



# Global Clean Energy Investment Overview

Trends and Issues in the Financing of Renewable  
Energy and Low-Carbon Technology

Investment in renewable energy and low carbon technology has more than doubled in the last two years. \$48.9bn was invested globally in clean energy in 2005, up 62% from \$30.1bn in 2004, making up around 10% of all investment in the energy industry worldwide. New Energy Finance estimates that this figure will grow by a further 30% to \$63.3bn in 2006.

All financial asset classes are seeing rapid growth, especially public market investments (IPOs and Secondary Offerings), venture capital and private equity, and project finance. \$14.3bn has been raised by funds targeting the sector, and a further \$7.0bn has been raised by 50 carbon funds. Investment is growing in all geographies and practically all sectors of the clean energy industry, including renewable energy, biofuels, energy storage and efficiency technologies, hydrogen and fuel cells and associated services.

This healthy investment environment bodes well for the continued growth of the clean energy sector. This paper aims to provide an overview of trends in investment activity, and highlight ten areas in which action is required in order to keep the investment from the financial sector flowing.

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## 1. Overview

Investment in clean energy worldwide has more than doubled in the last two years. \$48.9bn was invested globally in clean energy in 2005, up 62% from \$30.1bn in 2004. New Energy Finance estimates that this figure will grow by a further 30% to \$63.3bn in 2006 (see Figure 1).

With total worldwide investment in all parts of the energy industry estimated at between \$500bn and \$600bn per annum, this means that around 10% of total worldwide energy investment is already going into clean energy.

Growth in investment activity took off in 2005 with the unexpected news that Russia would ratify the Kyoto protocol, giving it enough signatories to enter effect. During the course of the next year, the value of clean energy companies quoted in Kyoto-ratifying countries surged 68% ahead of those quoted in non-ratifying Australia and the US – a phenomenon we dubbed “the Kyoto Effect”.

2005 saw a number of other major drivers of interest in the clean energy sector. Oil prices began the year at \$41 per barrel and ended the year at \$56, driven by geopolitical uncertainty and fears of scarcity, in turn driven by the continuing rapid growth in demand in China and India.

The solar sector underwent an extraordinary boom, driven almost entirely by extremely high feed-in tariffs paid for electricity from photovoltaic (PV) sources in Germany. The industry found itself up against a bottleneck in silicon production – an essential raw material for the most common type of solar cells – and able to sell all of its production at high prices for years to come, driving a surge in stock prices and IPOs.

In the US, 2005 saw the restoration of the Federal Production Tax Credit, which brought the wind industry out of its periodic hibernation. Biofuels became flavour of the month, as the high oil price and subsidies pushed returns on investment in bioethanol capacity over the 50% IRR mark.

The most eye-catching development in late 2005 was the ethanol frenzy which swept the US. Investors spotted what they believe to be a perfect storm of high gasoline prices, a supportive subsidy regime, the phasing out of MTBE and growing acceptance of the importance of action on climate change among consumers. Private equity investment in biofuels, which was almost negligible two years ago, shot up to \$1.1bn. Bill Gates, Vinod Khosla and Kleiner Perkins’ John Doerr all got in on the act.

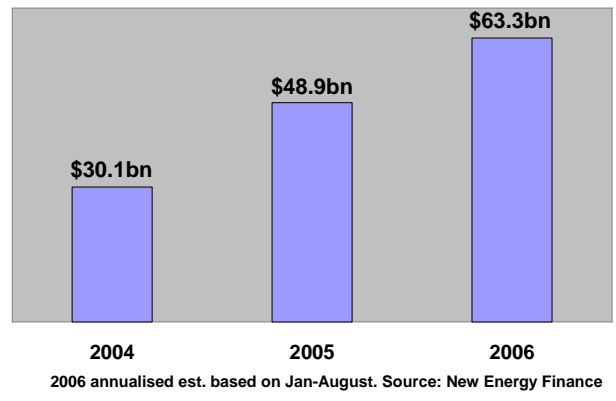
Oil prices continued to power ahead in 2006, spending most of the year to date above \$70, before easing to around \$65. The perfect storm finally broke when President Bush mentioned cellulosic bioethanol in his 2006 State of the Union address, driving the value of clean energy stocks up and depressing those of oil companies. Ethanol fever began to sweep the public markets a few months later, with IPOs of Verasun and Aventine raising a total \$810m.

Despite this excitement, investment in the first half of 2006 was up only 2.4% from \$19.7bn in the last half of 2005. It included \$2.7bn of venture capital and private equity investment in companies, \$7.0bn raised on public markets (helped by two large solar IPOs – REC and Wacker), and \$10.5bn of project and other asset financings (see Figure 3).

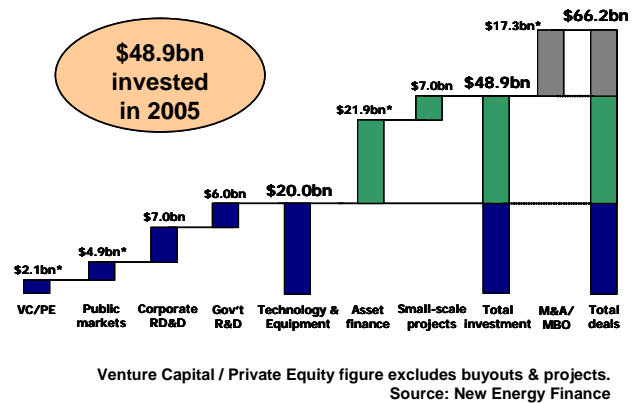
There were three reasons for this hiatus in investment activity in the first half of 2006: the market correction of May 2006, which hit clean energy stocks particularly hard, an overhang of large investments from the end of 2005 and bottlenecks in the supply chains of a number of clean energy sectors.

Much has been written about the silicon bottleneck affecting the solar photovoltaic sector, which has seen solar-grade silicon soar from \$9 per kg in 2000 to as much as \$150 per kg on the spot market now (although longer-term contracts are generally being secured for \$50-60 per kg). This is driving substantial investment in

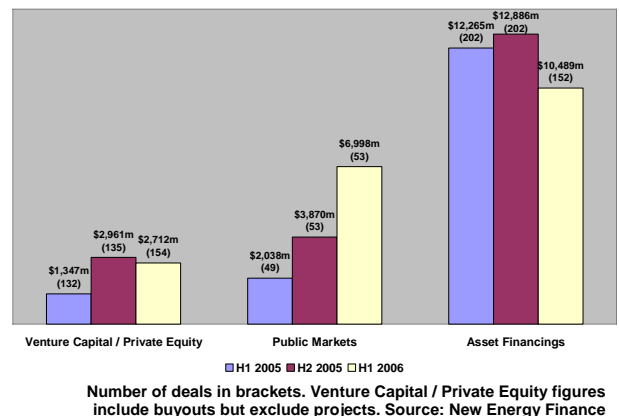
**Figure 1. Global Investment in Clean Energy, 2004 to 2006**



**Figure 2. Global Investment in Clean Energy by Investment Type, 2005**



**Figure 3. Global Investment in Clean Energy 2005 to 2006 – Venture Capital/Private Equity, Public Markets, Asset Financings**



silicon refining capacity, low-silicon and non-silicon PV technologies, but it will be some time before these efforts translate into a more rational supply-demand balance. Most commentators expect the silicon bottleneck to ease in 2008 – New Energy Finance believes it could take a year or two longer despite massive investment in the sector in China, as generous support programmes in Germany and California continue and are rolled out to other countries and regions.

In the wind sector, new private equity financings have dropped away dramatically in the first two quarters of 2006, driven in part by a shortage of turbines, with many manufacturers reporting a 24-month order pipeline. There are also difficulties securing key subassemblies like gearboxes – hence Suzlon’s acquisition of Hansen Transmissions from Apax and Allianz Private Equity for €465m (\$565m), a deal which netted the two private equity companies a return of €333m (\$404m) in just under two years.

In biofuels, investment is being slowed because there are a limited number of companies with experience in the design and building of refining plants. While new companies are entering the space, investors wanting to work with top name service providers are having to stand in line.

As more and more sectors of the clean energy industry achieve meaningful industrial scale we expect to see them hit similar bottlenecks – shortages of vital commodities or skills. It is not that growth will stop, or go into reverse, it just that despite all the media attention, the high oil prices, favourable policy regimes and all the money pouring into the sector, the growth rate of the industry is bumping up against a natural ceiling.

Surprising, perhaps, for those that expect clean energy to display the same growth dynamics as biotech, or software, but welcome to the world of commodity cycles and heavy engineering. And with growth rates looking set to settle at 25-30% per annum, hardly a catastrophe. Q3 2006 has started strongly, and we estimate the year will close with total investment in clean energy up 29.4% to \$63.3bn.

## 2. Public Markets

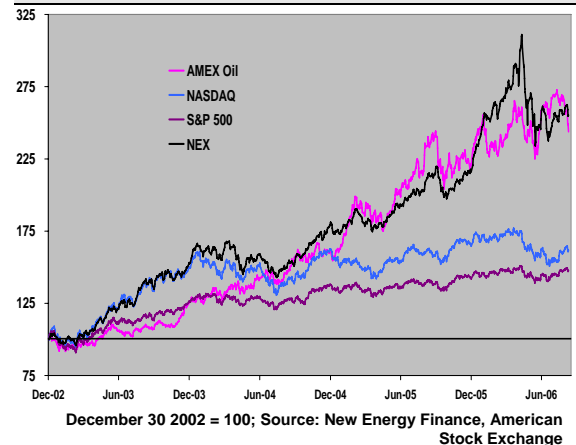
**The fastest-growing area of investment in clean energy during the past 24 months has been the public markets.**

The WilderHill New Energy Global Innovation Index (ticker symbol NEX) consists of quoted companies around the world with substantial exposure to the clean energy industry. It surged 52.6% during 2003, followed by rises of 18.7% in 2004 and 19.3% in 2005, a compound annual growth rate of just under 30% (see Figure 4).

The NEX started 2006 at 216.25 points, surged 44% to reach a peak of 310.96 on May 10, before dropping to 234.19 by the end of middle of June, a fall of 25% from its peak. There were four main reasons for the drop: the effects of the general market correction; some profit taking among investors that had seen particularly good gains over the past 18 months in clean energy stocks; concerns that some valuations were running ahead of results; and the crash in the European carbon prices, which affects the prospects of some NEX constituents.

Since the end of June, it appears the NEX has returned to its long-term trend. By the beginning of September it had risen to 261.60, up 21.0% on the year (see Figure 4).

**Figure 4. Wilder Hill New Energy Finance Global Innovation Index (NEX), December 2002 to September 2006**



## 3. Private Equity

**The venture capital and private equity industry undertook transactions totalling \$7.2bn in 2005 in the clean energy sector. We expect a total of \$100bn of deals between now and 2012.**

The 2005 figure was up an extraordinary 158% on 2004 as the community anointed clean energy the hot new sector. Early stage venture capital – supporting companies developing or commercialising new technologies – made up a relatively modest \$1.0bn of this total; private equity investment into later stage companies was \$0.8bn. Corporate spin-offs and MBOs accounted for \$1.9bn and private equity-type investment in small-cap public stocks was \$320m. By far the biggest proportion - \$3.1bn - went into renewable energy projects: with the building of wind farms and biofuel plants taking the bulk of the money.

Estimated venture capital and private equity investment in companies (excluding projects) during the first half of 2006 totalled \$2.4bn, an increase of 92% on the first half of 2005.

Despite the rapid growth in investment in renewable energy projects, installed power capacity varies globally (see Figure 7). In 2005, estimated worldwide renewable power capacity (excluding large hydro) was 182GW (4.4% of total installed power capacity). Developing countries, including China and India, account for 79GW (5.3%). EU-25 countries total 63GW (8.9%), and the US 23GW (2.2%). Germany and Spain are the largest countries by percentage of installed capacity (17.8% and 15.8% respectively). With most countries and regions setting targets of 10-20% of installed capacity by 2020, there are many opportunities for investment in renewable energy projects.

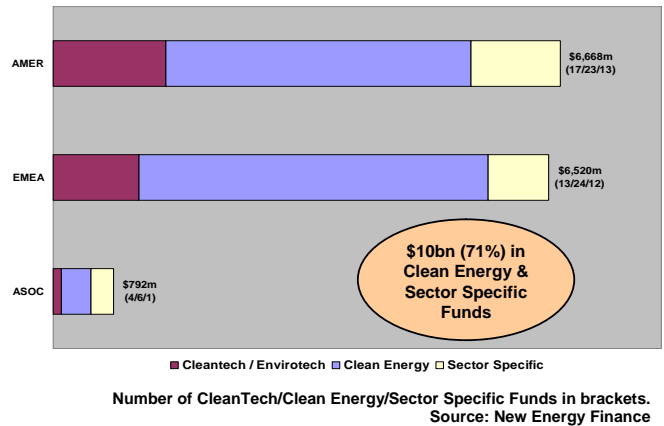
#### 4. Equity Funds Under Management

By the end of August 2006, a total of \$14.0bn had been raised by asset management companies from their limited partner investors (pension funds insurance companies, family funds etc).

Funds under management encompass quoted and unquoted funds targeting private and public equities. They tend to invest either in clean technology companies, or else in renewable energy or biofuels projects, rarely in both. Funds were equally split between Europe and North America, and Asia (see Figure 5).

Of the total, \$10bn (71%) is specifically targeting clean energy or its specific subsectors - wind, solar etc, with the remainder focusing on broader cleantech and envirotech solutions. The rest targets clean energy as a major part, but not all of its remit, often also looking for opportunities in other areas of sustainable technology.

Figure 5. Funds Focusing on Clean Energy, by Geography & Strategy, Beginning of September 2006



#### 5. Carbon Funds

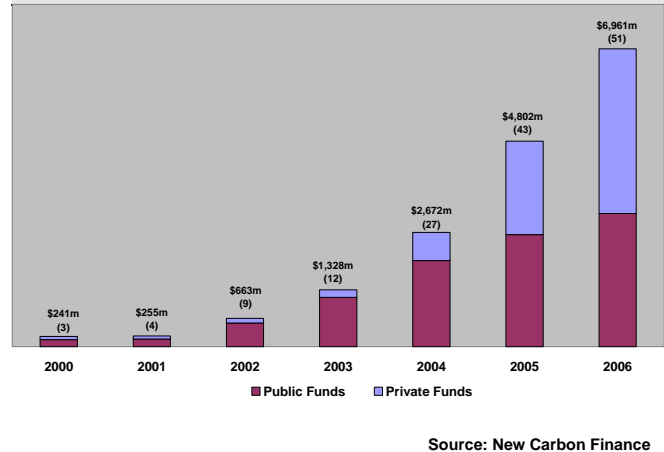
Since 1999, 51 funds have been raised, with over \$7.0bn focusing on investing in carbon credits. This consists of \$3.1bn of public money and \$3.9bn of private money.

These funds divide into sell-side funds, which work with developers to create projects that will generate credits, and buy-side funds, which invest in the resulting credits, either to meet the compliance needs of their owners, or to sell on later to compliance buyers. The majority of existing funds are buy-side funds, although there is a trend in the past few months to set up sell-side funds.

The US and UK are the favoured locations for managing carbon funds, each home to around a quarter of the world's invested capital (\$3.7bn between the two countries, 52.9% of the total; the next largest manager of funds is Portugal with just 6% of global carbon assets). This bodes well for a rapid adoption of carbon trading in the US, either under New England's Regional Greenhouse Gas Initiative, Governor Schwarzenegger's recently announced Californian, or any eventual national initiative.

Any link up between US and European schemes, as recently discussed between Governor Schwarzenegger and Prime Minister Tony Blair, would add further impetus to the markets.

Figure 6. Carbon Funds Under Management, by Type, Beginning of September 2006



#### 6. Asset Based Financings

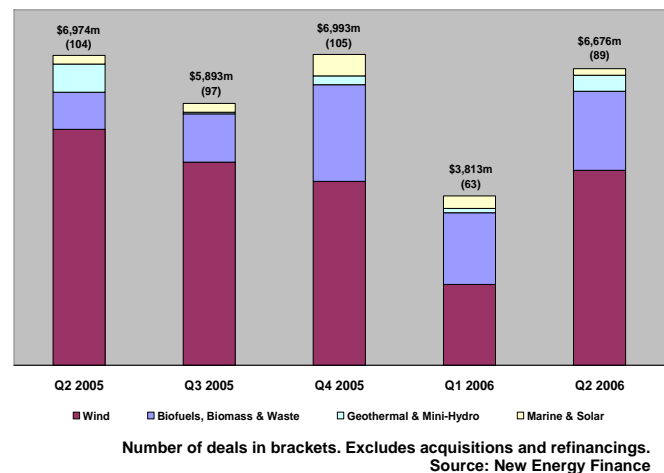
Financings of clean energy projects and other assets totalled \$10.5bn in the first half of 2006. This is slightly lower than in 2005, mainly due to bottlenecks in the supply chains, such as wind turbines and solar-grade silicon.

Wind and biofuels dominate the roll-out of clean energy capacity (see Figure 6), with \$19.7bn of investment during the last 12 months.

There are several sources of capital including private equity, on-balance sheet financing, bank loans, bonds and leasing.

In addition, \$6.7bn worth of clean energy generation and biofuels refining assets have changed hands in the year to July 2006 as developers, investors and corporates/utilities seek to acquire or strengthen portfolios. This trend is set to continue as supply chain bottlenecks limit the construction of new assets.

Figure 6. Total Asset Financings Worldwide, by Sector, 2005-06



## 7. Ten Areas For Action

New Energy Finance estimates that global investment in clean energy will reach \$100bn per annum by 2010. However, there are a number of areas in which actions need to be taken in order to maintain the long-term attractiveness of the industry to investors.

As we have seen, the clean energy industry is growing healthily, and there is no shortage of finance available worldwide. However, there are a number of areas of concern – either where attractive technologies, companies or projects are unable to find finance, or where investors are unable to structure suitable investment vehicles to give them an attractive risk-weighted return on their investment, or both.

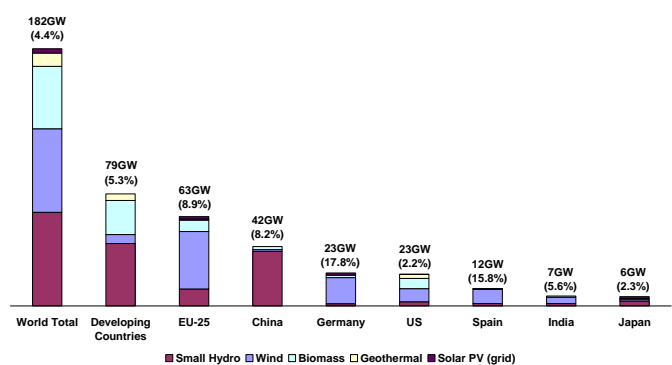
The following ten action points are designed to achieve the following goals: remove barriers to the deployment of existing technology; spur the development and deployment of new technologies; and accelerate the flow of investment to the developing world.

### 1. Address policy weaknesses in developed country laggards.

Differing levels of renewable energy penetration in neighbouring countries or regions indicate that legislation can have a very substantial impact on uptake (see Figure 7). Germany generates 17.8% of its electricity from renewable sources, France just 1.0%. At least 28 US states have embraced some form of carbon mitigation programme, yet there is limited support at the Federal level. Australian states are similarly more engaged than the national government, while Italy and Korea have been among the slow starters.

A level of competition between different regulatory regimes is healthy, especially in an industry as complex as energy. But when winning models emerge, it would behove governments to learn from the private sector and copy them more quickly.

**Figure 7. Global renewable power capacities, as GW & % of total electricity generation capacity, 2005**



Excludes Large Hydro  
Source: REN21 Renewables Global Status Report 2006 Update

### 2. Develop retail finance models for home and small business-scale clean energy projects

Consumers in the developed world express a strong desire to behave in an environmentally-friendly way, until it comes to purchase decisions. This is nowhere more clear than in capital purchase decisions, whether for home appliances, heating and air-conditioning, building insulation or commercial equipment.

One reason is that clean energy solutions frequently represent higher capital costs with lower operating costs. Consumers' purchase decisions are often based on very high perceived discount rates, such that immediate savings are overly valued relative to long-term benefits. The automobile and other industries overcome this by providing access to finance. Those promoting clean energy – whether marketing a product or providing fiscal incentives – need to do so too.

### 3. Roll out microfinance programmes for small-scale projects in the developing world.

The key question facing many developing world countries is not how to generate power from clean rather than dirty sources, but how to provide power at all to much of their population. It can be argued, given the very small contribution to global greenhouse gas emissions by the poorest 25% of the world's population, that any attempt to steer them towards clean energy sources with higher costs than fossil fuels is inefficient and immoral.

With the current high costs of oil and gas, clean energy can in fact offer cheaper solutions in many situations. For example, rural electrification through solar power in grid-remote communities, or the use of gas from small-scale agricultural bioreactors for cooking and heating. The initial finance for such solutions is, however, always problematic. The only way to provide it efficiently on a substantial scale is through the development of microfinance initiatives.

### 4. Accelerate the incubation of new technologies.

There is no shortage of promising ideas for improved clean energy technology. However, energy technologies can easily take 15 years from their first inception in the lab to full-scale commercial roll-out. This makes them challenging for conventional venture capital community, and even for many corporations. There is therefore a vital role to be played by business incubators, which can nurture technologies through the first few years of life until they are ripe enough for further funding.



In June 2006 New Energy Finance identified 114 business incubators around the world working to create viable clean energy technology and service companies. There are some very successful incubation programmes, such as the UK's Carbon Trust, the US's National Renewable Energy Lab's NACEBI initiative, and that associated with Germany's Fraunhofer Institute. The success of clean energy business incubation programmes, whether public sector or private sector, can be greatly enhanced by creating a suitable legislative and cultural environment and by providing them with information and networking services.

#### **5. Improve the macroeconomic environment for early stage technology companies.**

Much has been written about the reasons the USA leads the world in the creation of start-up technology companies, there is little point repeating it here. However, it is striking that even clean energy, an industry in which Europe's policy-makers believe they have an almost genetic advantage, US venture capital investors are out-investing Europeans by a factor of three to four.

In April 2005 we wrote a paper on Europe's Innovation Deficit in Clean Energy, recommending a number of areas for action. The intervening 18 months have seen an uptick in the rate of new company formation in Europe, but even more so in the US. So the issues remain. If we want to see more early stage technology companies see the light of day, we must do the following – most of which, it is worth noting can be achieved at no fiscal cost:

- Reduce high levels of taxation & bureaucracy for early-stage companies across all industries. Decouple incentive programmes for start-ups from social/political goals.
- Ease restrictive labour laws to make it easier for companies to hire employees during rapid expansion without creating substantial future liabilities.
- Improve regimes for protection of intellectual property and its transfer from universities to the private sector.
- Ensure access to markets for clean energy suppliers vis-à-vis incumbents.
- Reduce or remove taxation on clean energy products and services. Remove regulatory/legislative barriers to clean energy solutions. Stop subsidising fossil-based energy.
- Develop agreed industry codes and standards; mandate the introduction of Net and Smart metering. Ensure stability of regulatory regimes over time.
- Use the public sector to create markets by mandating clean energy usage in public procurement and ensuring a level playing field for start-ups in attracting research funds.
- Resist the urge to create green funds to pick winners. Civil servants make poor venture capitalists.

#### **6. Develop mechanisms to support pilot projects which require debt but still have technology risk.**

Large-scale production of energy is a capital-intensive business. All meaningful energy infrastructure has to be partially financed by debt in order to reduce its cost of capital. This works because revenue streams are generally stable, lending themselves to structured finance.

This does not work, however, if there is any technology risk. Project finance debt providers will not back projects with technology risk. They do not share in the upside if the technology is successful, only the downside if it fails. If technologies are unproven, they require warranties from manufacturers, maintenance guarantees or insurance. Smaller producers of innovative clean energy solutions find it almost impossible to provide any of these and many providers have gone to the wall as a result. The solution lies in a combination of innovative insurance products to pool risk-taking, perhaps with some element of public sector support.

#### **7. Break the offshore wind funding bottleneck.**

As the penetration of hydroelectric and onshore wind power in more and more countries saturates, offshore wind represents the single best opportunity for large-scale development of renewable energy resources. Yet in July 2005 New Energy Finance analysis showed that Europe alone had proposed 54GW of offshore wind capacity, but only 1.6GW of it had been financed; a further \$115bn was required. In the US offshore wind has fared no better, with the bellwether Cape Wind Project mired in battles over planning permits.

One problem is the cost of offshore wind, around double that of onshore wind, due to the hostile environment, long distance to grid feed-in points and higher maintenance costs. The other is lengthy permitting processes, with up to 15 different agencies involved. No large-scale energy source has ever been developed without substantial legislative and fiscal support. Offshore wind will be no different.

## 8. Ensure the developing world has access to the most energy-efficient generation and industrial technologies.

The developing world has an opportunity to leapfrog the mistakes made by the developed world in its choices of energy sources. Just as many of the former Soviet countries passed on the development of land-line phone systems and went straight to mobile networks, so developing countries can move directly to clean energy solutions.

Too often, however, these newer technologies are not being made available to developing countries – either through fear of intellectual property theft or because they are marginally more expensive than existing technologies. Both of these problems can, and must, be solved.

## 9. Introduce “industrial strength” mechanisms to finance large projects in the developing world.

According to the IEA, of the \$17 trillion that will need to be invested in energy in the 25 years to 2030, nearly one-third, or \$5.5 trillion will need to be invested in the developing world. This level of funding can only be provided by private sector investors, but they are currently deterred by three factors: sovereign risk; legislative instability of regulations covering renewable energy investment; and governance risk.

Current mechanisms are inadequate to deal with the volume of funding required. Multilateral organisations like the World Bank, EBRD, Asian Development bank and Germany's KfW can only offer part of the solution. Traditional trade finance works for larger projects, but not distributed projects. The Kyoto protocol's CDM mechanism is extraordinarily bureaucratic, hobbled by the ineffectiveness of the UNFCCC Executive Committee and subject to price volatility on the European carbon markets.

## 10. Ensure the survival and extension of carbon trading.

The European Emissions Trading Scheme (EU-ETS) was a pioneering development which created new pools of finance to fund clean energy projects. Yet the combination of weak National Allocation Plans (NAPs) and abundant credits from the developing world and former Soviet block (CDM and JI credits) looks set to swamp the system and ensure a low carbon price through at least to 2012.

While the EU-ETS looks set to survive the demise of the Kyoto Protocol in 2012, to be useful it requires the following: extension to cover air travel and a greater proportion of Europe's industry; meaningfully tight NAPs, set by a competent and believable independent authority; a limit to the number of credits that can flood the system from outside Europe. It would be useful if it were also extended to include other countries, but this can only work if they sign up to the same carbon “fiscal policy” as the EU.

### About New Energy Finance

New Energy Finance is a specialist provider of financial information and analysis on renewable energy and low-carbon technologies. Our research staff of around 40 tracks deal flow in venture capital, private equity, M&A, public markets, asset-based finance and major grants around the world. New Carbon Finance, a division of the company, provides analysis and price forecasting for the global carbon markets.

Industry sectors covered include renewable energy (wind, solar, marine, geothermal, mini-hydro); bioenergy (biomass, biofuels); energy architecture (supply- and demand-side efficiency, smart distribution, power storage, carbon capture & sequestration); hydrogen & fuel cells; carbon markets and associated services. New Energy Finance covers all stages of investment activity, including venture capital, private equity, public markets, asset-based finance and M&A. The company has offices in London, Washington, New York, Beijing, Shanghai, New Delhi and Perth.

Services include the New Energy Finance Briefing (Global and US versions), the New Energy Finance Desktop, and the Newswatch service which keeps investors up-to-date with financial developments in the market. New Energy Finance also publishes reports on clean energy sectors and countries (most recently China), undertakes research and consultancy, and runs senior-level networking events and briefings. In January 2005 New Energy Finance began publishing the world's first global clean energy stock market index; since January 2006 the Wilderhill New Energy Global Innovation Index (ticker symbol: NEX) has been calculated and distributed by the American Stock Exchange.

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