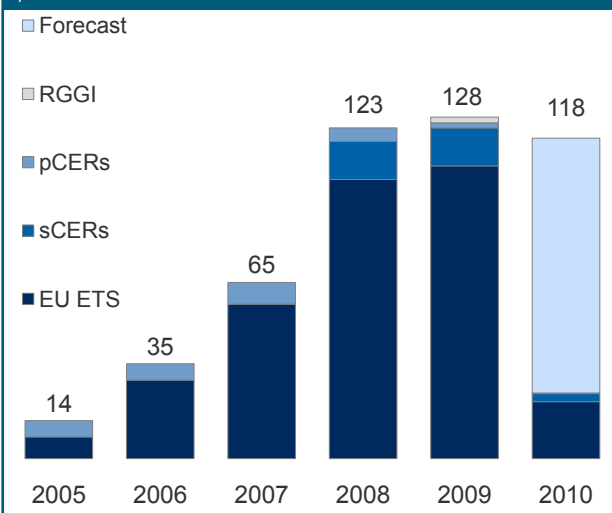
The muted global economic climate had a negative impact on carbon trading worldwide, and the knock-on fall in industrial output, in Europe in particular, created uncertainty over future demand levels for emission credits. Furthermore, they restricted investor appetite for higher-risk projects.

In the short term, regulatory uncertainty is likely to continue to restrict investor confidence, though the longer-term picture implies much stronger growth opportunities from 2012 onwards, driven by a ramp-up in EU /Emission Trading System buying and the possibility that the US, Japan and Australia will implement their own carbon reduction schemes. These schemes are forecast to go ahead independently of a global emissions reduction agreement, which was the intended outcome of the UNFCCC meeting in Copenhagen in December 2009. Any further progress towards this objective during 2010 could potentially be the catalyst to even faster growth. This anticipated new demand will underpin the price of emissions credits, and that in turn should encourage further CER projects to come to market.

Measuring new investment flows into carbon projects is notoriously difficult. One of the best estimates comes from the World Bank, most recently in its State Of The Carbon Market 2010. It put carbon market inflows via primary CDM, JI and voluntary market project-based transactions in 2009 at \$3.4 billion, down 54% from 2008 levels.

The value of the traded carbon market does not shed light on the scale of project activity, but it does reflect the extent of trading activity and the carbon price. The value of the global

FIGURE 44. VALUE OF CARBON MARKET 2005 - 2009, \$ BILLION



Source: Bloomberg New Energy Finance

FIGURE 45. FORECASTED VALUE OF CARBON MARKET TO 2010, \$ BILLION



Source: Bloomberg New Energy Finance

traded carbon market stood at \$128 billion at the end of 2009, up by a modest 4% from the previous year (see Figure 44). This growth is weak in comparison with the compound annual growth of 102% experienced between 2005 and 2008. Trading volumes continued to record robust growth, rising by 96% in 2009 compared with 2008, though the dramatic increase in volumes was offset by a falling carbon price, thereby suppressing the rate of overall growth in market value.

Bloomberg New Energy Finance anticipates that the value of the traded global market in 2010 will fall for the first time. The projected market value is \$118 billion, which would represent a 7% drop from 2009 levels. This fall is expected to result from the fact that some proportion of the 2009 trading volumes was artificially inflated by VAT fraud. That will not be repeated this year. In addition, the carbon price is forecast to remain fairly stable, and if so, market values will get no boost from that.

In the longer term, the global value of carbon trade is forecast to reach \$874 billion by 2020 (see Figure 46). The pace of growth is expected to develop particularly rapidly from 2013 onwards as the impact of Phase 3 of the EU ETS, allied to the expected development of carbon markets in the US, Japan and Australia, contributes new sources of demand for emission reduction credits.

Europe is presently the prominent global location for carbon trading. The EU ETS continues to be the largest market for carbon emissions, accounting for 85% of trading by value in 2009. The secondary CER market was the next largest, with 11%.

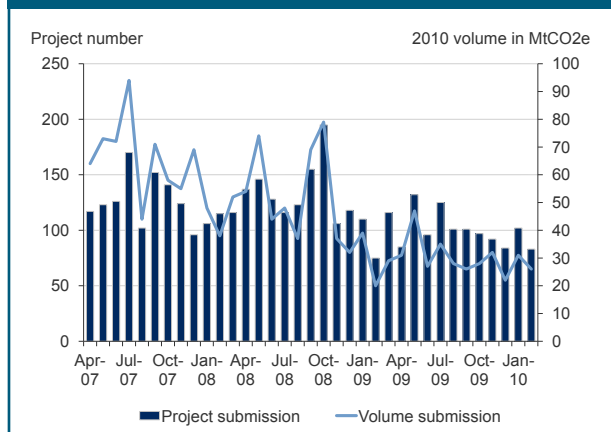
The UNFCCC meeting in Copenhagen (COP15) in December 2009 failed to deliver the binding carbon reduction targets that are needed to underpin a global cap-and-trade system. This may have the near-term impact of prompting countries to act unilaterally to enact carbon reduction schemes. Though these programmes may ultimately be woven into a global framework, the immediate way forward is likely to consist of national or regional schemes that will lead to multiple prices for carbon. This lack of fungibility of credits is largely explained by eligibility constraints between markets.

Both the US and Australian proposals encountered headwinds as they attempt to pass through the legislative phases. In both countries bills cleared the lower houses but failed to get past the Senate stage. Clean energy legislation may continue to run up against contrasting political priorities in the absence of fresh political impetus.

Figures 47 and 48 show recent trends in CER projects and credit issuances. CDM project credit issuance still continues to be small when compared with the scale of global emissions. CER credits issued at the end of 2009 totalled 368Mt, which compares with annual global emissions of 40 GtCO₂e.

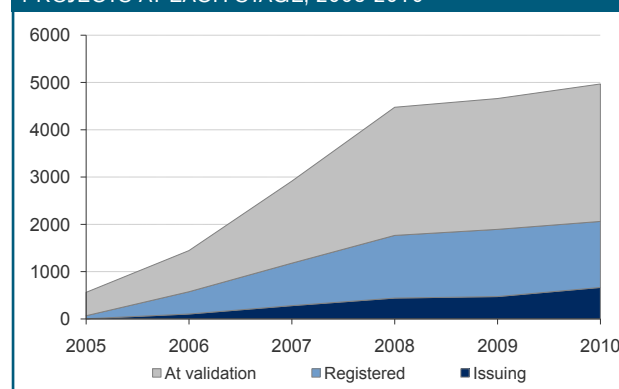
New CDM project submissions were lower in 2009 than in the previous year. The number of projects fell in number from

FIGURE 46. PROJECT SUBMISSION TO THE CER PIPELINE, MONTHLY NUMBER OF PROJECTS AND VOLUME 2012 MTCO₂E



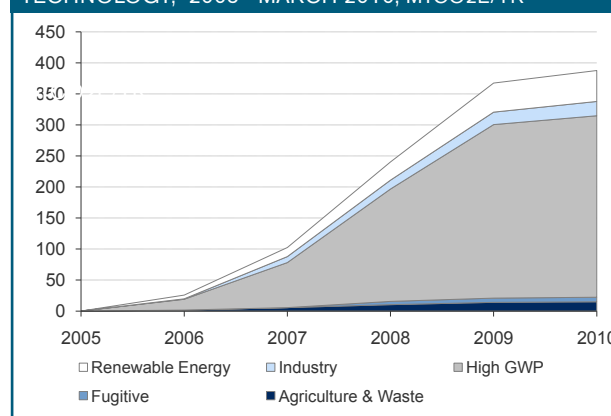
Source: Bloomberg New Energy Finance

FIGURE 47. CER PROJECT PIPELINE, NUMBER OF PROJECTS AT EACH STAGE, 2005-2010



Source: Bloomberg New Energy Finance

FIGURE 48. CER CREDIT ISSUANCES, VOLUME BY TECHNOLOGY, 2005 - MARCH 2010, MTCO₂E/YR



Source: Bloomberg New Energy Finance

1561 to 1214 on the year, with the volume of emissions they represent falling 40% from 611 MtCO₂e to 364 MtCO₂e over the period.

CER credit issuance is presently dominated by projects that address the emissions of high global warming potential (GWP) gasses. At the end of 2009 these projects accounted for 76% of the total credits issued. The scope of these projects is finite and a greater proportion of credits will come via other technologies in the future with hydrogen and wind prevalent in the project pipeline.

The rapidly industrialising countries of China, India and Brazil are important sources of CDM projects. By March 2010, some 78% of the projects being issued credits worldwide were based in these countries, receiving 301Mt CO₂e of CER credits between them. Participation by other smaller developing countries is typically low, but a review of the eligibility of projects which target afforestation and reforestation resulting in up to 16kt of CO₂ reductions per year by lower income communities, could lead to increased project activity and greater access to revenue on the part of these countries.

While low demand prospects and the global economic crisis have caused project development to falter in 2009, the slowdown in China was particularly strong. From 2008 to 2009 the number of project submissions in China dropped by 30%, while development in all other host countries declined by 25%.

At 20 April 2010, 752 projects have been removed from the pipeline at validation stage, while another 147 projects have been rejected at registration. Biomass, hydro, wind and energy efficiency projects are among the project types with the highest number of rejections, together accounting for more than 80% of all rejections. In contrast, no industrial gas project has been rejected to date.

The falling price of CERs in 2009 may well have caused developers to reassess the longer-term viability of projects, or at least delay bringing them forward. The price of CERs fell to a low of EUR 7.50 per tonne during February 2009, though it recovered to trade higher, reaching its year high of EUR 13.60 per tonne in October. This is some way down from the peak of EUR 23.80 per tonne in July 2008.

The new money raised by carbon based investment funds slowed to a near halt during 2009, with just \$50 million invested during the year, down from \$762 million in 2008. To put this in perspective, new investment into funds during 2009 stood at only 1% of 2007 levels of \$4.6 billion.

This current inertia in investment inflows can be attributed to weak short-term demand for credits. The market for emission permits within the Kyoto period to 2012 is thought to be in balance and there is a lack of certainty over the sources of future demand after this date. At present, Europe is the only guaranteed source of demand post 2012 and this appetite can be satisfied by existing projects. The hope among carbon market investors is that policy developments within the US, Japan and Australia will be the catalyst for a renewed pick-up in activity.



CHAPTER 10 INVESTMENT IN DEVELOPING COUNTRIES – CHINA, INDIA AND BRAZIL

- China, Brazil and India ranked first, fifth and eighth in the world, attracting a combined total of \$44.2 billion in 2009, representing 37% of global financial investment in clean energy.
- Investment in China grew by 53% from 2008. Wind attracted 81% of new financial investment in clean energy in that country, with \$27.2 billion of new funding. The potential for renewables investment is vast, with the government indicating that renewable power's share of total energy consumption will rise to 15% by 2020.
- Brazil recorded financial investment of \$7.8 billion, which was 39% lower than in 2008. Biofuels remained the largest beneficiary with \$3.3 billion, though this was down by 66% on 2008 levels as investors proceeded with caution after the financial crisis. Wind saw the fastest growth, attracting more than three times the investment it did in Brazil in 2008.
- Investment in India fell back in 2009 to \$2.7 billion, from \$3.4 billion the previous year, despite the economy's resumption of its rapid growth trajectory in 2009. Wind attracted 59% of financial investment in clean energy in India in the year.

The rapidly industrialising economies of China, Brazil and India have dramatically altered the new energy investment landscape in recent years. China became the largest recipient of renewable investment in 2009, attracting \$33.7 billion. This was 98% higher than the US in second place, and an increase of 53% on 2008. China's investment represented 77% as much as that in the whole of Europe. Even more startlingly, it represented a thirteenfold increase on comparable 2005 levels.

Brazil and India are also major international players, with new investment of \$7.8 billion and \$2.7 billion respectively during 2009, seeing them ranked fifth and eighth globally, though both of these economies saw reduced investment in clean energy in 2009 compared with 2008, as the economic climate weighed on investor sentiment.

Forecasters expect all three nations to enjoy growth in economic output and energy demand that will outpace the

global average. This, allied to tougher policy commitments made during 2009 to reduce carbon intensity, implies that all will remain significant global players in clean energy investment for the foreseeable future.

CHINA

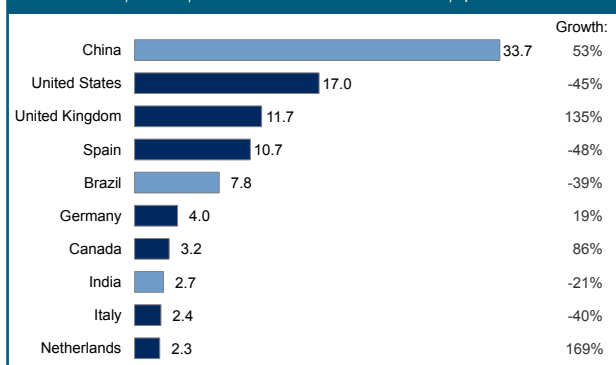
New financial investment in renewables in China reached \$33.7 billion in 2009, putting it ahead of all other countries. China accounted for over a quarter of global financial investment (28%) and it recorded growth of 53% between 2008 and 2009. A combination of centrally-driven capacity targets and good access to finance saw investment, particularly asset finance, go from strength to strength.

The increase in renewable capacity has admittedly been from a low base, given China's high dependency on fossil fuels for electricity. In excess of 80% of power production is sourced from conventional, thermal plant using coal or gas. Renewables, excluding large hydro, currently account for only 4% of generation capacity, but government sources have indicated a longer-term ambition for this share to rise to 15% by 2020.

Prior to the Copenhagen climate summit in December 2009, the Chinese government announced it would set targets to reduce the carbon intensity of economic output by between 40% and 45% by 2020. This implies the need for the further rapid development of the renewables sector in the near term, as well as action on energy efficiency by generation, transmission and consuming sectors.

The majority of the new investment in clean energy in China in 2009 was channelled toward wind energy projects. At \$27.2

FIGURE 49. NEW FINANCIAL SECTOR INVESTMENT BY COUNTRY, 2009, AND GROWTH ON 2008, \$BN



Top 10 countries. Adjusted for re-invested equity

Source: Bloomberg New Energy Finance

billion, it represented 81% of the national total, and a 63% rise from the 2008 figure of \$16.7 billion. Solar was next at \$3.3 billion (10%) followed by biomass at \$3 billion (9%). All other renewable energy sources accounted for less than half of one percent, combined.

FIGURE 50. FINANCIAL NEW INVESTMENT IN CHINA BY SECTOR AND ASSET CLASS, 2009, \$BN

Data				
Units: \$bn	Asset finance	Public markets	VC/PE	Total
Energy smart technologies	0	0.04	0.03	0.1
Other renewables	0.02	0	0.05	0.1
Biomass & w-t-e	3.0	0	0.0	3.0
Solar	1.6	1.6	0.1	3.3
Wind	24.5	2.8	0.01	27.2

Other renewables includes biofuels, geothermal & small hydro. Asset finance adjusts for re-invested equity.

Source: Bloomberg New Energy Finance

The increase in wind sector investment propelled China into approximate parity with Germany in terms of installed wind capacity, with only the US still ahead of it. Capacity more than doubled on the previous year, up from 12GW to 25.8GW according to GWEC figures. This expansion makes the official longer-term government target of 30GW by 2020 look more than attainable, and indeed there is now talk of a big increase in the target towards 150GW.

The outlook for the Chinese wind market is positive for project development, as policy moves such as the imposition of a new feed-in tariff and an abundance of low-interest state bank loans, along with cheap turbines, continue to fuel a surge in development.

Solar capacity more than doubled in the space of a year to 290MW, from 140MW in 2008 and solar investment rose from \$1.9 billion to \$3.3 billion. This expansion of the market was largely due to the building-mounted PV subsidy scheme and the 'Golden Sun' programme, announced in March and July 2009 respectively. These provided a fixed feed-in tariff regime for solar PV projects.

Cost reduction in some Chinese silicon plants has been significant and faster than expected. This is improving the commercial viability of solar projects. Despite falling input costs, market consolidation is on the cards among Chinese PV manufacturers. Some of them used risky procurement and expansion strategies, backed by low-interest bank loans from China's state-owned banks. The expectation is that weaker players will fall by the wayside and only cost-leaders will survive.

Biomass was the third largest recipient of financial investment at \$3.0 billion, though rumours of a downward revision to China's biomass energy target continue to dent investor confidence. The sector continues to face financial difficulties, mostly related to the high cost of biomass feedstock purchase, collection, and storage. Aside from the straw-abundant provinces in eastern China (Shandong, Henan, Jiangsu, Anhui), the northeastern province Heilongjiang is emerging as a hot-spot for the sector, with the largest project pipeline in China and considerably lower feedstock prices.

Biofuels would seem to feature lower on investors' priorities in China than other renewable energies. Biofuels investment was practically negligible during 2009 and consequently production capacity remains largely unchanged. Bioethanol production capacity remained at 1.7 billion litres, and biodiesel was up only slightly to 1.2 billion litres. Long-dated government targets to 2020 envisage growth in these areas but investment activity will need to pick up to make them a reality.

The dominant form of investment in Chinese clean energy is made via asset finance, which accounted for \$29.2 billion (87%) of the total financial investment in clean energy in China in 2009, up from \$22.0 billion in 2008. Asset-based lending was strong as banks sought to meet ambitious targets.

Public market fundraising reached \$4.4 billion in 2009, a dramatic jump from the \$0.2 billion the previous year under sclerotic market conditions. The largest public market deal was undertaken by Longyuan Electric Power, China-based wind project developer, which raised \$2.6 billion in an IPO on the Hong Kong Stock Exchange in December 2009. That issue had been shelved during 2008 due to the global economic climate.

Suntech Power Holdings and Yingli Green both tapped the markets for further capital via secondary offerings of American Depository Shares on the New York Stock Exchange, raising \$287 million and \$239 million respectively.

Venture capital and private equity investments were relatively insignificant in China at \$0.2 billion, down from \$0.7 billion in 2008. The largest clean energy deal in this space in 2009 was the sale of a 15% stake in a plant owned by LDK, a



manufacturer of solar wafers to Jiangxi International Trust, in a deal valued at \$219 million, but this has not been included in the 2009 figure because it was a buy-out of shares in an existing asset.

M&A activity was subdued, though GCL-Poly Energy Holdings acquired 100% of GCL Solar Energy, China-based solar-grade polysilicon producer, for \$3.4 billion in the largest transaction.

BRAZIL

FIGURE 51. FINANCIAL NEW INVESTMENT IN BRAZIL BY SECTOR AND ASSET CLASS, 2009, \$BN

Data				
Units: \$bn	Asset finance	Public markets	VC/PE	Grand Total
Biomass & w-t-e	0.6	0.0	0.0	0.6
Small hydro	1.7	0.0	0.0	1.7
Wind	2.0	0.2	0.0	2.2
Biofuels	2.6	7.0	0.30	3.3

Asset finance adjusts for re-invested equity.

Source: Bloomberg New Energy Finance

Brazil saw \$7.8 billion of new financial investment in clean energy in 2009, enough to see it ranked fifth in the world. However investment was down by 39% on 2008 from \$12.8 billion, with access to capital, notably in the biofuels sector, constrained as banks turned more cautious on lending in the face of the economic downturn.

Brazil is a major clean energy centre, being a pioneering producer of biofuels and important generator of hydroelectric power. It is also the third largest consumer of hydro-electricity in the world after China and Canada at 364TWh.

From a policy perspective, Brazil committed in the run up to the Copenhagen summit to reducing carbon emissions by 39% below its expected growth trajectory by 2020. It is expected that investment in renewables will play a key role in reaching this target. Renewable power excluding large hydro presently accounts for 9.1GW, which represents 9.8% of generation capacity.

Biofuel was the largest destination for investment, at \$3.3 billion, accounting for 42% of the country's total, though this was down by 66% from 2008 as access to finance became more difficult.

Brazil is the second largest ethanol producer in the world behind the US. Though the country is a major exporter, domestic Brazilian demand continued to drive sales of biofuels in 2009. Having overtaken gasoline as the largest source of road fuel in 2008, ethanol continued to grow faster than its fossil fuel rival, as the relative price of the former was around 60% of the

latter during the year, despite the softening in global oil prices. The increasingly widespread occurrence of flex-fuel cars will increase the potential for drivers to respond to price signals. Ethanol production capacity rose from 25 billion to 30 billion litres during the year. Biodiesel was up from 3.4 billion to 3.8 billion litres.

During the year, in a bid to develop its ethanol sector along more sustainable lines, the Brazilian government approved an agricultural map designating which areas of the country are suitable to grow sugar cane. This was to cope with the expectation that over the next 8-10 years, the industry will require 6m additional hectares for expansion, less than 1% of the land mass of Brazil. Companies that build sugar cane refineries outside areas the government has ordained suitable for the crop will not be able to access government financing, in particular cheap, long-term loans from national development bank BNDES.

Investment in wind took off in 2009, more than trebling to \$2.2 billion from \$0.7 billion the previous year. Installed wind capacity rose from 359MW to 605MW over the year. Part of the increase in wind was due to the appreciation of the real against the euro, the currency in which most turbine purchases are denominated. This had a positive impact on project economics.

During 2009 Brazil had its first wind energy auction, which commercialised 1.8GW of new projects and will quadruple total installed capacity from the current 600MW to 2.4GW by 2012.

Asset finance provided the majority of financial investment in Brazil at \$7 billion (89% of the total), followed by venture capital and private equity. There was only a very small role for public market finance in 2009.

Venture capital and private equity activity saw \$0.9 billion of investment in 2009, the majority of which was for biofuel company expansion, making Brazil the second largest global market for clean energy VC/PE activity after the US. In notable deals during the year, LDC-SEV raised \$232.5 million and Cosan Bioenergia \$223.4 million. Also in the year ERSa, the Sao Paulo based wind and small hydro developer, raised \$163 million, with the funding to be used to roll out 1GW of new capacity over the next five to seven years.

Merger and acquisition activity was substantially down on 2008 with what activity there was centred around the ethanol sector. The largest transaction in 2009 was Cosan acquiring a 100% stake in Sao Paulo-based ethanol producer Nova America for \$842.3 million. Bloomberg New Energy Finance estimates that there are up to 50 sugar and ethanol producers on the look out for new investors to address balance sheet issues. Brazilian companies struggled to access funding via the stock market, which saw negligible activity in 2009, after new investment of \$1.4 billion in 2008.

Brazil itself could be a major source of finance for renewable energy projects elsewhere in the world post 2012. President Luiz Inacio Lula da Silva announced that his country could stump up funds for a post-Kyoto Protocol financing mechanism geared at expediting clean energy projects in developing countries. A government official indicated that some \$5 billion of cheap, government-subsidised debt had been pledged to renewable energy projects in developing countries by national development bank BNDES. These will fund a wide range of projects from ethanol mills in Mozambique to wind farms in Central America.

INDIA

FIGURE 52. FINANCIAL NEW INVESTMENT IN INDIA BY SECTOR AND ASSET CLASS, 2009, \$BN

Data				
Sector/asset class	Asset finance	Public markets	VC/PE	Grand Total
Solar	0.05	0.02	0.03	0.1
Biofuels	0.1	0.1	0.0	0.2
Small hydro	0.2	0.0	0.0	0.2
Biomass & w-t-e	0.5	0.0	0.1	0.6
Wind	1.0	0.5	0.0	1.6

Asset finance adjusts for re-invested equity.

Source: Bloomberg New Energy Finance

Financial investment in clean energy in India stood at \$2.7 billion in 2009, ranking it eighth in the world, though this was down 21% from the \$3.4 billion seen in 2008. This was due to banks adopting a more cautious attitude to lending to renewable energy projects in the wake of the global economic slowdown. Asset finance, the largest form of clean energy investment in the country, fell back from \$3.1 billion in 2008 to \$1.9 billion in 2009.

In the run-up to COP15 in Copenhagen in December 2009, India announced its intention to reduce the carbon intensity of its economic output by 25% by 2020. This will require a substantial increase in renewables capacity. Excluding large hydro, renewables currently account for a modest 16.5GW (9%) of installed capacity, compared with conventional thermal at 65%. India faces a capacity deficit and investment in generation from both renewables and thermal power is required.

The wind energy sector was the largest recipient of new investment in 2009 at \$1.6 billion, representing 59% of the national total, some 11% higher than 2008. Wind proved more resilient than other sectors, most of which suffered drops in investment in 2009.

India moved up to fifth place in the world for installed wind power during the year. Capacity rose by 12%, from 9.7GW to 10.9GW, during 2009, according to GWEC. If it continues

to increase at this pace, the government target of 17.5GW by 2012 will not be attained.

In 2009 India released the Jawaharal Nehru Solar Mission which plans to target 20GW of installed solar capacity by 2022. This would represent a significant increase from current capacity which stands at just 6MW.

The power grid is under-supplied relative to demand. This causes chronic reliability issues and the solar initiative is lauded as a means of easing this problem by establishing more local generation. The plan also includes interim targets of 1GW of grid-connected capacity by 2013 and 4GW by 2017.

The proposed feed in tariffs would make private investment in projects attractive and would imply that investment in solar will likely pick up dramatically from present levels. In 2009, it was ranked fifth among sectors in terms of attracting new funding within India, with \$0.1 billion.

Biomass and waste was the second largest sector recipient of investment, generating \$0.6 billion of new financial investment or 22% of the total. During 2009, the Indian Ministry of New and Renewable Energy prepared a set of guidelines on biomass projects to provide transparent information to stakeholders. Government sources indicate that India has a potential for 18GW of biomass power and 5GW of cogeneration power from sugar mills, but it has achieved only 800MW and 1.2GW respectively so far.

During 2009, the Indian government approved its national biofuels policy, targeting 20% biodiesel and ethanol blends in diesel and petrol respectively by 2017. Under the plan, the government proposes a minimum support price for non-edible oilseeds. This policy framework ought to see investment in the sector increase from current levels of \$0.2 billion, which was less than 10% of the total financial investment in clean energy in 2009.

Clean energy investment in India in 2009 was dominated by asset-based finance, with \$1.9 billion (73%) coming in this form. This was down from \$3.1 billion in 2008. Public market activity in India made up the bulk of the remainder with \$0.7 billion (25%). NHPC, the Indian state-owned hydro power company, raised \$1.3 billion via an IPO on the National Stock Exchange and Bombay Stock Exchange during the year. NHPC intended to use the net proceeds of the issue for general corporate purposes, as well as to finance the construction and development costs of hydro-electric projects. This equity issue is not included in the clean energy public markets total, since the main focus was large hydro rather than new renewables.

Private equity and venture capital activity in India constituted a very small proportion of all investment, at just 4% of the clean energy total or \$0.1 billion. This was down from \$0.4 billion in 2008. Late in 2009, wafer, cell and module maker Jupiter Solar Power announced plans to raise \$193 million to finance expansion, but this was not completed before the end of the year.

CHAPTER 11

INVESTMENT IN DEVELOPING COUNTRIES – OUTSIDE THE “BIG THREE”

- Developing countries in Latin America, Africa and Asia (excluding Brazil, India and China) received \$7.5 billion of new financial investment in 2009, some 6.3% of the global total and 26% higher than 2008 levels.
- Mexico was the largest recipient of clean energy investment in Latin America with \$2 billion of new funds, followed by Chile with \$0.7 billion. Developing Asian nations saw investment fall on 2008 levels, though Pakistan experienced a rise, becoming the largest recipient in the region with \$0.5 billion of new investment.
- New investment in Africa was led by Egypt, but the continent's total was down slightly on 2008 levels.

New financial investment in the developing countries in Asia, Latin America and Africa, excluding the giants Brazil, China and India, was \$7.5 billion in 2009, up from \$6 billion in 2008, with the increase being provided mostly by Latin America. In contrast, Asia and Africa saw reduced investment in 2009 compared with 2008. These developing countries in the three regions account for 6.3% of total new global investment in clean energy.

OTHER ASIA

FIGURE 53. FINANCIAL NEW INVESTMENT IN NON-OECD ASIA (EXCLUDING CHINA AND INDIA), BY COUNTRY 2009, \$BN



Omits countries with less than \$0.1bn investment

Source: Bloomberg New Energy Finance

New investment in developing Asia (excluding China and India) fell from \$3.1 billion in 2008 to \$2.5 billion in 2009. This equated to just 6% of overall new investment in Asia, reflecting the dominance of China in that total as well as the more modest scale of capital commitments elsewhere.

Of those developing countries outside the big two in Asia, Taiwan (Province of China) saw the largest investment at \$0.9

billion in 2009, up from \$0.3 billion the previous year. Pakistan, Indonesia, Thailand, Philippines and Vietnam ranked next by investment (see Figure 53).

During 2009, Pakistan's Alternative Energy Development Agency announced its aim to source a 14% share of the national energy mix from renewables by 2022. This implied a cumulative capacity addition of 17GW of renewable energy. The majority of this are likely to come from wind power.

The core aim of the proposed policy is to make Pakistan self sufficient in energy supplies by adding capacity from different sources, including renewables. The country had only 42MW of grid-connected renewable energy in 2009 and plans to add another 100MW this year.

Biofuel developments in Pakistan also saw investment, with Canada-based Kijani Energy announcing plans to spend \$130 million to grow large-scale jatropha and set up an oil extraction unit. The country has set a target of blending 5% biodiesel with conventional diesel by 2015.

A large share of the investment in clean energy in Indonesia is channelled into exploiting the potential of geothermal energy. It is estimated that Indonesian volcanoes possess around 28GW of exploitable geothermal potential, though only 1.1GW of capacity is currently installed. During 2009, Indonesian geothermal firm PT Geo Dipa Energi secured a \$103 million loan for its 55MW project in West Java, enabling it to start construction. GE Energy Financial Services made its first geothermal investment outside the US, announcing a \$50 million loan for the 220MW Wayang Windu plant in Indonesia developed by Star Energy.

In Thailand, Hong Kong-based CLP Holdings, Thai utility EGCO and Japan's Mitsubishi are planning to set up a 73MW PV plant near Bangkok that will require an investment of nearly \$270 million. The project is expected to be completed in 2011. The incentives offered by the Thai government for renewable energy projects, including tax holidays and soft loans, will help make the project commercially viable.

State-owned utility Electricity Generating Authority of Thailand said it will invest \$880 million for renewable energy projects through to 2025. The investment, some 36% more than under a previously announced plan, is in response to the government's target for 20% of all energy to be derived from renewable sources by 2023. The country sources about 5% of its energy from renewables (excluding large hydro) presently.

The Philippines has an established geothermal sector and is presently the second largest producer in the world after the US. During 2009, geothermal firm Energy Development Corporation said it plans to develop 200MW of greenfield projects, which will take the firm closer to challenging Ormat as the largest geothermal generator in the world. The country is aiming to double its renewable energy capacity to 9GW by 2020 though this figure includes the contribution of large hydro. Geothermal power is expected to play a major part in this target, with the Department of Energy estimating that it will produce 4.5GW. The rest is expected to come from hydro (1.3GW), wind (766MW), and marine (1.7GW).

On the supply side the International Finance Corporation signed in May 2010 a \$75 million loan with SunPower Philippines to bankroll 574MW of solar cell and module manufacturing facilities.

Vietnam plans to have 5% of its total electricity output coming from renewable sources by 2020. The country is estimated to have potential for 2GW of wind power, though access to finance is constraining project development.

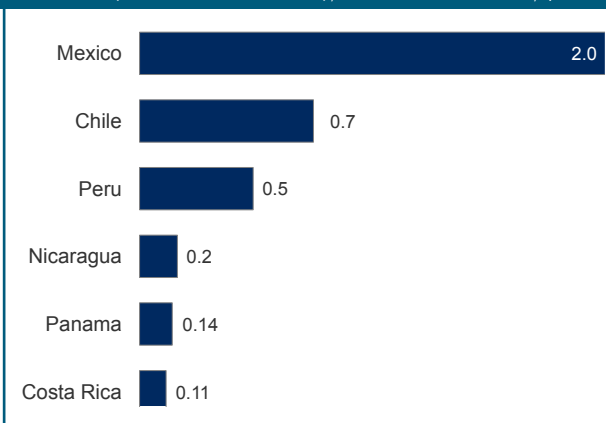
In 2009, US-based Golden State Biofuels signed a deal with the Vietnamese government to invest \$200 million to develop 10 ethanol plants. Under the 49-year agreement, the plants will use equipment manufactured in the US to produce ethanol from rice hulls. In the same year the Asian Development Bank signed a \$151 million loan agreement with the government of Vietnam for renewable energy in rural areas. The loan will be used for up to 10 run-of-river hydro projects.

OTHER LATIN AMERICA

New clean energy financial investment in Latin American countries, excluding Brazil, was \$3.8 billion in 2009, up from \$1.9 billion in 2008. Mexico was the largest individual country recipient of new investment, recording \$2.0 billion during the year (see Figure 54). Chile was the next largest with \$0.7 billion, followed by Peru, with the latter seeing a jump in investment to \$0.5 billion from \$0.1 billion in 2008.

During 2009, Mexico released a plan featuring specific targets for installed capacity and electrical generation from wind, geothermal, biomass, and biogas by 2012. Even though the targets are non-binding, they represent a clear government commitment to develop renewable energy.

FIGURE 54. FINANCIAL NEW INVESTMENT IN LATIN AMERICA (EXCLUDING BRAZIL), BY COUNTRY 2009, \$BN



Omits countries with less than \$0.1bn investment

Source: Bloomberg New Energy Finance

The programme calls for increasing the nation's installed renewable energy capacity from approximately 3.3% of the total in 2008 to 7.6% by 2012 with wind power the prime beneficiary. Under the plan, installed wind capacity will grow from approximately 0.1% of Mexico's total installed energy capacity in 2008, to 4.3% by 2012.

The Peruvian government concluded a tender process in November 2009 that was designed to add 500MW of new renewable generation capacity by 2012, in response to the Lima government adopting its first formal renewables target in 2008. This called for a renewables share of generation capacity of 5% by 2013.

Biomass projects accounted for 310MW of 412MW successfully tendered in the initial phase, though wind, solar, and small hydro projects were also approved. The new capacity, alongside Peru's existing 172MW of commissioned clean energy (excluding large hydro projects) would put the country on track to meet 7.6% of its electricity needs by 2013, significantly above the 5% target.

Chile enacted a law stipulating that 5% of total production in new energy contracts must be provided by non-conventional sources. By 2024 it must be 10% of total energy production, equivalent to a figure of 3410MW.

The new law requires new energy generation contracts to include 5% generated from renewable sources starting in 2010, with possible fines in place from 2014. That quota of renewable energy will then increase, starting by 0.5% each year from 2014 to 2025, when generators must secure 10% of power generated through renewable sources.

In Colombia, the national government has issued a directive that all new vehicles must have E85 flex-fuel capability by 2012. Colombia is second behind Brazil in biofuels production in South America, expecting to produce 137 million gallons of ethanol in 2010.

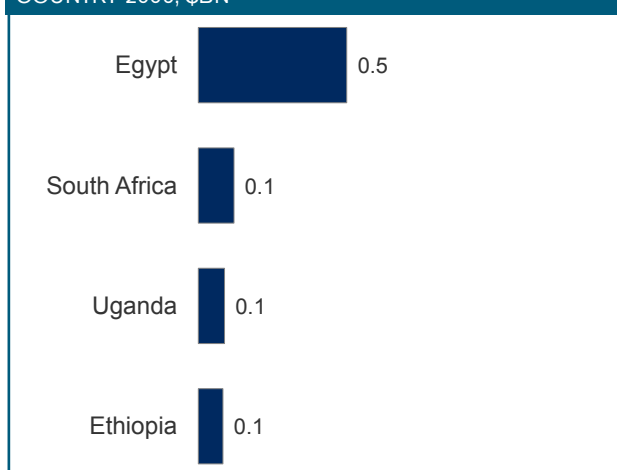
In Argentina the government launched a 1GW renewable energy tender as part of its new Renewable Energies Law that aims to achieve 8% of energy sourced from renewables by 2016.

Meanwhile the regional development bank Corporación Andina de Fomento was looking in 2009 to scale up its engagement through a \$2.23 billion Special Financing Program for Clean Energy Projects (Propel) operating in Argentina, Colombia, Ecuador, Peru, Uruguay, and Venezuela.

According to the Economic Commission for Latin America and the Caribbean (ECLAC), countries in the region will require investment of \$572 billion in the electricity sector between 2007 and 2030 to meet growing energy demand, or about \$24 billion annually. Including Brazil, the total clean energy investment in the region was \$11.9 billion in 2009, so already half of total required investment.

AFRICA

FIGURE 55. FINANCIAL NEW INVESTMENT IN AFRICA BY COUNTRY 2009, \$BN



Omits countries with less than \$0.1bn investment

Source: Bloomberg New Energy Finance

Africa remains a relatively minor player on the global clean energy landscape. Investment fell to \$0.9 billion in 2009, from \$1 billion the previous year, and the continent accounted for less than 1% of the global total. Egypt attracted the most investment with the wind sector being the major recipient in that country (see Figure 55).

The largest investment in Egypt in 2009 was in a \$490 million, 200MW wind project in the Gulf of El Zayt. It will be developed by the New and Renewable Energy Authority in collaboration with German development bank KfW and the European Investment Bank.

This project forms a further piece of Egypt's expanding wind ambitions in the Gulf of Suez region. Plans are in place to follow this new capacity with a 220MW farm in the same region in

cooperation with the Japanese Aid Agency, then a further 300MW stage in conjunction with the Spanish government. Egypt's strategy aims to satisfy 20% of the country's electric energy demands from renewables by 2020, including about 12% from wind power. The EIB has also been active elsewhere in the region, offering in December 2009 to lend southern Mediterranean states EUR 5 billion (\$6.71 billion) over three years to invest in renewable energy.

The South African Department of Energy launched its first national Integrated Resource Plan in 2009, outlining measures for incentivising energy efficiency and the development and commercialisation of renewable power.

The plan, formulated under the Electricity Regulation Act, outlines energy guidelines that public utility Eskom and the National Energy Regulator (NERSA) must follow. It stipulates that 1,145MW of power must come from renewable energy projects in the private sector by 2012.

The IRP focuses on saving energy rather than building new power stations. It includes plans to install solar panels on government buildings, as well as fit one million low cost, government-built homes with solar water geysers before 2014. In addition, it considers financial incentives to encourage households and companies to save energy.

Also in the year NERSA launched a set of feed-in tariffs designed to encourage investment in renewable energy. Under the proposed Renewable Energy Feed-in Tariffs scheme (REFIT), private renewable power generators will be able to sell electricity at fixed subsidised levels to Eskom, South Africa's electric utility.

A funding deal for French institutions to invest \$283.4 million in Ethiopia's 120MW Ashegoda wind farm was agreed in 2009. The total project cost of Ashegoda stands at \$315 million with 90% financed by banks and the balance from project developer Ethiopian Electric Power Corporation. The Ashegoda farm, located in the north of Ethiopia and deemed the first of its kind in the country, is in the initial stages of construction.

The World Bank announced plans to invest \$75 million in Uganda in the second Energy for Rural Transformation Project, which aims to increase access to renewable energy and information technologies in rural areas of the country.



MULTILATERAL DEVELOPMENT BANKS

Development assistance for renewables in developing countries jumped sharply in 2009 to more than \$5 billion. This compares with an estimated \$2 billion in 2008. The World Bank Group, including the International Finance Corporation and Multilateral Investment Guarantee Agency (MIGA), saw the largest increase in finance compared with previous years. Finance increased fivefold in 2009 as the World Bank Group committed \$1.38 billion to new renewables (solar, wind, geothermal, biomass, and hydro below 10 MW), and another \$177 million for large hydropower. (These figures exclude Global Environment Facility funds and carbon finance.)

The Asian Development Bank invested approximately \$933 million in renewable, including \$238 million in large hydro”; Para 4, change to “The Global Environment Facility (GEF) funded 13 renewable energy projects with a total direct GEF contribution of \$51.2 million and associated co-finance from other sources of \$386.8 million. The Inter-American Development Bank committed over \$1 billion in loans for renewable energy, including \$941 million for hydropower.

The World Bank and the regional development banks also joined forces to provide a range of new financing facilities through the newly formed Climate Investment Funds, including the \$300 million Scaling-up Renewable Energy Programme.

The Global Environment Facility (GEF) funded 26 renewable energy projects with a total direct GEF contribution of \$74 million and associated co-finance from other sources of \$477 million.

Bilateral development banks committed large funds to renewables in 2009. Germany's KfW committed EUR 284 million (\$381 million) to new renewables and an additional EUR 20 million (\$27 million) to large hydropower. In addition, KfW committed EUR 819 million (\$1.1 billion) at the governmental level for renewable energy during 2009 through its Special Facility for Renewable Energies and Energy Efficiency. The Netherlands Development Finance Company committed EUR 276 million (\$370 million), the Agence Française de Développement EUR 570 million (\$758 million) and the Japan International Corporation Agency provided JPY 110 billion (\$1.2 billion).

Other official development assistance (ODA) figures from a variety of bilateral and multilateral development agencies suggest additional flows to renewables to the order of \$100-200 million per year. UNEP and the UN more broadly have also been scaling up support for renewables deployment through a range of programmes.



CHAPTER 12

SPECIAL FOCUS: SUSTAINABLE ENERGY WITHIN THE CONTEXT OF A GREEN ECONOMY

- Since the concept of a global “green New Deal” gained prominence in 2008, national and regional green economy initiatives have been announced on a regular basis in both developed and developing countries.
- By May 2010, approximately \$188 billion had been allocated to measures to encourage clean energy within major economies’ green stimulus programmes, according to Bloomberg New Energy Finance, although only some \$16.6 billion, or 9%, was actually spent by the end of 2009.
- The potential to create green energy industries that can deliver jobs and economic growth is being examined by a number of institutions. Greenpeace estimates that, on business-as-usual trends, job losses are expected in the fossil fuel sector, which could be compensated for by job creation in the renewable energy industry.
- Meanwhile, the various costs of dependence on fossil fuels are being tallied. In 2010, subsidies to fossil fuels from governments around the world are likely to be some \$550 billion, according to the Global Studies Initiative. In June 2010, BP was still struggling to contain the two-month old Deepwater Horizon oil disaster in the Gulf of Mexico.

The notion of the green economy has attracted much interest as a result of the financial crisis. Advocates have argued for a shift from government stimulus to bail out the brown economy, to building a greener alternative. Green economy investments, both public and private, should lead to a higher share of clean technology sectors in the economy and green jobs in the workforce, while reducing energy and material intensities and waste generation. The purpose of this special focus section is to provide an update of the recent analysis and events that have brought the energy aspects of the green economy into closer focus.

According to Bloomberg New Energy Finance, some \$188 billion in government stimulus packages was allocated to greening and climate change measures in 15 major economies between the autumn of 2008 and early 2010. The actual delivery of green expenditures in 2009 was sluggish however, with only an estimated \$16.6 billion, or 9%, disbursed. But the company predicts that green stimulus spending will increase more than threefold in 2010 to \$55 billion, with an even higher figure to come in (see Figure 56).

A geographical breakdown shows that the US accounted for the largest green stimulus programme, at \$67 billion, with China at \$47 billion and South Korea \$25 billion (see Figure 57). The European Union countries announced smaller green stimuli in 2008-09, reflecting the fact that fiscal policy in their countries tends to adjust automatically towards deficit during recession, and also the fact that they were already providing significant help for clean energy via feed-in tariffs, targets, carbon prices and certificate schemes.

The green stimulus programmes consist of a mixture of grants for energy efficiency schemes, cash for research and

development, government contribution to grid developments, and assistance for projects. Figure 58 shows that efficiency is the area that stands to benefit most, receiving \$56 billion worldwide, followed by renewable energy (\$51 billion), grid improvements (\$32 billion) and research and development (\$27 billion).

Specific programmes include a EUR 4.5 billion CO₂ Building Regeneration Programme in Germany, EUR 1 billion clean energy elements in a EUR 5 billion sustainable projects programme in Spain, CAD 650 million for supporting carbon capture and storage projects in Canada, and CNY 130 billion for clean technology support in China.

A large part of government enthusiasm for greening the economy centres more on the economic growth potential of these sectors than the environmental benefits.

Until recently, China has mostly deployed an export-led strategy for its renewables sector growth, seeing significant results in 2009 as its leading companies took three spots in both the wind and solar manufacturers’ top-10 league tables. Solar exports from China were \$15 billion in 2008 and its wind industry’s movements into the US market, and Texas in particular, led four US Senators to call for the US stimulus programmes to be halted while legislation was crafted to limit support to projects using US-made devices.

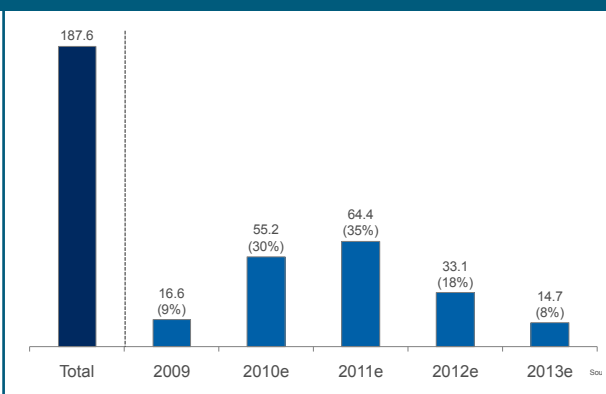
No subject related to green stimulus has attracted more attention than job creation. Estimates of green jobs created in the clean energy sector vary widely, depending partly on whether induced jobs are included. Induced jobs are people working in other sectors as a result of the money spent by employees of the clean energy sector. Another difference is whether the job

estimates are full-time equivalents, or whether, for instance, a farmer who makes some income out of operating a biogas plant is included as a full-time job. A third is productivity – many estimates for the future assume that the number of people employed per MW of renewable energy capacity will remain at current levels. This is clearly unrealistic, since all sectors and particularly those subject to fast technological change will see large productivity improvements by 2020 or 2030.

The German government for years has placed economic growth and job creation at the heart of its push to scale-up renewable energy in the country. Germany has set clear clean energy goals; for example, in 2020, at least 10% of the total energy demand and at least 20% of electricity is to be generated from the renewable resources wind, water, biomass, solar energy, and geothermal energy. The German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) conducted a study “Impact of the Expansion of Renewable Energy on the German Labour Market with Special Consideration of Foreign Trade” based on a two-year survey involving more than 1,000 companies and extensive theoretical models.^{vii} The study demonstrated that increased generation and use of renewable energy and job creation can go hand in hand permanently. Accordingly, employment in the renewable energy sector could double by 2020, even based on conservative assumptions. Furthermore, the net impact – after subtracting all possible negative employment effects – is also a clear and sustainable positive employment stimulus. According to an ongoing BMU research project, the number of people working in the renewables sector in Germany increased to around 300,500 in 2009. Compared with around 160,500 in 2004, approximately 140,000 new jobs were created in only five years.

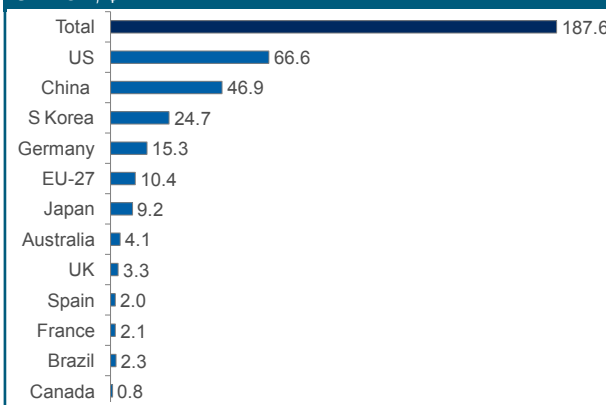
In its September 2009 report “Working for the climate”, Greenpeace projected that the overall global level of investment required in new power plants up to 2030 will be about \$11 to \$14 trillion.^{viii} In the Greenpeace projections under the reference scenario, the levels of investment in renewable energy and fossil fuels are almost equal, about \$4.5 trillion each up to 2030, but with an Energy [R]evolution Scenario the world shifts about 82% of investment towards renewable energy (20% in cogeneration, 62% in mainly PV, wind, biomass, geothermal, concentrating solar thermal). Then, the fossil fuel share of power sector investment would be focused mainly on combined heat and power and efficient gas-fired power plants. In an Energy [R]evolution scenario the overall increase of power sector jobs compared with the reference scenario would be around 2 million. This compares with a reference ‘high carbon’ scenario that projects half a million job losses in the power sector (see Figures 59 & 60). Even if gas capacity is increased by 50% to meet rising demand, total power sector jobs would not go back to 2010 levels.

FIGURE 56. ANNUAL PROFILE OF SPENDING ON CLEAN ENERGY STIMULI



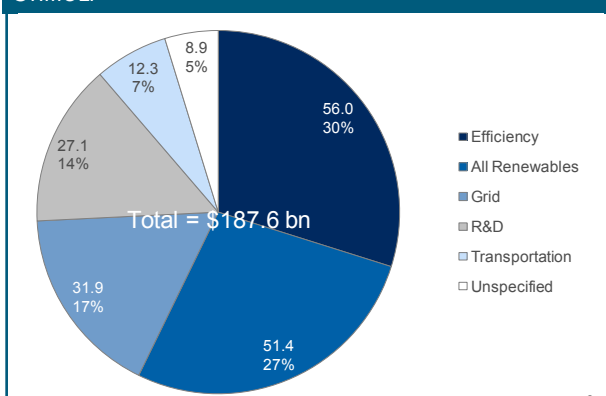
Source: Bloomberg New Energy Finance

FIGURE 57. COMPONENTS OF GREEN ECONOMIC STIMULI, \$BN



Source: Bloomberg New Energy Finance

FIGURE 58. SECTOR BREAKDOWN OF GREEN GLOBAL STIMULI



Source: Bloomberg New Energy Finance

Bloomberg New Energy Finance conducted a green jobs analysis on the wind and solar sectors in 2009. The findings were that the solar sector could expect significant net job creation between 2008 and 2025 (from 173,000 to 764,000), but that the wind sector would only see modest gains (from 309,000 to 337,000) due in part to sharp increases in productivity.

Most parts of the broad renewable energy sector are capital intensive, rather than labour intensive. Manufacturing a wind turbine or producing solar-grade silicon involves a lot of heavy plant and equipment, and the operation of wind farms and solar parks is highly automated. In general, for most renewable energy technologies, the manufacturing, construction and installation phases are the ones that offer the highest job creation potential. The opposite is true with fossil fuel technologies such as coal and natural gas. According to the 2008 UNEP/ILO greenjobs report, the technology which offers the highest employment generation is solar PV with 7 to 11 jobs per MW of average capacity.^{ix}

In late 2010, UNEP will be releasing its Green Economy Report, which will contain a modelled assessment of the impact of an additional share of 1%, 2% and 4% of GDP invested in various green sectors, including renewable energy, on global and selected national employment trends.

Job creation is only one measure of a number of economic benefits of investment in renewables and increasing energy efficiency. A green economy also implies the decoupling of environmental impacts, such as carbon emissions and resource use, from economic growth. When looking at the carbon intensity (the ratio of carbon emissions to economic activity) over the past 50 years, it can be noted that a number of economies have tended increasingly to decouple their carbon emissions from GDP growth, but few have made absolute reductions on a per capita basis.^x

The US, for instance, saw rapid growth in carbon dioxide emissions from 1960 to 1979, and then flattened out or

'decoupled' emissions growth while GDP continued to expand. This decoupling was mainly caused by an industrial decline in the US and an increased diversification of the economy, with the percentage of GDP attributable to industry falling steadily from 34.1% in 1981 to 21% in 2009.

China saw rapid growth in both emissions and GDP between 1960 and 2009, although on a per capita basis its absolute 2008 emissions of 4.9 tonnes per capita were still only about a quarter of the 19.2 tonnes emitted per capita in the US. Since 2005, China's emissions grew four times more rapidly than the global average. This growth in emissions is reflective of the economy's dependency on industry, which made up more than 49% of China's GDP in 2009. However, China has set a target of a 40-45% improvement in carbon intensity from 2005 levels by 2020 (nearly 4% per year), and a look at the CO₂ emission per unit of GDP shows that the current trend for improvement in recent years is in line with the set target, with an observed average annual CO₂ intensity reduction rate of 5% over the period 2005 to 2008. Since 1960, India has seen its carbon emissions increase by a factor of 10 to 15 whilst GDP has increased by a factor of six. Since the mid 2000s, India has started showing some initial signs of carbon decoupling from GDP growth.

In the case of Sweden, the country not only managed to bring to a peak its emissions intensity in 1970 but also its per-capita emissions, which were brought down more than 50% to 6.2 tonnes per capita by 2008. This full decoupling was due to achieving the highest share of renewables in the energy mix of any European country, a high reliance on nuclear and also de-industrialisation. Other European countries such as France and Germany have also managed to decrease per-capita emissions in recent years.

Although the timing and absolute reductions will need to be different for developed and developing economies, the success of ongoing climate negotiations will ride on the ability of countries to commit to economic development that not only



flattens emissions growth, but leads to absolute reductions on a per capita basis.

While some economies have been making efforts to reduce their CO₂ emissions, as already discussed in Chapter 2, the combined effect of existing targets falls short of what the Intergovernmental Panel on Climate Change has suggested is needed to prevent a two degree Celsius temperature rise.

One key to reversing carbon emissions growth would be the removal of fossil fuel subsidies. Over the past decade, subsidies to fossil fuels have reached record levels, with countries spending about \$500 billion in 2010, according to the Global Subsidies Initiative.^{xi} The OECD estimates that removing consumer subsidies in the 20 largest subsidising developing countries would yield significant environmental benefits, reducing global greenhouse gas emissions by 10% in 2050. And this captures only some of the world's subsidies – it excludes consumer subsidies in other countries and subsidies granted to producers of fossil fuels. In September 2009, the leaders of the Group of 20 countries agreed to phase out inefficient fossil-fuel subsidies in the medium term.

Looking beyond the issue of climate change and fossil fuel subsidies, many other societal costs of fossil fuel production and use are well-known and yet are still not reflected in market prices. In 2009 and 2010, a number of studies have been examining the cost of fossil fuel externalities.

Data analysis conducted by the Food and Agriculture Organization in December 2009 on the origins of high food prices in developing countries found that the cause was not free market regimes or perverse effects from international financial speculation, as was often stated, but rather an income increase effect from China and India, and increases in petroleum prices and to a certain extent from biofuel mandates.^{xii}

The World Health Organisation meanwhile has reported on the causal relationship in developing countries between emissions from fossil fuel combustion and impacts on human health including cardiovascular and respiratory diseases. In 2005, about 3.4 billion life-years were lost in those countries due to exposure to anthropogenic emissions of particulate matters present in the air and generated by the use of fossil fuels. This estimate is dominated by impacts in China and India, which together contribute more than 90% of years of life loss in 2005.^{xiii}

And in 2010, the environmental impacts of oil transport came back to centre stage. Less than two months after the explosion and the sinking of the Deepwater Horizon mobile offshore drilling unit off the coast of Louisiana, the cost of the oil spill clean-up to BP amounted to \$990 million.

Analysts estimate the eventual cost of the clean-up operation at tens of billions of dollars. The short- and long-term economic and social cost of the destruction of biodiversity and other environmental degradation is estimated to be much higher, as it will damage employment in several US states which have economies dependent on fisheries and tourism. Figure

61 provides some comparative cost estimates for oil spills in recent history. In many cases governments end up covering the costs of clean-up.

FIGURE 59. ESTIMATED WORLD JOBS UNDER GREENPEACE REFERENCE SCENARIO (MILLIONS)

JOBS	2010	2020	2030
Coal	4.65	3.16	2.86
Gas	1.95	2.36	2.55
Nuclear, oil, diesel	0.61	0.58	0.50
Renewable	1.88	2.41	2.71
Energy supply jobs	9.1	8.5	8.6
Energy efficiency jobs	0	0	0
Total jobs	9.1	8.5	8.6

Source: Greenpeace

FIGURE 60: ESTIMATED WORLD JOBS UNDER GREENPEACE (R)EVOLUTION SCENARIO (MILLIONS)

JOBS	2010	2020	2030
Coal	4.26	2.28	1.39
Gas	2.08	2.12	1.80
Nuclear, oil, diesel	0.56	0.31	0.13
Renewable	2.38	5.03	6.90
Energy supply jobs	9.3	9.7	10.2
Energy efficiency jobs	0.1	0.7	1.1
Total jobs	9.3	10.5	11.3

Source: Greenpeace

FIGURE 61. COST ESTIMATES FOR SEVEN OIL SPILLS 1967- APRIL 2010

YEAR	INCIDENT	COST	PAID BY
1967	Torrey Canyon	\$8 million	Paid by French and British governments
1978	Amoco Cadiz	\$280 million	Paid by Amoco, Shell
1980	Tanio	\$80 million	Paid by French government and municipalities
1983	Exxon Valdez	\$3,4 billion	Paid by Exxon
1992	Aegon Sea	\$100 million	Paid by Spanish government, FIPOL and ship-owner
1999	Erika	\$250 Million	Paid by Total, ship-owners
2002	Le Prestige	\$1,3 billion	Paid by FIPOL, London Club
2010	Deepwater Horizon	Estimates in the many billions	To be paid by BP

Source: Agence France Presse, April 2010
(amounts converted from euros to US dollar, using May 2010 currency rates)

GLOSSARY¹

Asset finance

All money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. This excludes re-financings. The asset finance numbers represent investment raised in each year – i.e., equity that is committed, or debt that is provided (sometimes in tranches). The plant or project may not be commissioned in the same year.

Capital Expenditure – CAPEX

Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. Some investment will translate into capacity in the following year.

Club deals

A club deal is a small syndicated loan provided by a group of lenders whom the borrower has specified.

Convertible bond

A bond that can be exchanged for a fixed number of shares in the issuing company.

Feed-in tariff

A premium rate paid for electricity fed back into the electricity grid from a designated renewable electricity generation source.

Green stimulus

The share of government economic recovery packages allocated to “green” initiatives such as renewable energy, energy efficiency, smart power grid, transport, and other clean energy technologies.

Initial Public Offering (IPO)

A company's first offering of stock or shares for purchase via an exchange. Also referred to as “flotation”.

Mergers & Acquisitions (M&A)

The value of existing equity purchased by new corporate buyers in companies developing renewable technology or operating renewable energy projects.

Non-recourse project finance

Debt and equity provided directly to projects rather than to the company developing them. The lender is only entitled to repayment from the profits of the project and has no access to the borrower's other assets in the event of default.

Over-the-counter (OTC)

Trading of stocks, bonds, commodities or derivatives directly between buyers and sellers as opposed to via a formal exchange.

Private investment in public equity (PIPE)

The purchase of securities directly from a publicly traded company by private investors.

Public markets

All money invested in the equity of publicly quoted companies developing renewable energy technology and clean power generation. Investment in companies setting up generating capacity is included in the asset financing figure.

Production Tax Credit (PTC)

The support instrument for wind energy projects at federal level in the US.

Tax equity

Tax equity investors invest in renewable energy projects in exchange for federal tax credits.

Venture capital and private equity (VC/PE):

All money invested by venture capital and private equity funds in the equity of companies developing renewable energy technology. Similar investment in companies setting up generating capacity through special purpose vehicles is counted in the asset financing figure.

[1] Further definitions and explanations can be found in Private Financing of Renewable Energy – a Guide for Policymakers. S. Justice/K. Hamilton. Chatham House, UNEP Sustainable Energy Finance Initiative, and Bloomberg New Energy Finance, December 2009

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ABOUT SEFI

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

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

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

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New investment in sustainable energy in 2009 was \$162 billion, down from a revised \$173 billion in 2008. The 7% fall reflected the impact of the recession on investment in Europe and North America in particular, with renewable energy projects and companies finding it harder to access finance.

China was the strongest feature of 2009, with money raised by Chinese clean energy companies and utility-scale projects jumping no less than 53% to \$33.7 billion. The equivalent figure for the whole of Asia, at \$40.8 billion, exceeded that in the Americas last year for the first time ever.

There were other important trends during the year too. One was interest in energy-smart technologies, such as energy efficiency, electric vehicles and batteries. Companies in that sector enjoyed more investment from venture capital and private equity funds than wind, solar or any other clean energy sector. Another was an increase in government research and development spending, as money started to be spent from the \$188 billion of “green stimulus” programmes announced by major economies after the financial crisis.

But there is a gap between the ambition and the science in terms of where the world needs to be in 2020 to avoid dangerous climate change by mid-century. Sustainable energy can assist in bridging that gap if the right kind of green economy policies are accelerated and embedded internationally and nationally.

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