Joined at the hip: the US-China clean energy relationship

White Paper

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Section 1. Executive Summary

The US – China relationship is the most important bilateral engagement in the world today, as the two countries engage on issues of commerce, currency, and their respective roles in international relations. In recent years, another aspect has entered the dynamic: the future of clean energy policy, manufacturing, technology, deployment, and trade.

Some have painted competition between the two nations on these issues in stark terms with China feared or admired as an exports winner and the US criticized or dismissed as a manufacturing loser. 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. In this research note, Bloomberg New Energy Finances takes a closer look at this critical relationship as it impacts the solar and wind sectors and finds:

- For both countries, clean energy is viewed as an imperative, partly political, partly economic, and partly environmental. With 5% annual power demand growth over the next decade, China needs all sources of energy, clean or otherwise, to maintain growth; for the US, clean energy is an option meant to displace incumbent generation and spur technological innovation.
- China's manufacturing base for clean energy equipment has expanded at a torrid pace over the past three years. On the wind side, the country offers local power generators high revenues in the form of fixed feed-in-tariffs and low costs in the form of lower priced equipment and capital. This has fostered a boom in new installations with the country installing 14GW of new capacity in 2009, compared to approximately 10GW in the US. Regarding photovoltaics (PV), the Chinese government created the domestic 'Golden Sun' subsidy program in 2009 during a period of soft global demand for modules.
- The US and China are on track to account for 65% of global wind turbine demand in 2010. US-based companies will account for 12% of manufacturing capacity (as measured in MW produced) while China-based firms will account for 39%. For PV, the US and China will together account for 14% of global demand. US-based companies will produce 9% of modules globally while Chinese companies will make 43%.
- Chinese solar companies have been successfully exporting into the California PV market, taking a 42% market share there in Q1 2010. However, significant barriers remain before Chinese wind turbines turn up on in large numbers on US horizons. We do not expect to see volume exports of Chinese turbines to the US before 2013 at earliest, but once there they could have a significant impact on the market.
- End product sales should not be the sole focus of any US-China clean energy comparison. A more detailed analysis reveals that US companies would capture at least 44% of the value of a hypothetical US wind farm using a generic 3MW Chinese wind turbine. In PV, capital equipment sales and system installation are proving to be significant value creators for US companies.
- Both countries have imposed, or threatened to impose protectionist measures. China previously implemented domestic content requirements favouring wind turbines made locally, but has since removed them. The US is now considering imposing "Buy American" requirements on a key subsidy programme. Such protectionism could deny market opportunities and has the potential to drive up clean generation costs in both countries. This would slow clean energy adoption and make it more difficult to achieve meaningful reductions in harmful greenhouse gas emissions. Both nations could be hurt should a full-fledged clean energy trade war be declared.

- Innovation levels at US PV cell and module companies remain high. Nascent US PV manufacturing firms have attracted no less than $3.7bn in venture capital and private equity investment over the past six years. Publicly-listed US PV firms tend to invest more in R&D than their Chinese counterparts. Both suggest the next big breakthrough in solar technology could come from the US.
- A focus solely on trade-based winners and losers in the US-China clean energy relationship neglects the gains from both lower cost and higher quality clean energy technology. Both countries, and indeed all countries, will benefit as the US and China drive the cost of renewable energy below that of conventional energy.

Section 2. US, China clean energy growth drivers compared

The rate at which any market around the world adopts clean energy is driven entirely by whatever all-in profits can be generated by market participants, namely power generators. In general, those profits are defined by a simple formula:

(Economic revenue + Revenue-side subsidies) - (Economic costs - Cost-side subsidies) = Profit

To understand the differing rates of clean energy adoption in the US and China, it is worth scrutinizing each component of the formula:

- **Economic revenues:** Cash flows generated entirely due to economic fundamentals -- i.e. funds generated from power purchase agreements or similar off-take contracts.
- **Revenue-side subsidies:** Additional revenue provided from government support in the form of a renewable energy credit, a carbon credit, a feed-in-tariff (FiT), or some other mechanism. Note that often revenue-side subsidies eclipse economic revenues altogether when a FiT is in place.
- **Economic costs:** The true levelised cost of producing a MWh or kWh of electricity that allows for backers of such power projects to earn a reasonable return.
- **Cost-side subsidies:** Government provided financial support intended to lower the cost of adding clean energy capacity. These can include tax credits, cash grants, special tax rates, and government-backed loan guarantees.

Much has been written about the extraordinary influx of investment in Chinese clean energy in the past several years and the torrid pace at which new generation has been added in the country. In the US, policymakers and others have wrung their hands in frustration at the trend. The reason is quite simple: *China offers generators high revenues in the form of FiTs and low costs in the form of lower priced equipment and capital.*

Table 1: Comparison of drivers for clean energy in US and China

Country	Power demand growth	Targets/RPS	Nature of financial support
China	2005-2010: 9% 2011-2020: 5%	Non-hydro RPS: 1% by 2010, 3% by 2020 Targets for each sector	FiTs for wind, and biomass, and waste to energy; expected for solar in 2010
US	2005-2010: 0.5% 2011-2020: 1%	30 states with RPS; federal RES under consideration	PTC/ITC Treasury grants

Source: Bloomberg New Energy Finance, EIA, NDRC, US state and federal governments

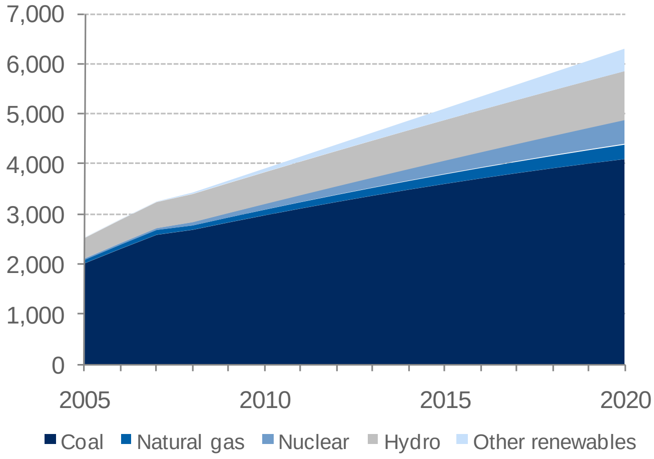
Since the creation of its Renewable Energy Law in 2006, China's government has provided increasing support to the clean energy sector in the form of FiTs and national targets. Additionally, LCOEs for clean energy technologies have fallen in China and power demand has surged.

Meanwhile in the US, while LCOEs have also fallen over the past few years for the most established clean energy technologies, the other three growth drivers listed above are not as potent as they are in China. On the revenue side, the country lacks a FiT and instead offers a hodgepodge of support in the form of 30 different state-level renewable portfolio standards (RPS). On the cost side, substantial subsidies have been put in place, but nothing as certain as a FiT.

2.1. Economic revenues: forecasted demand in the US and China

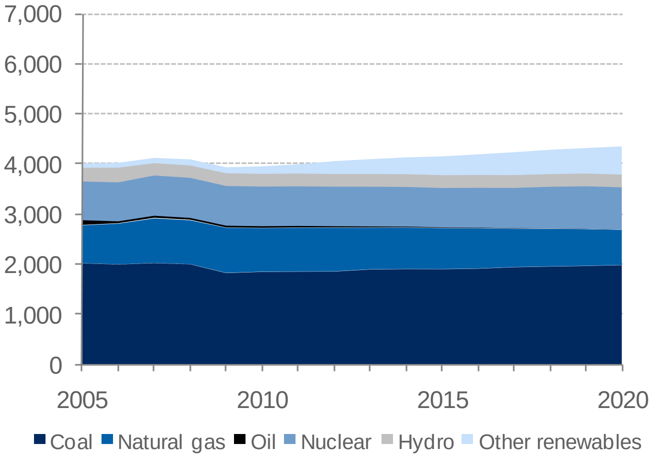
China's power demand has surged over the past two decades from 623TWh in 1990 to 3271TWh in 2007 for an average annual growth rate of 10.2%. 2008 and 2009 saw more modest growth of 5.8% per year, partially due to the financial crisis. Bloomberg New Energy Finance projects China's power demand to grow on average of 5.1% per year out to 2020. Urbanisation will still occur but at a slower rate than before and increasing industrial efficiency will keep power demand in check to a certain extent.

Figure 1: Power production, China (GWh)



Source: Bloomberg New Energy Finance

Figure 2: Power production, US (GWh)



Source: Bloomberg New Energy Finance Note: Coal includes a small but growing amount of new CCS generation from 2011 onwards. Assumes a $6.90mmbtu natural gas price 2010-2020. A lower natural gas price would result in less coal generation and more natural gas generation.

Power demand growth and China's aim to diversify its electricity portfolio are the two main drivers for clean energy growth in China. The country's political leadership is also keen to be seen addressing climate change issues. Figure 1 shows the breakdown of power production by resource. In 2009, China got 16% of its power from hydro due to the exploitation of its resources largely in the southwest parts of the country. Another 1% came from wind and other renewables and 2% came from nuclear. China has realized that its over reliance on coal has caused many domestic problems including environmental degradation and mining accidents. Therefore as power demand continues to grow, China will continue to exploit hydropower resources while trying to increase the proportion of power coming from nuclear and other renewables.

US power production has historically grown slowly but steadily, from 3038TWh in 1990 to 4055TWh in 2005 for an average annual growth rate of 1.9%. According to the US Energy Information Administration (EIA), power generation fell 0.9% in 2008 as the financial crisis hit in Q3. The drop was fully felt in 2009 with power generation declining 4% to 3953TWh. Assuming the US economy recovers, demand for power will likely return to trend, posting roughly 1% growth rate per year.

Although a large proportion of power comes from coal in the US (46%), the rest of generation is diversified. As seen in Figure 2, nuclear and natural gas accounted for 20% and 23% of power production in 2009, respectively. With yearly power growth to 2020 projected at only 1% per year, US demand for new power capacity is not nearly as significant as in China. Still, the demand for new generation capacity is sure to be higher than the overall demand for power as a substantial number of the country's aging fleet of coal-fired power stations is due to be mothballed over the next several decades. US nuclear plants are also aging and will need to be replaced.

All of the above trends factor directly into the levels of economic revenues that clean energy project developers can generate for their projects.

2.2. Revenue-side subsidies: higher expectations in China

The reasons for governments to provide support for clean energy development have gained recognition in the past decade. As oil prices spiked and fears of climate change grew in 2006 and 2007, domestic energy security and greenhouse gas mitigation were the primary drivers. After the economic crisis took hold in 2008, the emphasis has shifted more to economic development opportunities and job creation.

One of principal ways governments support and stimulate growth in the sector is by setting national requirements for clean energy generation, or Renewable Portfolio Standards (RPS). In the US, there is no such federal standard despite numerous and ongoing attempts to establish one. However, to date 30 states have RPS of one form or another on their books meant to increase clean energy penetration while supporting job creation and economic development within state borders. These state standards alone mandate the installation of 65GW of new renewable energy capacity through 2020. This should lead to a net generation of 361TWh of renewable power. A federal RPS requiring all states to meet a 20% target by 2020 would increase that generation requirement to 870TWh, although legislation would likely include a number of exclusions as well as efficiency measures.

Table 2: China 2009 installed capacity and 2020 targets (GW)

	Hydro (small, large)	Wind	PV	Biomass and waste
2009 installed	197 (146, 51)	25.5	0.3	4.9
2020 target	300 (225, 75)	150	20	30

Source: Bloomberg New Energy Finance Note: Wind and PV targets expected based off of comments from Shi Lishan, deputy director for new and renewable energy at the National Energy Commission

In China, the National Development and Reform Commission (NDRC) initially announced headline targets for clean energy capacity as part of the Medium to Long-Term Development Plan in 2007 (Table 2). More aggressive wind and PV goals have not yet been made official, but are expected to be announced this year when the "Development Plan for Emerging Industries" is released.

The targets for these flagship industries will likely be met and surpassed. Investment often follows signals of government support, and in the case of clean energy, the government has been quite positive. Still, an RPS with strong legal backing would be useful to ensure that wind and solar projects actually get connected to the grid. It has not been uncommon in recent years for grid companies to decline to buy all renewable power produced by projects in their service areas. The China Electricity Council said that grid-connected wind capacity at the end of 2009 was 16.9GW; compared with Bloomberg New Energy Finance's estimate of 25GW installed capacity indicates that roughly 33% of wind farms are not connected to the grid currently.

As a result of targets, we project that renewable, including large-scale hydro projects, will produce 1430TWh or 22.6% of power in 2020 in China. Hydro will remain at around 16% of power generation while wind increases to 4%, biomass and waste to energy to 2.5%, and PV to 0.5%. Non-hydro generation from renewables would total 7%, much higher than the 3% unofficial non-hydro RPS for 2020.

In terms of revenue-side subsidies, FiTs represent the clearest price signal a government can send to its clean energy sector. FiTs have spurred enormous growth in recent years in the Spanish and German PV markets. In Germany, a remarkable 3.8GW of PV was installed last year alone representing more than 50% of the global market for the year. Similarly, in China, FiTs for biomass and wind have led to rapid growth. For instance, biomass capacity grew 35% in both 2007 and 2008 on the back of a CNY 0.25/kWh subsidy (above the coal-fired power price) for all facilities.[1]

In the wind sector, China set FiT levels varying between CNY 0.51-0.61/kWh in August 2009, although generally these tariffs did not differ much from levels seen from national and local concession projects in 2008. This tariff level is equivalent to a price of $75-89/MWh. Given that the LCOE of wind in China ranges from $48-105/MWh (see below), the tariff will be wasteful in some cases but roughly on target in most. Regardless, it helped to trigger a 127% year on year growth rate in 2009, with the "Big Five" state-owned utilities (fuelled by healthy balance sheets and abundant bank loans) taking 79% of the market.

The government is currently considering a fixed FiT for PV as well, but there is concern that too many developers will rush into the space and put up projects in areas with poor resources. Recently, four projects in Ningxia received a FiT of CNY 1.15/kWh or $168/MWh.

In the US, a FiT has never seriously been considered at the federal level. Even if it were to pass Congress somehow, it would be terribly difficult to implement given that most regulation of electricity in the US comes at the state level.

The other significant revenue-side subsidy the US government could implement would be a carbon cap and trade scheme. Legislation that would establish such a programme (the "Waxman-Markey" bill) passed the House of Representatives in 2009 but prospects for passage remain slim in the Senate as mid-term elections loom and 60 out of 100 votes in support are needed.

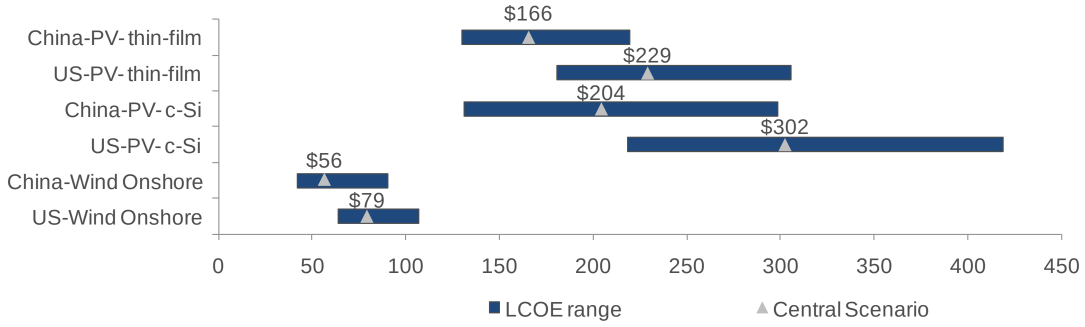
2.3. Economic costs: substantially cheaper wind in China

Clean energy demand, whether from new power needs or regulation, will be helped along by the fact that the levelised costs of energy (LCOE) of a number of clean energy technologies are declining such that some are becoming more competitive with traditional energy technologies. Figure 3 shows the LCOE for the main wind and solar technologies. Thin-film and crystalline PV systems saw their LCOEs fall 35-50% in 2009, while onshore wind fell 6-10%. Wind turbine prices have fallen

[1] The down-side to FiTs is that they can spur development of economically inefficient projects. Numerous developers, most of them lacking biomass power experience and also lacking proper biomass rushed into the sector. Currently, those facilities are facing very low profitability due to high feedstock costs. The government has temporarily introduced an extra CNY 0.10/kWh to make up for the facilities' losses.

consistently since 2008, although in the US this has mostly been offset by an increase in financing costs. Even if financing prospects improve, current low natural gas prices (and the belief they will stay low due to shale gas potential) will keep the gas LCOE down and make it harder for onshore wind to compete.

Figure 3: Levelized cost of energy in US and China for wind and PV (USD/MWh)



Source: Bloomberg New Energy Finance Note: LCOE is local inflation adjusted $/MWh price of electricity that meets 10% hurdle rate for developer, assumes 20-year depreciation, standard local income tax rates, and country specific financing and cost assumptions. See BNEF LCOE quarterly outlook for full methodology

Despite the precipitous decline in price, renewables remain more expensive than coal or natural gas on a levelised basis in most cases around the world. However, in particularly tight electricity markets or areas with extremely good natural resources, renewables can today occasionally give fossil fuels a run for the money. More importantly, over time renewables are on track to close the gap. (For more on how PV, in particular, is making strides in that direction please see the 30 April 2010 Bloomberg New Energy Finance Research Note *The Experience Curve Revisited*)

Meanwhile in China, turbine prices have fallen between 22-29% for both domestic and foreign-made turbines since 2008 while debt is cheaper and more available than in Europe and the US. The existence of a feed-in tariff in China has also made these products more bankable. Given these financial considerations, Bloomberg New Energy Finance finds that the LCOE for onshore wind is 29% lower in China than it is in the US under our central scenario. The LCOE for crystalline silicon PV is 32% lower than in the US and will likely fall in the future as Chinese project developers gain experience and develop projects at lower cost.

2.4. Cost-side subsidies: stimulus help in the US, special tax rates in both US and China

As discussed above, on the revenue side China provides fixed FiTs for wind, biomass, and waste to energy and is considering implementing one for solar PV as well. The US offers far more limited revenue-side support via 30 state-level RPS, which creates a market for renewable energy credits.

On the cost side, however, the gap between Chinese and US subsidies is not be quite so wide at the moment, though the US has offered considerable less certainty in this regard than China. The US provides production and investment tax credits that project owners can claim and apply to their tax bills to offset CAPEX. In the 2009 American Recovery and Reinvestment Act (ARRA), the US sweetened the deal by offering cash grants for capital investment in lieu of credits. The ARRA also established a "Manufacturers Tax Credit" programme which allows equipment makers to reduce the cost of building a new plant by 30% via tax credits.

Still, generally speaking, the US's financial support on the cost side has been regarded as insufficient in the eyes of most developers and financiers, primarily because the policies have lacked long-term certainty. The PTC for wind, for instance, expires at the end of 2012 with the grants-in-lieu-of-credits programme expiring at the end of 2010.

In addition, the PTC has never been immediately useful to project developers with small balance sheets who lack of tax exposure. Lacking that grant, to take advantage of the full set of tax incentives, small developers must use outside investors with large tax exposures as project partners. These so called tax-equity providers have invested in the clean energy projects in their place and took their investment payouts in the form of tax credits. Other debt investors and the project developers took the cash flow generated by wind farm electricity sales.

When the financial crisis hit, however, the number of tax equity providers fell from 16 players to five as capital became sparse and expected returns on investment jumped from 6.5% to 9%. The specific goal of grants-in-lieu-of-credits programme discussed above was to address this issue. Project developers breathed a sigh of relief when those grants started flowing in September 2009.

Meanwhile, the prospects on tax equity availability have been slow to improve making the market all the more concerned that the grant programme expires at year end.

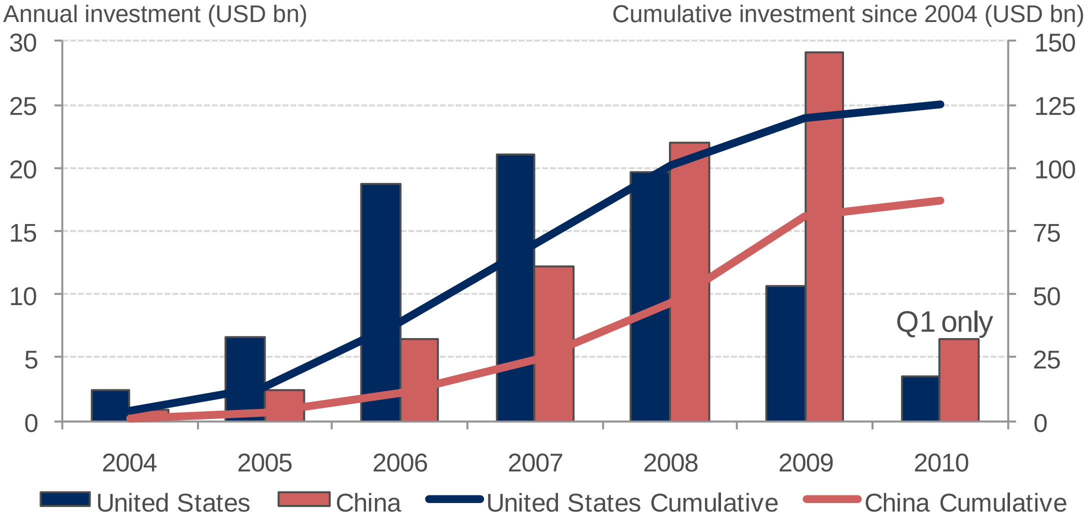
The other significant cost-side subsidies for clean energy projects are decreased tax rates. In China, the income and value added tax rates for wind farms are currently half of what they are for other power projects at 15% and 8.5% respectively. In the US, clean energy projects are still technically exposed to the normal income tax rate, however projects receive heavy tax-subsidies in the form of accelerated depreciation (six years).

2.5. US cumulative project finance level 44% higher than China

As discussed above, China clearly outpaces the US in three of the clean energy growth factors identified by Bloomberg New Energy Finance. In the fourth -- cost-side subsidies -- the two are close to even, at least for now as the US continues to implement its stimulus bill.

It comes as no surprise that China asset finance levels are currently ramping up, surpassing the US in 2008 and 173% higher in 2009 (Figure 4). However, the US has spent 44% more than China on clean energy asset finance since 2004 with cumulative investment totalling $126bn for the US and $87bn for China. This difference can be largely explained by: (1) assets are cheaper on a per-MW basis in China and (2) abundant tax equity paired with the production tax credits led to a healthy asset finance environment in the US from 2006 through the first half of 2008.

Figure 4: Clean energy asset finance new build in US and China, 2004 - Q1 2010



Source: Bloomberg New Energy Finance Note: All figures are grossed and buffered to include estimates for undisclosed and unknown deals

Section 3. Wind, solar manufacturer competitive analysis

With the US and China accounting for an aggregate 65% of wind demand in 2010, it is little wonder that poorly-informed discussions of China's supplier position have permeated US political debate. It is true that Chinese equipment makers have staked a strong claim on the global PV market, including the US. In wind, however, Chinese turbine makers enjoy dominant positions in their domestic market but have made few inroads overseas. There is only one grid-connected wind project in the US today that employs utility-scale Chinese turbines, for instance.

The following sections discuss how supply-side manufacturing has boomed in China and dwindled in the US. Although Chinese companies are seeing success in exporting to the US solar market, certain barriers remain before Chinese wind turbines can be installed.

It is important to note that this discussion represents only a snapshot of the competitive landscape today and that there are many more innings to be played in this game. The true economic opportunity still lies at some point in the future when clean energy equipment can generate a MWh of electricity *at or near the cost of fossil fuels on an unsubsidized basis*.

Table 3: 2010 forecasted demand and supply for wind and PV sectors in US and China (GW)

	Wind demand	% of global total	Wind supply	% of global total	PV demand	% of global total	PV supply	% of global total
US	8.5	21%	6.8	12%	1.3	10%	2.3	9%
China	18.3	44%	21.6	39%	0.5	4%	5.2	43%

Source: Bloomberg New Energy Finance Note: Supply indicates equipment produced by companies headquartered in given country. PV supply includes thin film silicon, thin film other, and crystalline silicon module plants currently commissioned, partially commissioned, or under construction

3.1. China – Driving prices down and volume up for proven products

When there is demand for a new product, Chinese companies seek to supply it; PV modules and wind turbines are no exception. The solar manufacturing sector has been growing rapidly in China since 2005 and wind since 2007. Chinese banks and local governments have been especially generous in supporting this build out of manufacturing capacity.

Table 4: Top 10 Tier 1 c-Si cell manufacturers

Name (Country)	Current capacity (MW)
Suntech (CN)	1090
Q-Cells (DE)	1000
JA Solar (CN)	800
SolarWorld (DE)	710
Sharp (JP)	695
Trina Solar (CN)	600
Yingli (CN)	600
Canadian Solar (CN)	420
SunPower (US)	414
Solarfun (CN)	360

Source: Bloomberg New Energy Finance Note: Tier 1 is here defined as 'definitely bankable'

Solar

Most of China's large PV manufacturers were founded in the early- to middle-2000s, at a time when European demand for PV modules was beginning to soar, and when the market was under-supplied. Chinese companies quickly ramped production of PV cells and modules and were able to put their equipment into the field to meet demand due to tight supply. Since then and with the benefit of a significant "second-mover" advantage, Chinese crystalline silicon PV manufacturers have risen to the top by consistently under-pricing their competitors and generally matching them on quality.

While many European and Japanese manufacturers have facilities with capital equipment installed earlier in the decade, Chinese manufacturers which built large facilities in 2007-2008 were able to install and utilise capital equipment that was more efficient and less costly than what first-mover Europeans installed years before. Given China's advantages in labour costs, it was a relatively easy road to the top for its module makers. Out of the top ten crystalline silicon cell producers in 2010, six are Chinese (Table 4). Final prices for Chinese solar modules are consistently 20-30% lower than those assembled by European peers.

There have been a few potholes for the sector, of course, most notably the economic crisis, the lower-than-expected demand in 2009 created by the end of Spain's FiT, and the Germany's preference for German product. In the face of declining global demand growth, the Chinese government sought to pick up the slack back home by releasing the "Golden Sun" subsidy programme to stimulate short-run domestic demand. There are also prospects of a PV FiT in the short to medium-term.

The sector has also been floated by a significant amount of corporate debt. Nearly $1bn in Chinese bank loans was given out to solar supply chain companies (module, raw silicon, or wafer producers) in 2008. Lending by Chinese banks fell slightly in 2009 given lower demand, without about $633m doled out to the sector. Demand seems to be healthy again, and 2010 has already seen two significant transactions that dwarf all to date: China Development Bank's $4.4bn credit line for Trina Solar and its $7.3bn credit line for Suntech.

Wind

From the start, the Chinese government has pursued the dual purpose of building a wind manufacturing industry along with the power generation assets, thereby capturing the added value that a complete supply chain can bring. There was also the realisation that building out China's ambitious wind energy targets with higher priced foreign turbines would be too costly, not to mention deny Chinese companies an important opportunity to build a new manufacturing and export industry.

To achieve these associated goals, the government has implemented a number of supply- and demand-side policies. Demand-side supports have included GW installation targets, an RPS, and political directives for state-owned banks and utilities to support wind energy. Supply-side supports included R&D grants and other incentives given to large state-owned manufacturing companies to encourage them to diversify into the wind sector. A 70% local content requirement was implemented for wind turbines, effectively forcing foreign companies to set up manufacturing centres in China and also bringing many of their component suppliers with them. Some of these took the form of JVs, which brought further advantages in technology transfer.

When leading Chinese wind turbine manufacturers began mass production and sales of their products in 2006, turbines were typically priced 15-20% lower than their foreign counterparts. Since then, the price gap between domestic and foreign turbines has widened to over 27% in Q1 2010. The cost of a domestic-made 1.5MW wind turbine is now only $0.67m/MW, the lowest the industry has ever seen.

Table 5: Top 15 wind turbine manufacturers

Name (Country)	Production (GW)
Vestas (DK)	6.3
GE Wind (US)	5.8
Sinovel (CN)	5.8
Gamesa (SP)	4.4
Suzlon (IN)	3.5
Goldwind (CN)	3.4
Enercon (DE)	3.3
DFSTW (CN)	3.3
Repower (DE)	2.9
Nordex (DE)	2.5
Acciona (SP)	2.5
Siemens (DE)	2.2
Mitsubishi (JP)	1.6
XEMC (CN)	1.2
Clipper (US)	1.0

Source: Bloomberg New Energy Finance Note: Figures show estimated annual production for 2010

The price difference, coupled with the implicit government encouragement to buy domestic, has caused market shares of domestic manufacturers to expand dramatically at the cost of their foreign competitors. In 2006, when China installed 1.3GW of new wind, foreign suppliers held 59% of the market. By 2009, when China installed 14GW of new capacity, their share plummeted to just 14%.

In terms of global production levels, Table 5 shows that four of the top 15 wind turbine manufacturers (in terms of estimated 2010 production) are Chinese. Almost all of what they produce will be installed in China, with their eyes set on moving into markets abroad. A number are focused on the US market. Goldwind, for instance, recently hired a sales manager in the country. At least one other major Chinese player plans to open an office in the US in 2010.

As the domestic market expands, growing economies of scale and fierce competition have driven turbine costs down even further. However this has also resulted in an oversupplied market still brimming with a large number of inexperienced new entrants who have diversified into the sector from generic heavy manufacturing backgrounds. This is especially true for the current 1.5-2MW turbine product range, which domestic manufacturers can produce in abundance. Competition has thus settled into a price war rather than a race for innovation. Quality also remains a key concern as most domestic made turbines tend to have lower availability and frequent malfunctions when compared to established foreign brands.

Faced with these challenges, the government has been trying to move the market forward towards newer products, particularly those of larger (>2MW) and offshore turbines, which are still out of reach for most Chinese turbine suppliers and component makers. In addition to encouraging corporate R&D and requiring newly tendered projects to use larger turbines, a trio of recent policy moves has also been designed with this purpose in mind. In November 2009, the government removed its local content requirements. In March 2010, it drafted a policy which seeks to eliminate all but the largest and most advanced turbine manufacturers. Finally, in April it removed VAT for imports of large wind turbine components. In particular, the removal of the local content requirement and the VAT for imported parts is designed to allow domestic manufacturers to more easily access wind components from foreign suppliers as they build the prototypes for their larger turbines. This not only allows technology transfer to happen but also helps improve the quality of the new domestic made turbines, which are eventually intended for export.

3.2. The US: Unspectacular domestic manufacturing growth due to demand uncertainty

The track record is clear; where strong policies are implemented investment dollars follow. Germany's PV industry was built on the back of its generous FiT. The same has been true for Spain's wind sector. The Canadian province of Ontario is now seeing a surge of interest after installing its own FiT. Despite some important efforts in various states, the US has not had a similar national policy to galvanize the industry and attract massive new investment in manufacturing.

US companies were early pioneers for both PV and wind technologies and currently rank among the global leaders in both sectors. Some foreign manufacturers, banking on the belief that the US will eventually have a very strong demand for wind and PV, have already set up factories in the US. Unless policy can help to increase demand however, competition will be fierce for both domestic and foreign manufacturers as the US PV and wind markets face oversupply this year.

Solar

The US PV industry has been a world leader since the first cell was created by Bell Laboratories in 1954. The US is home to some of the world's largest and best-established PV crystalline silicon and thin-film PV companies, including SunPower and First Solar, both of which emerged from academic research programmes. Solar thermal electricity generation, which began as an industry in the desert of southern California, is now being reborn as a major industry in the US as well, with technology developers attracting hundreds of millions of dollars of equity capital, as well as strong partnerships with aerospace, defence technology, and leading infrastructure firms. The US is home to leading polysilicon manufacturers whose high-quality and high-margin product is not under urgent pricing pressure from other markets. Finally, many of the largest and best-funded of venture capital-backed PV firms are based in the US, having attracted billions in private capital in the hopes of becoming the new industry leaders.

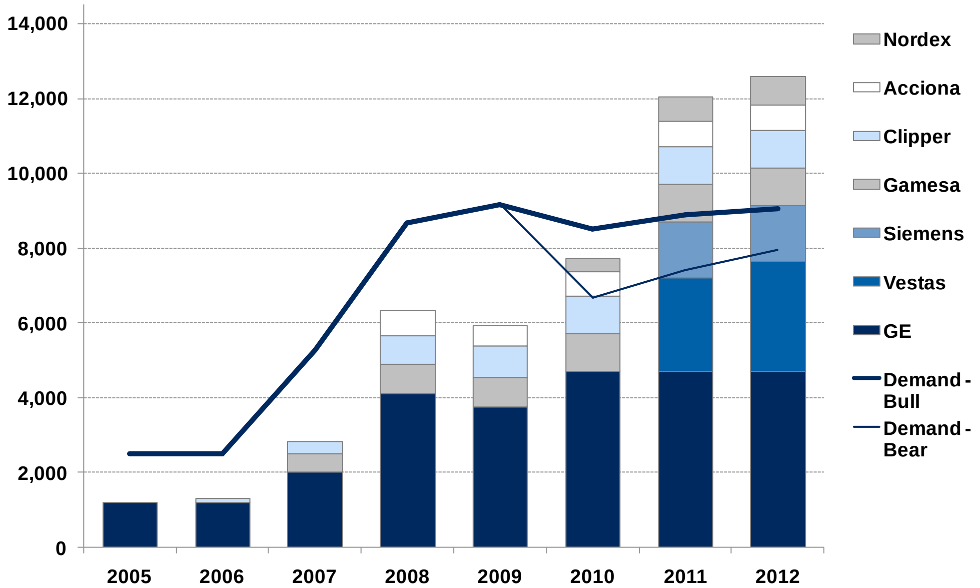
In the past several years, the US has attracted new manufacturing capacity. Most has been for technology specialists such as leading thin-film PV equipment maker First Solar and venture capital-backed thin-film companies such as Nanosolar, Miasole, and Solyndra. It has also attracted significant capital from overseas manufacturers, particularly those from Germany such as Schott, SolarWorld and Solon which see the US market opportunity, in the long run, as significant enough to support domestic manufacture. US companies have also consistently attracted capital through the public markets, not only in initial public offerings but through secondary offerings as well.

The US has tremendous solar resources, and will always offer opportunity for solar technology deployment, with its leading companies exporting equipment and expertise worldwide. Historically however it has not offered strong enough policy support to thrive as an end market for either PV or solar thermal.

Wind

Although US companies such as Zond and Enron were pioneers in the wind market in the 1980s, manufacturing capacity in the US has lagged Europe and China. Unlike the FiT policies of Europe and China, the policy tool of choice in the US has been the production tax credit (PTC) which was periodically allowed to lapse and never provided the level of long-term market visibility required to make a substantial manufacturing investment. As US demand heated up in 2006, the market was forced to import a substantial amount of turbines from Europe and Asia.

Figure 5: US wind supply-demand outlook (MW)



Source: Bloomberg New Energy Finance Note: Based on announced or estimated manufacturing capacities discounted/delayed according to announced production cuts. Capacity refers to nacelle assembly on US soil.

Despite the challenges of US policy, GE Wind and Clipper Windpower have both established domestic manufacturing capacity. GE has consistently been a major player in the market and with

12.4% total market share is a major global player.[2] Until recently GE has been nearly completely focused on the domestic market with its 1.5M turbines in some years accounting for almost half of the capacity installed in a given year. Clipper, the younger of the two, has ramped up capacity since 2006 with a total annual capacity of 1,150MW. Clipper has struggled with some problems with its initial products but is now a full-fledged competitor. While the US will remain their primary driver, both firms have looked to diversify away from the domestic market with GE making a push into Europe, both onshore markets in Eastern Europe and the growing offshore market. Clipper has recently commissioned its first non-US project, a 67.5MW project in Mexico built by EDF Energies Nouvelles.

With a four year extension of the production tax credit in 2008, foreign OEMs from Europe and Asia (though notably not China) announced investment in new US-based manufacturing in capacity in droves. Total capacity as measured by nacelle assembly is expected to reach 12GW per year by 2012, well above our short-term demand forecast (see Figure 5). In just a few years the US market will flip from extremely tight to a substantial oversupply, with competition certain to increase heavily.

The US will remain a major market for wind and a total collapse, as was seen in the 1980s, is very unlikely. However, a lack of progress on key long-term policies like cap and trade or a national clean energy target have reset the trajectory of demand lower, increasing the pressure on existing manufacturers to build cheaper more reliable turbines, and setting the bar even higher for new entrants.

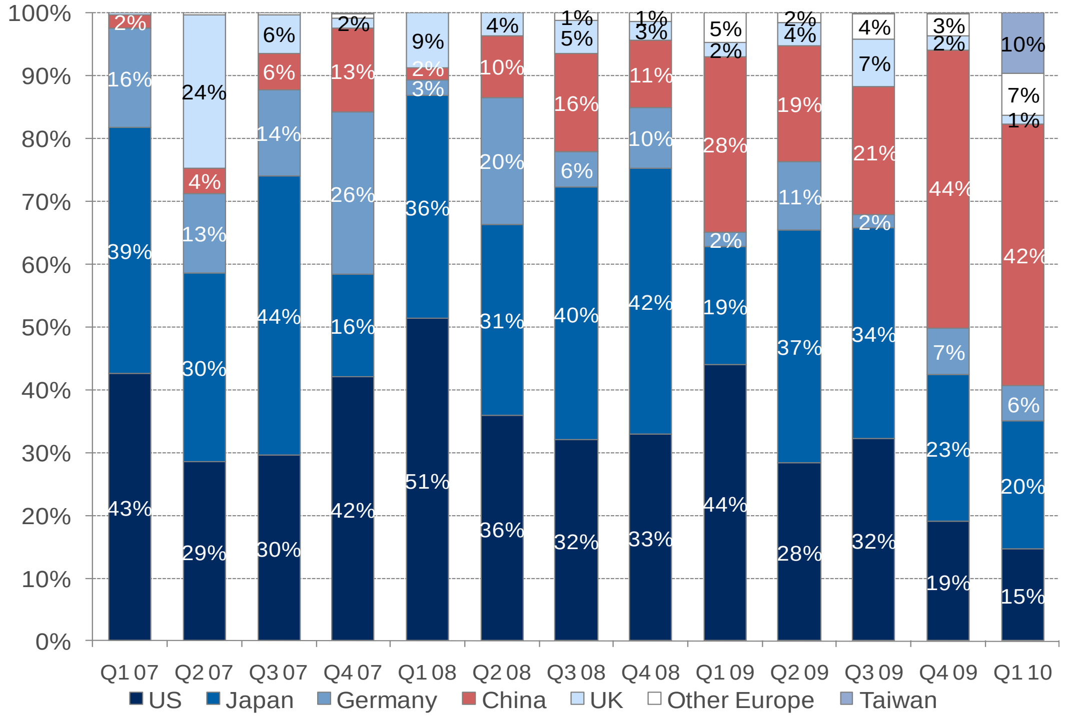
3.3. "Made in China": success for solar, a barrier for wind

The previous two sections focused on US and Chinese companies' market shares in the global market as a whole. Here we turn our attention to market share for US wind and solar manufacturers in China Chinese manufacturers in the US.

On the solar side, there are essentially no PV module exports from US companies to China as Chinese producers can make the equipment less expensively for the most part. On the wind side, GE Energy is the only wind turbine maker to have sales in China. With a production facility in Shenyang (in order to comply with local content requirements), GE Energy took 2.3% market share in 2008 but only a 1.6% market share in 2009. It will continue to hold onto a small market share as the years march on, but it will likely not increase as Chinese turbine makers become increasingly competitive in terms of cost and quality.

Figure 6: CSI module suppliers by country, 2007-Q1 2010

Market share



Source: CSI, Bloomberg New Energy Finance

[2] BTM Consult World Market Update 2009

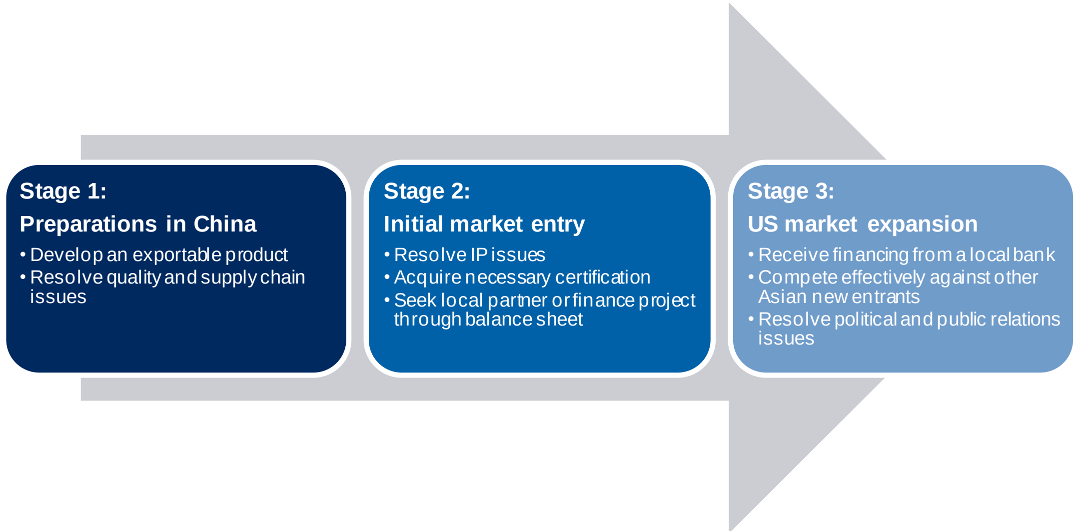
Meanwhile, Chinese companies are having strong success exporting PV modules to the US mainly to California which accounts for 45% of the overall US PV market. Figure 6 shows module suppliers for the California Solar Initiative. While Chinese firms held a small market share throughout 2007 and 2008, their stake ranged from 19-28% through the first three quarters of 2009. Q4 2009 marked a breakthrough as Chinese module makers seized a 44% market share. Their position as tops in California held steady in Q1 2010 at 42%.

Several leading Chinese solar companies now intend to establish manufacturing presences in the US. Suntech plans to open a module assembly plant near Phoenix, Arizona and will receive a 30% manufacturing tax credit as part of the US stimulus bill along with local tax credits provided by the municipality. The move could help Suntech's sales in the region by allowing the company to brand its equipment as locally-manufactured. Because the work performed at the plant will consist of just module assembly -- the last and not particularly labour-intensive segment of the value chain -- the company will not incur high labour costs.

Meanwhile, US companies Evergreen Solar and First Solar are eyeing cost saving advantages of having their products manufactured abroad. Evergreen is currently moving its wafer and module manufacturing operations from Massachusetts to Hubei province in central China. First Solar, which already has a large facility in Malaysia, intends to build another large thin-film PV module plant in China, in order to supply its recently announced 2GW project to be built in Inner Mongolia. The respective definitions of a US vs. Chinese PV module are getting ever blurrier.

Chinese wind manufacturers, now dominant in their domestic market, have their sights set on overseas markets including Brazil and Latin America, Eastern Europe, North Africa, and the US. However, in the US they face a number of key barriers to entry. Figure 7 highlights the process chart such firms must follow to export to the US. Most Chinese OEMs with intentions to export are entering Stage 2 in the process chart, deploying a few turbines in the US, setting up sales offices and seeking local partners. Despite this, many still have unresolved issues from Stage 1, whereby newly developed export turbines remain untested – some have only just been installed in China or have just come off of the assembly line.

Figure 7: Chinese wind turbine export process chart



Source: Bloomberg New Energy Finance

The US market is also saturated with over 1500 wind energy-related patents, according to the US Patent and Trade Office. Most of these are for power control systems and components for grid interaction, which will affect every turbine that is grid connected including even direct drive machines. A number of the most important of these patents are held by GE and the company has used them successfully in the past to battle competitors. While almost every new entrant to the US turbine market has had to deal with GE's IP portfolio, German manufacturer Enercon was successfully barred from exporting to the US several years ago while Mitsubishi recently went the distance and won a favourable decision from the International Trade Commission.

So far, Chinese exporters have avoided litigation challenges from US companies, presumably because they have not attempted any large-scale exports into the market. But as discussed above other leading manufacturers have faced litigation before and have typically settled out of court for a negotiated fee paid by the violator to the patent holder. There are a number of options for Chinese OEMs to pursue to resolve IP issues, ranging from redesigning their products to licensing their own patents to attempting to invalidate existing patents in court – but most of these options are costly and time consuming. In reality, the only option may be a reactive one in that if a challenge occurs, then the Chinese exporter will have to decide whether to settle out of court or to fight the case.

Stage 3 offers a separate set of challenges, most notably the challenge to secure Western third-party capital, i.e. the ability to establish "bankability." Currently, no western European or US bank will finance a large scale project that employs Chinese turbines because the equipment is regarded as too risky. Until these financiers can be convinced otherwise, Chinese equipment makers will either have to rely on their own balance sheets or tap Chinese banks for financing. Only after a first project has been established as operating successfully for some substantial period of time will Western money become available.

Chinese equipment makers are also looking to enter the US market at a period of turbine oversupply. As such there will be stiff competition from not only established European and US suppliers, but also from Korean new entrants who are also setting up facilities in North America.

Finally, there are tricky political challenges. As alluded to earlier, as the economy has soured politicians from both parties have increasingly portrayed the growth of clean energy as a means to generate jobs and create economic development. The proposed A-Power project has generated substantial unwanted attention from the Senator Charles Schumer of New York, the third ranking Democrat in the US Senate. Schumer and four of his colleagues have written legislation essentially requiring projects to use US-made equipment in order to qualify for Treasury grants. These “Buy American” or local content rules may force Chinese suppliers to build facilities in the US just as the rules the Chinese government put in place several years ago compelled GE to build manufacturing capacity in China.

The problem is compounded by the ownership structure of Chinese wind turbine manufacturers who are typically at least partially backed by the government. Whereas being state-owned is considered a strong advantage to a company’s credit rating and credibility in China, it carries heavy political baggage in the US, especially where it concerns the energy sector and energy security issues. A classic case of cultural misunderstanding occurred in 2005 when CNOOC (China National Offshore Oil Corporation) attempted to acquire to acquire US oil firm Unocal. Touting its state-owned credentials, CNOOC’s bid created a political storm in Washington, leading several senators to sponsor a bill to block the acquisition. Although CNOOC ultimately withdrew its bid, the case highlighted the sensitive nature of mixing a Chinese state-owned company in the energy sector with US politics.

Table 6: Challenges for Chinese wind OEMs hoping to export to the US

Challenge	The Problem	Chances of overcoming in short term (1-2 years)
Developing an Export Product	Leading Chinese OEMs need to develop a turbine capable of exports, without licensing restrictions and compliant with market conditions in the US. Typically these would be the next generation of >2.5MW turbines, some of which can also be deployed for offshore.	Moderate. The top five domestic OEMs in China are moving rapidly to develop a new generation of turbines for exports, but the process will take time, likely at least 1-2 years to reach volume production of these products.
Quality and Supply Chain	Chinese OEMs need to raise their game and narrow the gap with international suppliers. In terms of supply chain, Chinese OEMs still need to secure a ready supply of components for their larger turbines, whether through imports or domestic suppliers.	Moderate to Good. Quality issues will take time to resolve as the new untested turbines climb the learning curve. However, in terms of supply chain imports of components are already allowed without tariffs and domestic component suppliers are investing heavily to scale up.
Certification	Most Chinese wind turbines are not internationally certified or have the required certifications for exports to certain markets. These would need to be obtained first before volume exports can begin.	Varies. Certification is time consuming and can differ based on market requirements. Some Chinese OEMs have made more progress in this regard than others.
Intellectual Property	Most turbine exports to the US will face an IP risk as there is a large portfolio of wind energy related patents held by companies in the US primarily surrounding power control systems and grid interaction.	Difficult to moderate. Chinese wind exports to the US will run into IP issues but the actual effect will depend on whether the US patent holders will litigate against the Chinese violators. Historically, most OEMs have settled out of court where the violators pay a fixed amount to the patent holder.
Bankability and Finance	Banks and other project financing institutions will not finance a project that deploys Chinese wind turbines, citing too much risk.	Difficult. In the short term, Chinese turbines will be financed by balance sheet and will need to prove their worth through operational experience in the US, especially the newer models. However, once a breakthrough occurs and even if just one project is financed by a foreign bank, the doors should swing wide open. Given the current wind project financing

Challenge	The Problem	Chances of overcoming in short term (1-2 years)
		environment in the US, however, this could be challenging.
Competition in the US	The US market is entering a period of turbine oversupply and Chinese exporters will face stiff competition from not only the established US, European, Japanese and Indian suppliers, but also other new entrants from South Korea, such as Samsung and Hyundai.	Moderate. Chinese turbines will be highly competitive on price and born from an already crowded home market, are no strangers to competition. However, the fiercest competitors might be the new entrant Korean suppliers, who will also adopt low prices but have better branding and corporate governance advantages in the US compared to the unknown Chinese companies, which come from a very different state-owned business background.
Political and Public Relations	"Buy American" provisions or biases against Chinese manufactured goods will have an adverse impact on Chinese turbine suppliers in the US, both in terms of branding and reputation and potentially in more concrete ways such as restrictive policies or tariffs.	Challenging, but actual impact unclear. A backlash against Chinese made turbines being deployed at US wind farms has already begun, though no concrete policies have been established. Some type of restriction seems inevitable, but the actual extent of its harmful effects will be determined by the Chinese supplier's ability to handle media and government relations issues. Unfortunately, most Chinese turbine manufacturers have very little experience in this regard, being unlisted state-owned companies.

Source: Bloomberg New Energy Finance

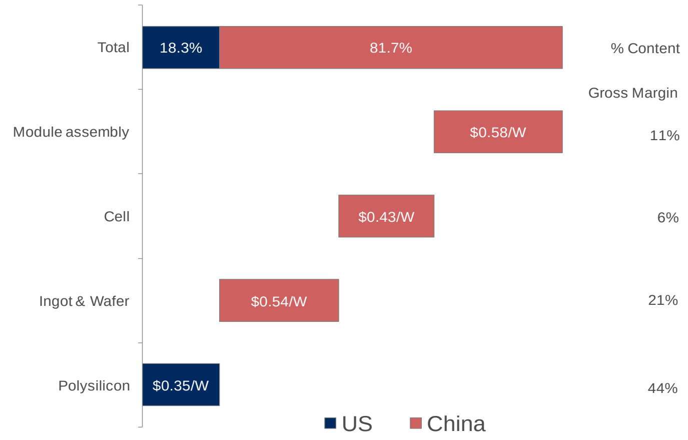
Section 4. Joined at the hip: US-China comparative value chain analysis

The US-China clean energy trade relationship has been described in stark terms in US political circles, with China regarded as "winning" primarily due to its success in exporting PV to the US. But little about the clean energy represents a zero sum game. "US-made" wind turbines virtually always include parts sourced from China, for instance. So-called "Chinese-made" PV modules are manufactured using machines designed by US firms.

While the US does not dominate end product sales, it is capturing the value from other parts of the clean energy supply chain. For instance, should the highly controversial proposed A-Power come to life, 44% of its dollar value of would be captured by US players, and that is assuming only one quarter of the potential financing would be put up by a US bank.

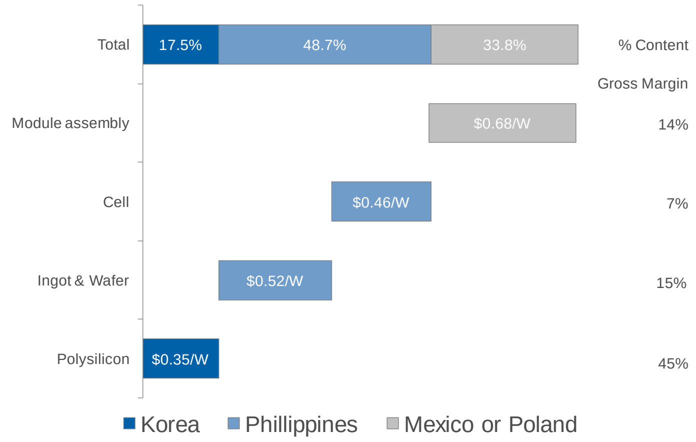
Even if US companies may never sell a single PV module in China, there is still a robust market for US PV capital equipment in the country. The clean energy supply chain has many parts which this section will expose in order to clarify which countries and companies will receive what benefits.

Figure 8: Value breakdown by manufacturing country of origin, typical Suntech module



Source: Bloomberg New Energy Finance Note: Based on where the product is manufactured. Polysilicon production for Suntech is provided by US-based MEMC.

Figure 9: Value breakdown by manufacturing country of origin, typical SunPower module



Source: Bloomberg New Energy Finance Note: Based on where the product is manufactured. Polysilicon from Korean DC Chemical, wafers by a Philippines-based First Philec-SunPower JV, cells in a Philippines SunPower factory, and module assembly in Mexico or Poland.

4.1. Manufacturing value creation

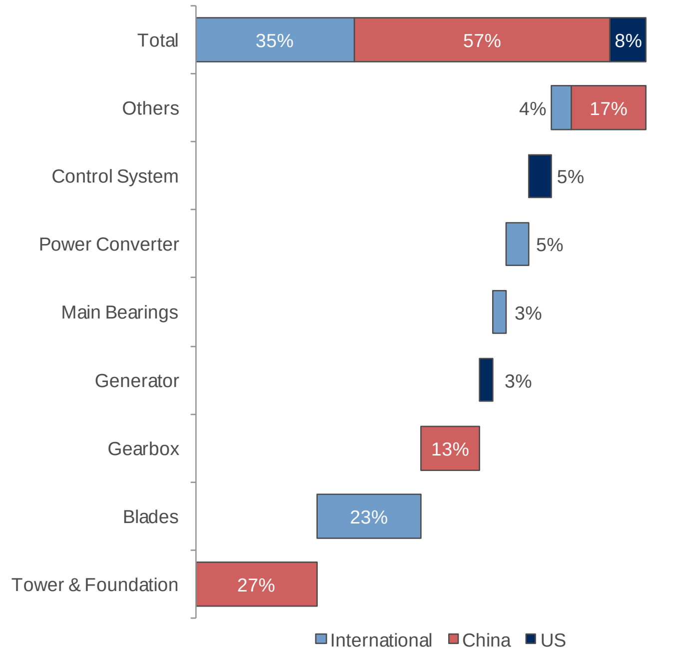
Any manufacturer seeking to produce modules or turbines must first procure the proper assembly line equipment. The PV sector has been quite a boon for capital equipment providers and larger specialty semiconductor equipment providers such as Applied Materials. The company recently established a $250m R&D and demonstration facility in Xi'an, China to better serve its customers there. Given all the new PV cell and module assembly lines under construction in China and Taiwan, Applied Materials can help its customers reduce operating costs of the lines, provide maintenance and troubleshooting, and ensure fast production ramp up through this new facility.

As with most industries, PV modules and wind turbines are comprised of a number of parts from all over the world. In the following figures, we disaggregate a typical solar module and wind turbine based on country of origin for each component in the value chain.[3] Figure 8 and Figure 9 break down where the parts are manufactured for a Chinese Suntech and US SunPower module. For the Suntech module, the polysilicon comes from US Tier-1 silicon producer MEMC, while ingots and wafers, cells, and module assembly are all based in China. For SunPower, silicon comes from the US, while wafers and cells are manufactured overseas, and module assembly takes place in Mexico.

[3] One caveat: our analysis assumes equipment suppliers produce their equipment locally and do not out-source. That may not necessarily be the case. Although the brand may be American, the product could be significantly Chinese, European, or otherwise. For instance, First Solar now boasts module production facilities in US, Germany, and Malaysia. SunPower does most of its cell production in the Philippines, with new lines opening in Malaysia, while its module assembly plants are in Mexico and Poland.

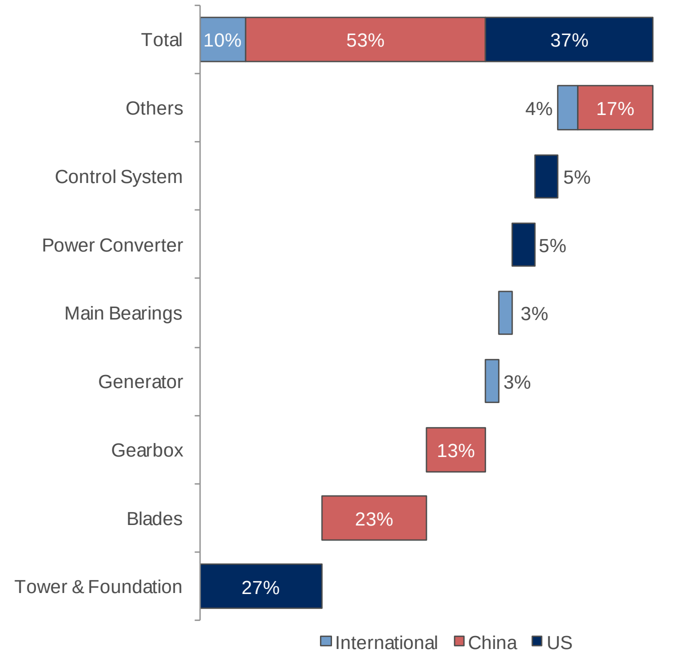
Wind turbines have more major components than PV modules and more sources. Figure 10 shows the value breakdown for a GE Wind turbine installed in China. In the past, 70% or more of the content will be produced in China due to a local content requirement (recently removed), while the company footprint of the parts would be quite varied. China Highspeed Transmission will provide the gearbox, GE Wind will provide the generator and control system, while various suppliers in Europe such as ABB, LM, and SKF will provide the remaining parts (power converter, blades, and bearings). For a Sinovel wind turbine hypothetically installed in the US (Figure 11), the footprint would be similarly varied. AMSC would provide the power converter and control system, while Huiteng would provide the blades with ELIN and SKF providing the generator and bearings.

Figure 10: Value breakdown by company country of origin, GE Wind 1.5MW turbine installed in China



Source: Bloomberg New Energy Finance Note: Based on the country of origin for the company producing the product, not necessarily where the product was produced.

Figure 11: Value breakdown by company country of origin, Sinovel 3MW turbine installed in US



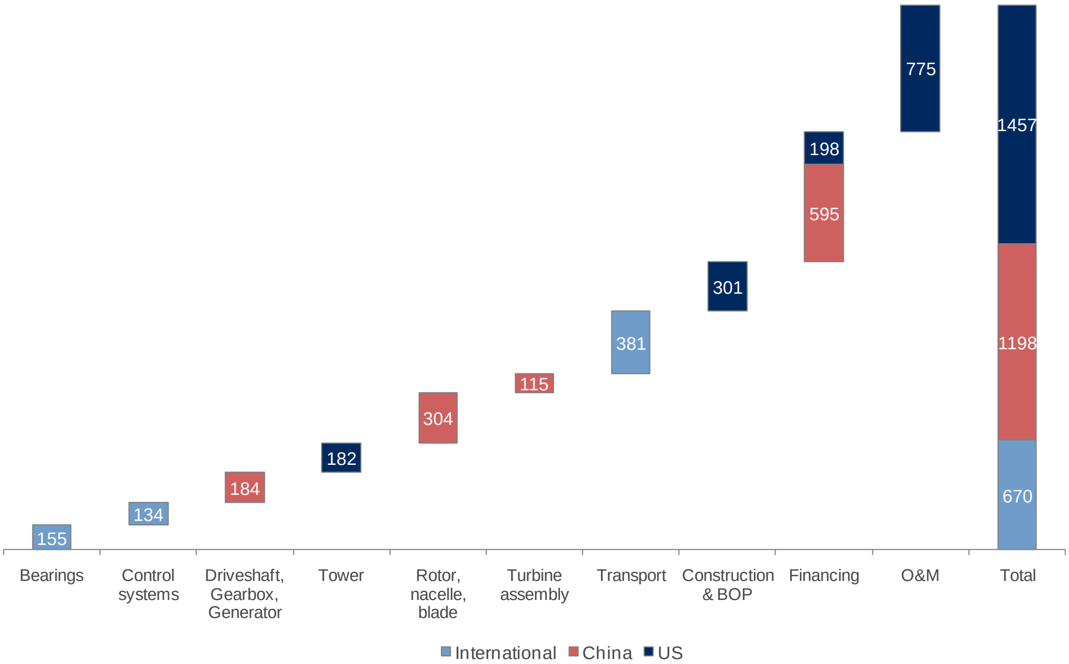
Source: Bloomberg New Energy Finance Note: Based on the country of origin for the company producing the product, not necessarily where the product was produced.

4.2. Financing, installation, and O&M value creation

In addition to the revenues generated selling components and final products, significant clean energy value creation comes from the transport and construction of equipment, plus so-called "balance of plant," financing, and operations and maintenance contracts. Taking all of these additional aspects of the value chain into account, Figure 12 examines how much US value would be derived should the controversial A-Power project move forward.

Bloomberg New Energy Finance has used this proposed Texas wind farm as a model for a hypothetical Texas wind farm using Chinese turbines. Figure 12 shows that the components and final turbine product only comprise $1.1m/MW or 32% of the net present value of the project. Since the transport of turbines and blades across seas and then halfway across the US is no small affair, transport costs account for 11% of the project costs. Construction, operation, and maintenance total another 32% of NPV. Finally, the financing of the project will account for the remaining 24%. This last portion will be broken down, depending on which institutions will decide to finance the project. As mentioned in section 3.3, it will be hard to convince US and European banks to finance Chinese wind turbines that have not yet been tested and used in China. For that reason, the assumed break-out here is 75/25 in terms of Chinese/US bank financing, as China Export Import Bank has expressed interest in taking a large stake in the project.

Figure 12: Estimation of value creation for a hypothetical Texas wind farm, $000s/MW



Source: CSI, Bloomberg New Energy Finance Note: Assumed to be using 3MW turbine from China. Blades may end up being produced in the US,

Section 5. Innovation: the race to cut unit costs

R&D and innovation in clean energy tends to have one goal -- to drive the per-kWh cost down below that of fossil generation (see section 1.3 for more on current levelised costs). On the face of it, it appears the US holds a solid lead in fostering such innovation. Venture capital and private equity investors have pumped no less than $20.6bn into various US clean energy companies since the beginning of 2004 with $6.3bn going into solar companies. Chinese companies attracted just $2.2bn with $1bn going into solar companies. Here, we look at how much money is being spent on innovation at US and Chinese companies in the PV and wind sectors as well as how this money will improve companies' market shares over time.

5.1. PV R&D: US companies focus on long-term breakthroughs while China perfects current processes

Table 7: Total VC/PE funding received for select US PV module companies

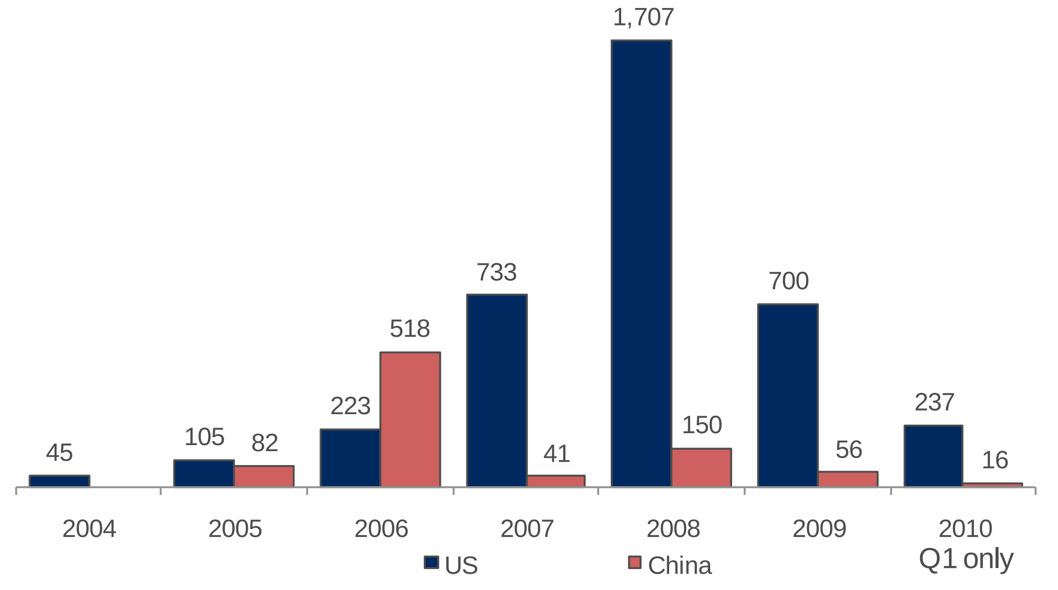
Name	Funding (USDm)
Solyndra	962
Nanosolar	395
Miasolé	333
Abound Solar	148
Heliovolt	144
Advent	118
Solaria	80

Source: Bloomberg New Energy Finance Note: Includes estimate for earliest 2004 round for Heliovolt; only includes VC/PE rounds beginning in 2004

The top five Chinese and top three US PV module manufacturers all had initial public offerings before 2008, when the PV market was still very much under-supplied. Evergreen was the earliest to list in 2000, with SunPower and Suntech following in 2005; First Solar, Solarfun, Trina Solar, and Canadian Solar at the end of 2006; and finally Yingli in 2007. The first half of 2006 saw a flurry of VC money flowing into PV companies in China (Figure 13, the only time when VC money for PV manufacturers was higher in China than the US), with Yingli, Trina, and Solarfun grabbing large chunks. One round of financing was enough for these companies to prove that they could produce a decent working module in an under-supplied market before they went public just a half year or so after their initial financing.

Such opportunities are not nearly so available for US PV firms today. Since the economic downturn took hold in 2008, the public markets have been generally inhospitable to new share offerings from clean energy firms. As a result, US companies have sought later and larger rounds of additional venture capital financing.

Figure 13: VC/PE investment in US and China PV manufacturing companies, 2004 - Q1 2010 (USDm)



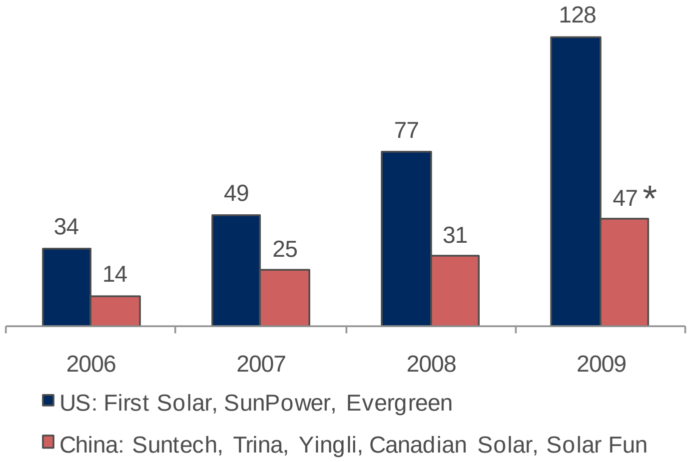
Source: Company filings, Bloomberg New Energy Finance Note: PV manufacturing companies encompasses raw material, wafer, and module producers

Figure 13 shows that large amounts of VC/PE finance continued to flow into US PV companies between 2007 and 2009, with $3.7bn total over the past six years. Table 7 breaks down the financing for seven module companies that accounted for $2.2bn or 58% of that total. None of these companies have much of a market share to speak of yet, and many of them are thin-film module companies which will compete for developer dollars with market leader First Solar's product.

The cost of First Solar's product had already fallen to $0.93/W in Q1 2009 as it hit an 800MW production capacity. In 2009, First Solar sold 1GW of product while Solyndra sold only 30MW. Solyndra has filed to raise $300m in an initial public offering in 2010. Its thin-film peers Nanosolar and

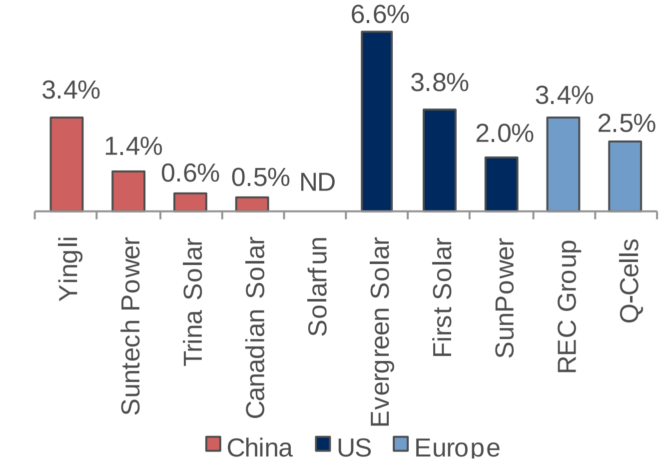
Miasolé may also pursue IPOs in the near future, though a successful listing could be challenging for companies that are not yet reporting profits. All of these companies are competing not simply on their per-unit generation costs, but on application-specific attributes. Solyndra, for instance offers a cylindrical design for commercial rooftops that will be able to capture more of the sunlight that hits the roof, while Miasole is offering CIGS thin-film cells that are flexible.

Figure 14: R&D for the top five Chinese and three US PV module manufacturers (USDm)



Source: Bloomberg New Energy Finance Note: 2009 figure does not include Solar Fun R&D and only includes Q1-Q3 data for Suntech, Yingli, and Canadian Solar, 2006 figure only includes data from August forward for Yingli

Figure 15: R&D/revenue ratios for selected top PV module companies, 2009



Source: Bloomberg New Energy Finance, company filings Note: only includes Q1-Q3 info for Yingli, Suntech, and Canadian Solar

Among publicly listed PV companies, the amount of R&D investment varies. In 2009, First Solar spent the most on R&D ($78m) while Evergreen poured the highest share of money into R&D relative to revenue (Figure 15). In fact, Evergreen has consistently spent much of its revenue on R&D -- an average of 15% since 2005. The company's cell production capacity is just 80MW meaning much of this R&D money is likely going to Evergreen's new “string ribbon” technology.

Of the Chinese top manufacturers, Suntech spent the most ($16m) on R&D in 2009. Much of this is likely to support its new product Pluto, which has the world record conversion efficiency for multi-crystalline silicon module at 16%. Yingli spent 3.4% of its revenue on R&D, comparable to the ratio spent by First Solar and REC Group; this money was most likely supporting its new Panda line producing high efficiency mono-crystalline modules.

Figure 14 shows that the top five Chinese companies have only spent 40% of the money that the top three US PV module manufacturers have, with Suntech accounting for nearly half of the money the Chinese companies have spent. It is difficult to determine the direct effects of R&D spending by Evergreen or Suntech will contribute to increased market share, and how much market share will simply be determined by the ability to quickly ramp up production and sell at competitive prices.

Meanwhile, First Solar appears poised to remain dominant in the thin-film space. The large amounts poured into early stage firms such as Solyndra, Miasole, and Nanosolar for early technology development have yet to pay dividends in a substantial way. Until and unless these firms go public, these will not have access to the sums of capital First Solar, Suntech, and others can tap.

5.2. Wind R&D: China thinks big, the US looks offshore

In contrast to solar, almost all innovation in the wind sector takes place within R&D departments of large, fairly well established companies. Most innovation currently revolves around cost reduction and future offshore wind products with the sector rarely seeing venture investments on the application side.

In China, the government has made explicit that turbine makers must not simply aim to produce and sell garden variety 1.5MW onshore models. It has explicitly mandated that money be funnelled from VAT refunds to R&D for 2-3MW turbine sizes. This has prompted Chinese firms such as Sinovel and Goldwind to think big. Meanwhile, in the US, the only two major turbine makers -- GE and Clipper -- are focused on competing on a per-kWh basis by emphasizing the efficiency of their devices. The two also have ambitious plans for the offshore market.

Observing that stiff domestic competition for sub-MW and 1.5MW models was already pushing cost reductions as fast as possible, the Chinese government decided research should begin on larger turbine sizes if domestic manufacturers would stand a chance abroad. In April 2008, the government said it would refund VAT and import duties on imported components for turbines above 1.2MW. All refunded money would be transferred as state-owned equity but could only be used for R&D purposes. The policy has produced an estimated $21m in R&D funding in 2008 and $80m in 2009 for the top three turbine producers Sinovel, Goldwind, and Dongfang.[4] All of these firms now have 2.5MW and 3MW products at the prototype stage with ongoing R&D for even larger models targeted at offshore markets.

A smaller domestic player XEMC actually acquired Darwind in August 2009 in order to gain the company's direct drive technology for a 5MW offshore wind turbine. Goldwind is focusing on a hybrid gear/direct drive technology for a 3MW turbine that could be used for offshore or onshore products. Although transport costs will keep many exports at bay, the companies have poured a significant amount of money into the research these larger turbine sizes and will therefore be trying their hand in foreign markets.

In the US, GE and Clipper have two main innovation strategies. The first is to focus on bringing down costs on a $/kWh basis. Nameplate costs ($/MW capacity installed) have fallen for several years. Today, the focus is on bringing down lifetime costs of each turbine. This means cutting long-term maintenance costs and increasing turbine availability in lower winds.

The second strategy involves developing large-scale offshore turbines. Clipper spent $21m or 3 percent of its revenue on R&D in 2008. A large portion of that went toward developing a massive 10MW offshore turbine as part of an agreement with the Crown Estate. GE Wind, while somewhat less ambitious in terms of size, is also looking to develop a direct drive turbine for the offshore market. This was a large reason for its $18m acquisition of Scanwind in September 2009.

[4] Assuming 17% VAT, 10% foreign content, $0.94m/MW price in 2008, and $0.79m/MW price in 2008

Section 6. The politics: Buy American provisions threaten to create inefficiencies, raise tensions

In 2004, China raised its local content requirement to 70% for all wind equipment installed within its borders. At the end of last year, the government lifted those. In the meantime, Chinese manufacturers were able to grow large enough to take dominant stakes in their domestic market.

Now, in the US, a somewhat similar effort is underway in the form of the American Renewable Energy Jobs Act. The legislation, which has not been approved by either chamber of Congress, would extend the “Buy American” provisions established in the 2009 stimulus bill and has been offered by Senator Schumer. Specifically, the legislation aims to restrict access to a highly successful programme run by the Treasury Department that awards project grants in the amount of 30% of CAPEX. Currently, Treasury must issue grants to essentially any clean energy project that is commissioned, regardless of where the equipment in that project has been manufactured. Schumer’s bill would give Secretary Timothy Geithner discretion to reject projects. Specifically, Treasury could offer no grant until Geithner “analyzes and takes into consideration domestic job preservation and creation provided by a specified energy property, including domestic job preservation and creation related.” Treasury would then be expected to produce a written analysis of that project and submit it to Congress.

In addition, the actual Buy American provisions require that any public building or public works project receiving stimulus use primarily US-produced goods. As established in the stimulus bill in 2009, the provisions did not apply to private projects. Schumer’s bill would change that to include private projects that aim to receive the Treasury grant.

There is an exception to Buy American in the stimulus law, however. Specifically, if the use of US goods increases costs by more than 25% then a waiver can be granted to use products from abroad. If private projects had the Buy American requirement, this exception would presumably apply to them as well. This would give project developers the right to apply for the waiver. However, doing so would inevitably add months to their development time, given the bureaucracy involved.

While Schumer’s frustration is somewhat understandable, given the protections Chinese turbine makers enjoyed, the rationale behind his legislation is not well considered. First, the project he is concerned about that would use Chinese-made A-Power turbines stands little chance of qualifying for the grant. Second, such a restriction would also introduce cost inefficiencies. For instance, currently the US has a tariff on imported ethanol of $0.54/gal. Given that there is cheaper ethanol available abroad in Brazil, US consumers pay extra for fuel to protect the revenues of American corn farmers. Interestingly, the tariff is still in compliance with WTO rules since ethanol is classified as an agricultural product for which the rules do not apply.

Meanwhile in California, consumers of Chinese PV modules are saving money relative to purchasing American or European products. The fact is that China has always been a low-cost manufacturing centre and will likely remain so in the future. Chinese companies will therefore always provide competition for both incumbent manufacturers of clean energy equipment, as well as potential new market entrants. If protective barriers are introduced, these could provide a disincentive for US companies to innovate and reduce the costs of their clean energy products. In the end, the consumer will pay a higher price for clean electrons.

Buy American provisions could also introduce political tensions between the US and other nations, which would hurt the prospects for the US clean energy economy. A representative from GE said recently, “Buy American provisions may cause other nations to retaliate by curbing their use of US products, shrinking domestic job creation tied to exports.”

Tensions are already running high in the US-China relationship. Politicians from the world’s top two greenhouse gas emitters are engaged on a number of bilateral issues: currency valuation, trade imbalance, climate change negotiations, human rights, and Taiwan arms among others. Carbon tariffs were a point of contention between the US and China throughout 2009. While Secretary of Energy Steven Chu has said carbon tariffs (for countries without carbon emission restrictions) may be necessary in order to get cap and trade passed through the US Senate, President Obama has tread more cautiously, saying last June: “At a time when the economy worldwide is still deep in recession and we’ve seen a significant drop in global trade, I think we have to be very careful about sending any protectionist signals out there." While carbon tariffs are more justified from an economic perspective, clean energy border tariffs or restrictions will be much harder to defend.

Additionally, in the lead up to COP15, President Obama and President Hu Jintao established the US-China Clean Energy Research Centre – a $150m agreement for cooperation over next five years on clean energy technology development. The prioritized technologies are building efficiency, carbon capture and storage (CCS), and clean vehicles.[5] Additionally, a number of platforms to support the centre were launched including:

- US-China Electric Vehicles Initiative
- US-China Renewable Energy Partnership
- US-China Energy Efficiency Action Plan
- US-China Shale Gas Partnership
- US-China Energy Cooperation Program

This cooperation is an important foundation for the US-China energy and climate relationship moving forward and will provide additional avenues for companies and investors to get involved in the effort to improve clean energy technologies.

[5] For fact sheets on the launch of the US-China Clean Energy Research Centre, see: http://www.energy.gov/news2009/8292.htm

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