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**TESTIMONY TO US THE SENATE ENERGY &
NATURAL RESOURCES COMMITTEE****Contents**

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8**Clean energy investment trends and the impact of domestic US policies**

Despite major disruptions to the global economy, new investment in clean energy has continued to surge in recent years. However, the pattern of that investment has shifted dramatically. China, a virtual non-player on the international stage as recently as four years ago, is now the undisputed leader in attracting and disbursing new capital. The US and all others trail behind by comparison. However, much remains to be played for as generating from truly clean sources generally is more costly than from fossil fuels on an unsubsidized basis. The true eventual 'winners' in any clean energy technology race will be those that can generate power or produce transport fuel at lower cost. In this regard, with its outstanding intellectual, entrepreneurial and other resources, the US is hardly out of the game. Still, with governments elsewhere recognizing the potential economic opportunity of clean energy and throwing major support behind the sector, the US runs the risk of being left further behind.

- Clean energy investment has proven surprisingly resilient, despite the economic downturn. Total new investment in the sector totalled \$243bn in 2010, up from \$186bn in 2009 and \$52bn in 2004.
- Investment is shifting rapidly from West to East. The Europe, Middle East and Africa (EMEA) region was still tops in attracting new clean energy funding with \$94.4bn in 2010. Looking at third-party private capital alone including funding for small projects, China is the undisputed single national leader with \$54.4bn. Germany (\$41.2bn) and the US (\$34bn) lag far behind.
- China is the world's leading exporter of solar modules and top producer of wind turbines though it has exported very few of the latter to date. The US-China clean energy relationship is hardly a zero-sum game, however. Integrated supply chains allow the US to supply capital equipment and key high-value components to Chinese manufacturers. Both countries could benefit as equipment costs drop and deployment increases, creating more local installation jobs.
- Major progress has been made in recent years to cut costs of clean energy equipment, particularly photovoltaic (PV) modules. PV is now cost-competitive with fossil sources in some markets where local electricity prices are high and/or solar resources are exceptional.
- Still, much progress remains to be made on PV and technologies such as advanced batteries and next generation biofuels. A consistent problem: the so-called 'Valley of Death', which hinders projects employing new technologies from being built at scale. Venture investors are willing to take the risk on such large-scale projects but generally lack necessary funds. Banks have the needed capital but lack the appetite for risk.
- The US Department of Energy seeks to address this quandary through its loan guarantee programs. While the agency has made major progress in making such guarantees available, it has faced major challenges due to its conflicting roles.

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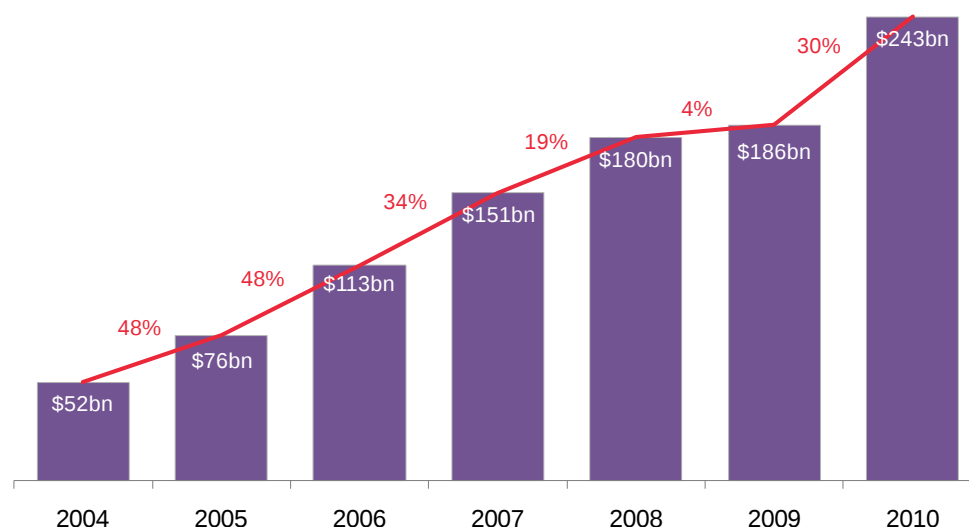
1. INVESTMENT UPDATE

1.1. Global investment

Global investment surged to a new record of \$243bn in 2010 but the patterns behind the capital flows have changed dramatically.

Global clean energy investment surged 30% in 2010 to a new record of \$243bn. This represents a major milestone for a sector that enjoyed an average compound annual growth rate of 37% between 2004 and 2008, but then saw growth stall in 2009 in the face of the worst recession in half a century (Figure 1). While overall growth has remained strong, however, the patterns behind the capital flows have changed dramatically. Investment is up substantially in Asia, China in particular. Installations and financings for small-scale solar have soared while wind installations and financings have slipped. Interest continues to grow in energy efficiency technologies, batteries and electric vehicles.

Figure 1: Global new clean energy investment, 2004-10 (USbn)



Source: Bloomberg New Energy Finance

The largest investment asset class in 2010 was, as usual, the asset financing of utility-scale projects such as wind farms, solar parks and biofuel plants. This investment in deploying proven technologies rose 19% to \$127.8bn last year.

Meanwhile, venture capital and private equity investment, which traditionally supports start-ups and new technologies had an improved year, up 28% from a relatively depressed 2009 total to reach \$8.8bn. That total still fell far short of the all-time high for venture capital and private equity of \$11.8bn in 2008.

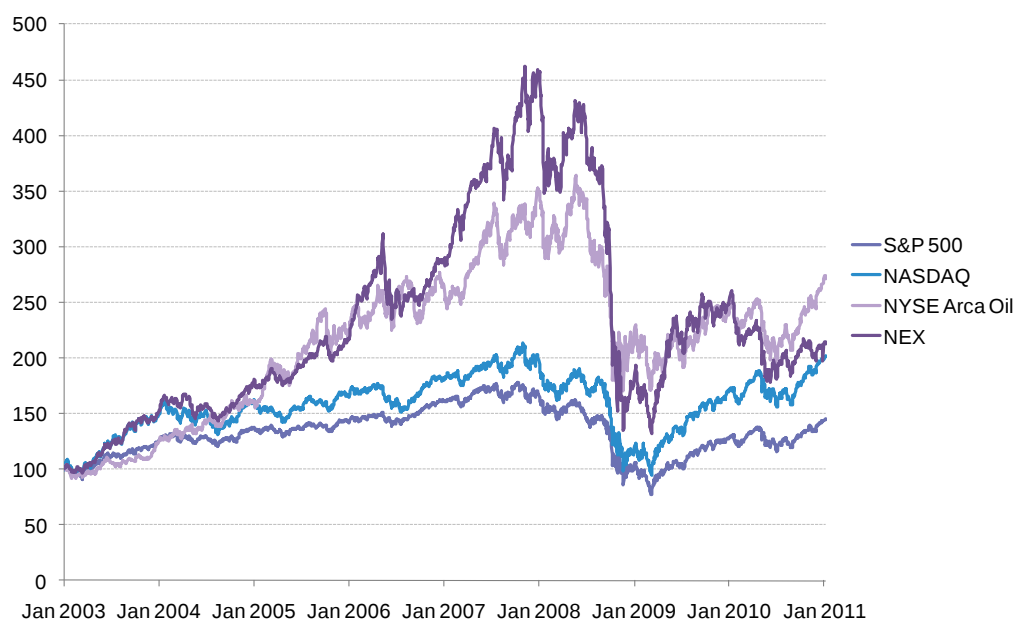
Public market investment (funds raised via initial public offerings and others on the stock exchanges) bounced back from its recession-driven lows in 2008 and 2009, up 18% to \$17.4bn in 2010, though well short of the record of \$24.6bn in 2007. This rebound came despite weakening sentiment among public market traders regarding the sector. The WilderHill New Energy Global Innovation Index (NEX), which tracks the prices of 100 clean energy stocks traded globally, lost 14.6% of its value in 2010 and under-performed the S&P 500 by more than 20% (Figure 2).

It was investment in small-scale, 'distributed' generation projects which really stole the spotlight in 2010, surging by 91% to \$59.6bn, and accounting for approximately one in four dollars invested in clean energy overall. This was almost entirely due to the installation of residential and small-scale commercial photovoltaics (PV). Germany alone saw 7.5GW of new PV capacity added in 2010, an all-time record and over one-third of the total 20.3GW installed globally. Other countries, including Italy and the UK also saw rapid growth, as did certain US states. Still, the US represented a relatively small share of the overall PV market; the Czech Republic installed nearly twice as much new solar capacity (1,727MW) in 2010 as the US (937MW).

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The mass scale-up of small-scale solar is being driven by an extraordinary decline in the cost of photovoltaic modules and financial support for project investment worldwide. For several years, high demand for solar led to a bottleneck in solar-grade processed silicon. This kept prices high, even as the underlying cost structure continued to improve. That bottleneck in silicon broke in 2008, allowing prices to fall very quickly thereafter. Today, solar technology is effectively cost-competitive with fossil generation in markets with either high utility electricity prices, particularly good solar resources, or both. This includes Hawaii and Italy. As costs continue to drop in 2011 and beyond, Bloomberg New Energy Finance anticipates PV reaching 'grid parity' in markets such as Turkey, Portugal, France, Greece and California in the next 5–10 years, perhaps even much sooner.

Figure 2: Performance of the Wilderhill New Energy Global Innovation Index (NEX)



Source: Bloomberg

On an individual country basis, China is now the undisputed leader in attracting new clean energy investment (Figure 3). In 2009, the country surged into the top spot of the Bloomberg New Energy Finance rankings published in conjunction with the Pew Charitable Trusts. In 2010, China extended its lead, attracting \$54.4bn in new third-party private capital (venture capital/private equity, asset/project finance, small-scale financings, and public market fundings). By comparison, Germany attracted \$41.2bn, primarily due to the tremendous growth in small-scale solar installations. The US finished in third place with \$34bn.

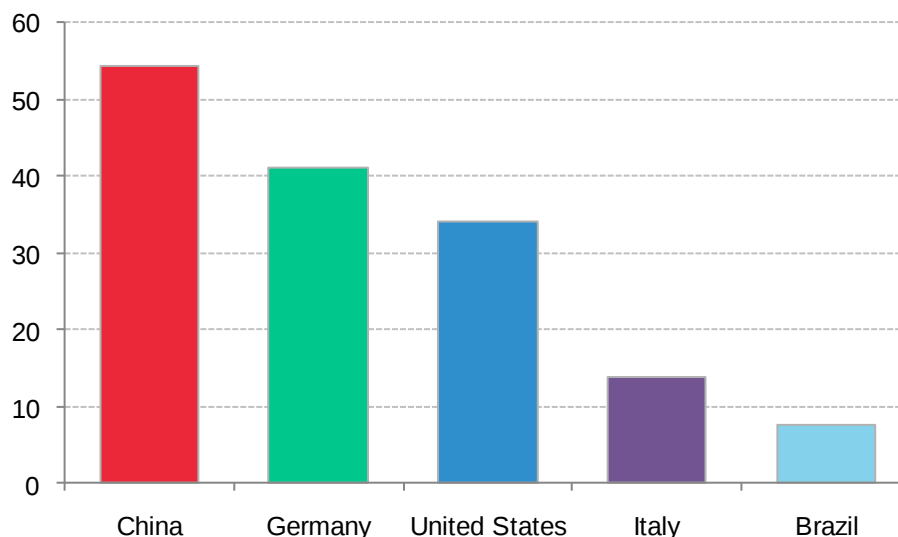
It is important to note that these figures do not take into account the extraordinary but difficult-to-quantify amount of public sector support provided to the clean energy sector by the Chinese government at both the national and provincial level. Bloomberg New Energy Finance has tracked a total of \$46.9bn in economic stimulus commitments to clean energy in the country. In addition, the China Development Bank made no less than \$35.3bn in credit facilities available to just six domestic solar and wind equipment makers in 2010. These companies are now using these funds to bankroll entry strategies to key developing markets such as Brazil and India. Finally, there are the local tax breaks and other benefits routinely offered by provincial governments to attract clean energy investment to their regions.

The surge in new private investment in China has gone primarily to fund expansion of wind and solar manufacturing and toward wind power generating assets. Today, China is the biggest player in the export of PV modules but installs relatively few (513MW in 2010) of them domestically.

By contrast, the country's wind turbine manufacturing plants have been producing equipment that has been deployed almost entirely locally to date. In 2010, China set a global record with 17GW of new wind power generating projects installed representing almost half of all capacity added

worldwide last year. By comparison, the US installed approximately 4.9GW in 2010, down from 10GW in 2009.

Figure 3: Total 2010 financial clean energy investment, \$bn



Source: Bloomberg New Energy Finance. Note: Includes asset finance, venture capital / venture capital, public markets, and small-scale project financings. Does not include public sector (government) investment

Longer term, China's wind turbine makers hope to match the success enjoyed by the country's PV equipment makers. Backed with substantial capital raised on the public exchanges and from the China Development Bank, they look to enter markets including Brazil, Turkey, India, various parts of Africa, and the US.

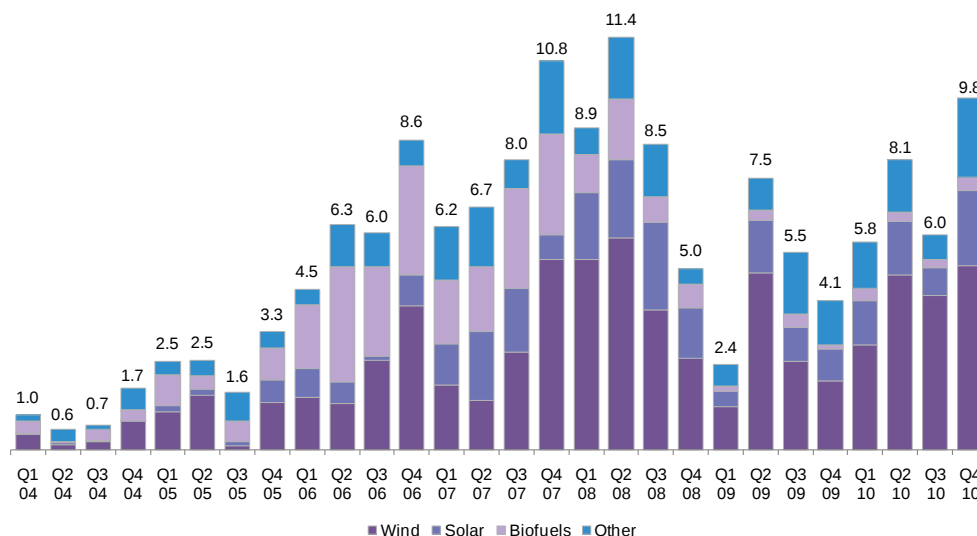
1.2. Clean energy investment in the US

As recently as three years ago, the US was the top country in attracting new clean energy investment, thanks to a surge of investment in new wind and corn ethanol projects (Figure 4). However, funding fell dramatically in the first half of 2009 in the wake of the global financial crisis as credit for new wind, solar, geothermal and biofuels projects became difficult to secure. Investment bounced back in the second half of 2009 and into 2010 thanks to significant support from the American Recovery and Reinvestment Act (ARRA), which allocated \$63bn to clean energy companies and projects. Today, the sector faces uncertain prospects. State renewable energy mandates (renewable portfolio standards) are not driving investment as they did several years ago; low natural gas prices are making it difficult for wind in particular to compete; and uncertainty remains around key federal policies.

Investment in large-scale projects in the US has been hampered since the onset of the financial crisis in Q4 2008. At that time, it was 'tax equity' investors that were primarily responsible for funding the country's wind installations by taking advantage of federal tax credits and accelerated depreciation. As the crisis grew, the pool of available tax equity capital all but evaporated leaving projects starved for capital.

In Q1 2009, Congress approved ARRA, which included a new program allowing project developers to, in effect, take the roughly equivalent benefit of the tax credits in the form of cash grants. The '1603 program' as it has come to be known sustained the US clean energy sector through a particularly difficult period. It also disbursed taxpayers' funds to clean energy projects in a substantially more efficient and cost-effective manner than the tax credits did. It supported financings in 2010 that will result in project constructions in 2011 and 2012. The program is now due to start expiring at the end of 2011 and the Production Tax Credit sunsets end of 2012.

Figure 4: New financial investment in clean energy by sector in the 2004-10 (\$bn)

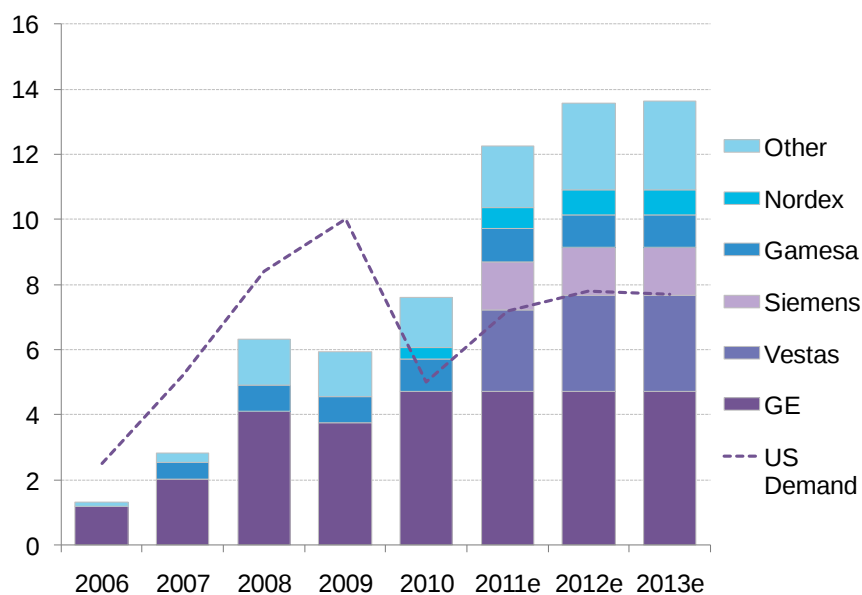


Source: Bloomberg New Energy Finance Note: Includes Asset Finance, Venture Capital / Venture Capital, and Public Markets investment. Does not include public sector investment or small scale projects.

Wind installations in the US fell by half in 2010. Bloomberg New Energy Finance anticipates somewhat of a pick-up in development activity in 2011 with between 5.8GW and 7.3GW to be installed this year. We anticipate new installation activity to remain relatively flat from 2012 through 2014, barring a major change in natural gas prices or a major new policy shift. Our forecast of wind capacity growth in the US assumes 1603 expires as planned but the PTC is extended. If the PTC is not extended, the US will likely see a sharp drop in project installations.

Today, the market both globally and in the US is fundamentally over-supplied with wind turbines. On US soil in 2011 (Figure 5), we anticipate over 12GW of final turbine assembly capacity, far above what will be demanded domestically. This will likely compel manufacturers to export their equipment elsewhere, run their plants below capacity, or take them offline altogether.

Figure 5: Annual US turbine production by original equipment maker, 2006-13E (GW)

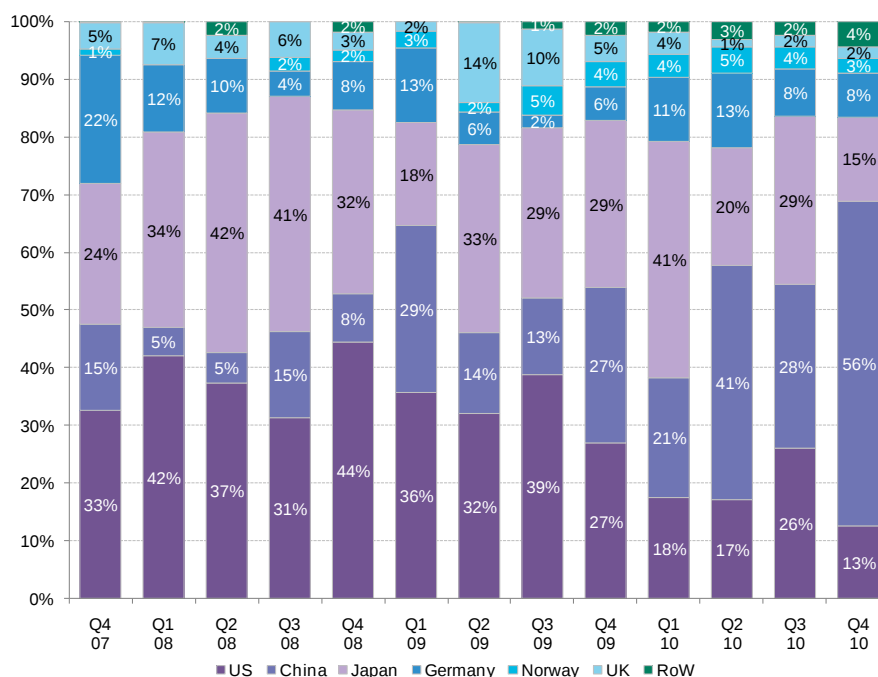


Source: Bloomberg New Energy Finance historical data and projections

It is for this reason that Chinese equipment makers are likely to have difficulty making significant inroads into the US market, at least in the short run. Thanks to over-supply, wind turbine prices have fallen from their highs of approximately \$1.5m-\$1.8m/MW to a current price of approximately \$1m-\$1.3m/MW. With equipment readily available from established Western companies with strong existing reputations in the US, market entry should prove challenging, at least for now.

By contrast, low-priced Chinese equipment has played an integral role in growth of the US PV sector, which has grown quite rapidly in the past three years, though off a very small installed base. In 2008, 342MW of new PV capacity was installed in the US. That jumped to more than 900MW in 2010 with over half of all installations coming in California and New Jersey, both of which have solar-specific subsidies in place.

Figure 6: Suppliers of solar photovoltaic modules in the California market



Source: Bloomberg New Energy Finance analysis of California Solar Initiative data. Note: 'Country' tracks country of corporate headquarters, not country of manufacture

Chinese PV equipment makers such as Suntech and Yingli played only a minor role in the US market less than four years ago. In California during the first three months of 2007, Chinese equipment accounted for 15% of all installations that requested rebates under that state's Solar Initiative (Figure 4, measured in terms of megawatts capacity). By the last quarter of 2010, Chinese equipment makers were the suppliers of choice on installations representing over half the megawatts to be installed. US-headquartered solar equipment makers such as SunPower and FirstSolar now account for a smaller share of what is now a much larger market.

Looking ahead, Bloomberg New Energy Finance anticipates strong growth in PV installation in the US with the market potentially doubling in 2011 to 1.8GW installed, then rising to 2.8GW in 2012. Still, the US market will remain relatively small when compared to Germany, Italy and Spain unless the federal government and/or states enact broader, more supportive policies.

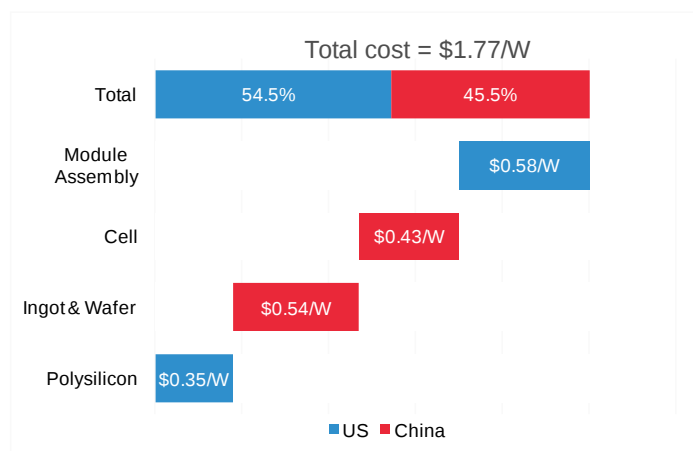
1.3. The US-China clean energy trade relationship

Some have painted competition between the US and China on clean energy manufacturing and development in stark terms with China feared or admired as an exports winner and the US criticized or dismissed as a manufacturing also-ran. But the relationship between the nations defies simplistic assumptions defined by economic nationalism. Chinese PV modules are often

manufactured using US-made equipment while US wind turbines regularly contain Chinese-made components. In this area as in so many others, China and the US are mutually dependent; each must rely at least in part on the other to achieve its clean energy and carbon reduction objectives.

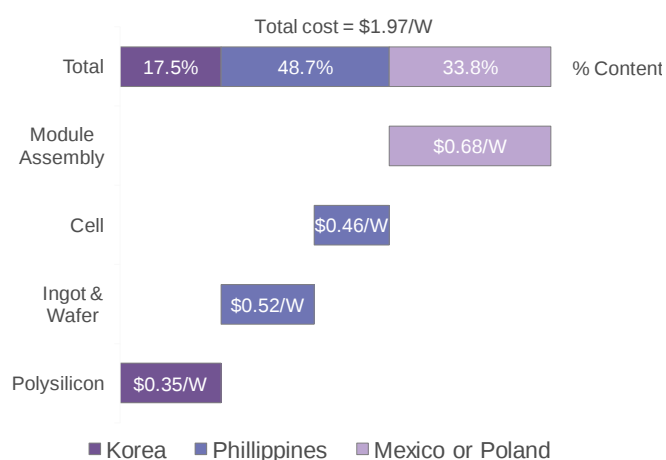
For instance, as with most technology products, PV modules comprise a number of parts from all over the world. Figures 7 and 8 break down where the parts are manufactured for a hypothetical module from Suntech, a China-headquartered firm, and for SunPower, a California-headquartered company. Suntech procures polysilicon from producer MEMC of Missouri, while ingot, wafer and cells manufacturing take place in China. Suntech now does some final module assembly at a new facility in Arizona. In some cases, over half the economic value of the module manufacturing goes to the US. (However, it should be noted that Suntech still does most of its final assembly of modules in China).

Figure 7: Value breakdown by country of origin, hypothetical Suntech (China) PV module to be installed in US



Source: Bloomberg New Energy Finance. Note: Example only. Suntech assembles the majority of its modules in China.

Figure 8: Value breakdown by country of origin, hypothetical SunPower (US) PV module



Source: Bloomberg New Energy Finance. Note: Example only. SunPower has also procured silicon from US producers.

For SunPower, silicon comes from the US or South Korea, while wafers and cells are manufactured in the Philippines, and module assembly can take place in Mexico.

The US-China clean energy trade has proven to be a flashpoint between the two nations in light of a 2010 complaint filed with the United Steelworkers with the US Trade Representative. Concerns have been raised among US policymakers that Chinese policies have made it difficult for US clean energy equipment suppliers to compete in China.

Questions of fair trade aside, there can be little doubt that China's extraordinary entry into the clean energy marketplace has played a major role in driving down the overall cost of clean energy equipment. The country's support for the largest PV and wind equipment manufacturing plants the world has ever seen has allowed for unprecedented economies of scale and lower prices. As discussed above, solar is rapidly moving toward grid parity. This is in no small part due to the build-out in China and its extraordinary financial resources.

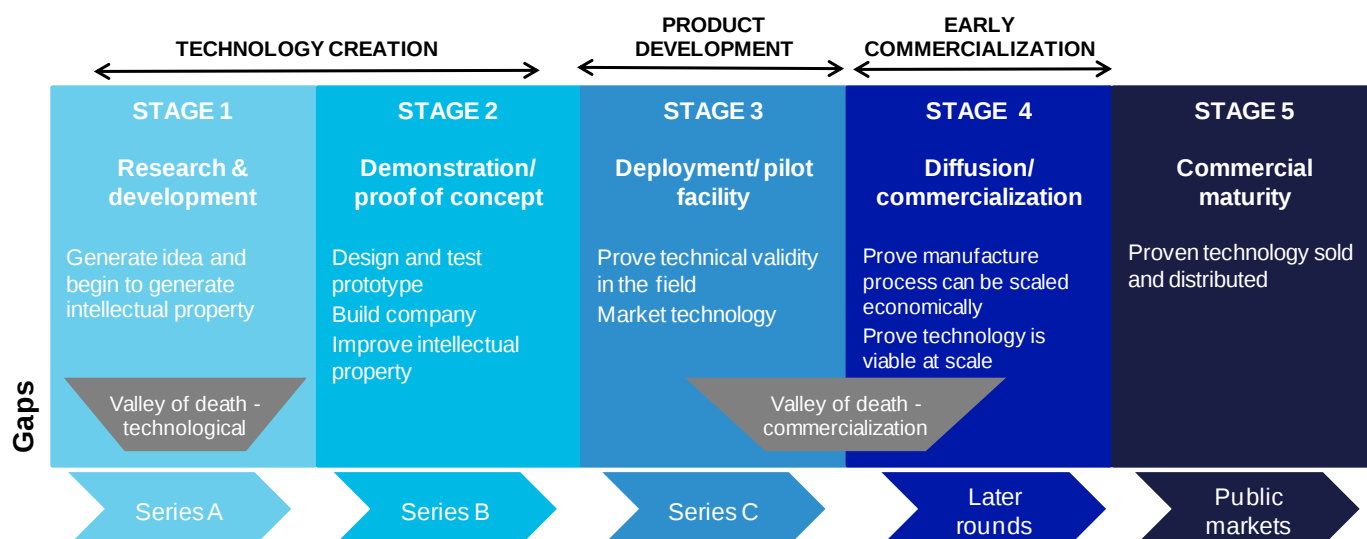
Finally, it should be noted that the faster clean energy equipment prices fall, the more quickly such equipment can be deployed into the field at costs competitive with conventional energy. This has major implications for job creation. Much of the 'green jobs' discussion to date has centered on manufacturing jobs. But clean energy can create significant employment opportunities at the final stages of the value chain as well. Bloomberg New Energy Finance calculates that for every megawatt of PV capacity installed on a residential rooftop, a total of 15.1 full-time workers are required. No less than 10.5 of them are involved in the final stages of installation, on average. By contrast, manufacturing accounts for just under one-third of the total employment per megawatt of new capacity.

2. THE 'VALLEY OF DEATH' CONUNDRUM

Thanks to a massive investment surge, clean energy technologies have made exceptional progress down their respective learning curves in recent years. Still, much work remains; the cost of generating a clean kilowatt-hour is still generally above that of generating one from coal or natural gas on an unsubsidized basis, assuming no associated costs are assessed for carbon pollution. One of the biggest impediments to further progress is a persistent dearth of capital for potentially lower-cost breakthrough technologies that have advanced out of the laboratory but still require extensive and expensive field testing and trial installations before being deployed at scale. Financing has existed in the past for early stage, potentially high-risk/high-return technologies in the form of venture capital. It is also available for late stage, potentially low-risk/low-return technologies in the form of project financing. But what about those technologies that fall somewhere in between?

As the old adage among entrepreneurs goes, 'banks will always be the first in line to finance your second project'. This so-called commercialization 'Valley of Death' – located somewhere between Silicon Valley VCs and Wall Street banks – poses a long-standing challenge to the clean energy sector, just as it has to other capital-intensive industries in the past. Bridging this gap is critically important; existing technologies have an important role to play but costs must come down further.

Figure 9: 'The Valley of Death' financing challenges



Source: Bloomberg New Energy Finance

Today, there are in effect two valleys for clean energy technologies. The first comes at the very earliest stage when the potential commercial applicability of a technology remains unclear. The later, better-known valley takes place as a new technology looks to scale up. This tends to occur somewhere toward the end rounds of venture capital investment.

In response to this conundrum, Congress in 2005 established a loan guarantee program intended to help bridge this gap. The program offered its first guarantee in 2009 and has served as something of a lightning rod in recent months. Developers and investors regularly complain that the application process for loans guarantees is confusing, difficult to navigate, and far too costly and time-consuming. Meanwhile, some in Congress have expressed concern that DOE has cut corners while conducting due diligence on potential guarantee recipients. In essence, industry is frustrated that DOE has moved too slowly while Congress has complained that it has moved too fast.

In our view, the loan guarantee program puts the federal government in a fundamentally awkward position. On the one hand, it has been charged with helping to finance potentially game-changing technologies. On the other, it must serve as a careful guardian of taxpayer funds. As private sector investors know well, investing in new technologies inevitably involves a high degree of risk. We believe the loan guarantee program can foster important breakthroughs, but will also inevitably result in some number of failures. If the federal government is going to guarantee financing for technologies, it must also be comfortable with the inherent potential downsides. As any serious investor in stocks, bonds, or other securities knows, having a portfolio of both winners *and* losers is inevitably part of the game. Success is determined by the portfolio's overall performance.

The loan guarantee program aside, the fundamental challenge of the valley of death remains for many new companies seeking to build their first pilot-scale project. From a larger strategic point of view, we would argue that whichever nation puts in place policies or financing schemes to bridge this gap stands to reap the greatest economic benefit in the long haul.