Solar PV Australia 2010 – a global outlook

Report February 2010

Clean Energy Council

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Facilitating and Delivering Australian Clean Technology Investments

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Executive Summary

The Australian Clean Energy Council commissioned this study to review the status and trends of the Australian solar PV industry to help inform its members and to assist them in planning for what may be coming in 2010 within a global context. Australian CleanTech provides specialist research and advisory services in the cleantech sector. It was commissioned to undertake this study because of its knowledge and understanding of emerging technologies and its ability to transfer and apply this knowledge to practical issues.

The study was completed through both a global literature review and interviews with a number of key Australian market participants. The list of participants is presented in Attachment 1, although generally no comments or data has been attributed to any specific stakeholder. Rather the general consensus opinions of those interviewed were used to build a picture of the current and future Australian market.

Current State of the PV Market in Australia

In the past year the sector has seen increasing volatility in the market, leading to the collapse of Solar Systems, a significant developer of large-scale concentrated PV and the closure of the BP Solar manufacturing plant. The industry has faced the closure of the Solar Homes and Communities Plan (SHCP) and Renewable Remote Power Generation Program (RRPGP) rebates and the suspension of applications to the National Solar Schools Program. The National Solar Schools Program's next tranche of funding will be available in July 2010 and will reopen for new claims in May 2010. There is also continuing uncertainty as to the future of the Carbon Pollution Reduction Scheme (CPRS).

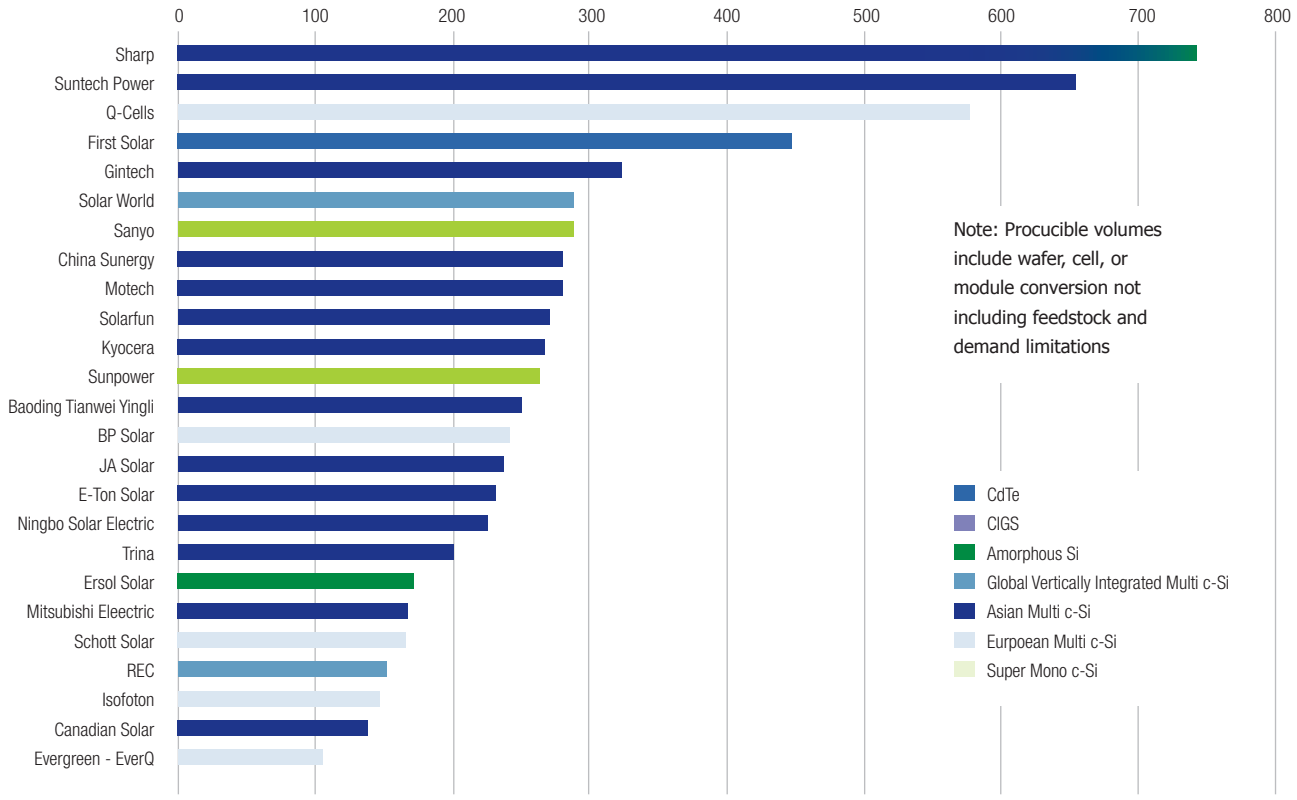
Under the expanded Renewable Energy Target (RET) scheme that was passed by the federal parliament in August 2009, the Solar Credits scheme, has been introduced to replace the $8000 SHCP rebate. This has created an output based mechanism as opposed to a flat rebate and is no longer means tested. This is expected to lead to a larger percentage of wealthier households participating in the scheme and a demand for larger high quality systems.

Stakeholder interviews have revealed that most firms are tracking well against the general industry growth rate. However, given the recent emergence of many new entrants into the sector it seems that some of the more established rivals may have lost some market share. Many of these new entrants are competing primarily on price and importing cheaper Chinese product and operating on slim margins.

Off grid is still the largest segment of the installed PV market. However, given the current regulatory environment under the REC program, grid connected systems continue to increase their share rapidly. Supply chain management has been an issue in 2009 and will continue to be crucial into 2010. Given the recent growth in the industry and as only a limited manufacturing base exists in Australia, the long lead times must be tightly managed on receiving stock in line with installation schedules. Several firms have also been experiencing supply shortages for inverters and panels.

A lack of genuine government support for new technology development means that most Australian technology developers ultimately head overseas for funding support as venture capital is limited in Australia. For these reasons, as well as the increased efficiencies being generated by the larger capacity of new production facilities abroad, it is unlikely that Australia will see the redevelopment of a manufacturing base in the short term.

Top 25 Global Producers In 2008 – Cells (Producible Volumes)



Source: Greentech Media Research

Overseas Market Trends

The solar PV industry globally is in considerable flux. Overbuilt manufacturing capacity, stagnant inventory and weak global macroeconomic conditions have significantly altered long held industry fundamentals. Polysilicon, in scarce supply over the last four years, is now readily available. Inventories have become bloated, and prices have fallen sharply across every step of the value chain.

Players with sub-optimal cost structures are being tightly squeezed, forcing some to outsource production through contract manufacturers. The balance of power has shifted from module producers to project developers, leading to a scramble towards downstream integration by many upstream companies. Consolidation, in countries such as China is beginning to rear its head with news of acquisitions and mergers, and insolvencies may not be far away.

This above graph shows the top 25 global cell producers in 2008, colour-coded by location and technology. As expected, crystalline silicon producers top the list of global PV cell producers.

Japan-based Sharp, China-based Suntech power and Germany-based Q-Cells occupy the top three spots, being the only companies to have producible cell output levels greater than 500 MW in 2008. First Solar (No. 4) is the only thin-film company on the list, with CIGs and amorphous silicon producers yet to ramp up to multi-hundred MW scale.

Combined with the increase in supply capacity, there have been changes to the global demand patterns. Spain was the location of the most installed PV in 2008 with nearly 2.5GW of new installations, but the Government then reduced the maximum size of the system to only 500kW and the demand reduced significantly during 2009.

Germany was the location of the most new PV installations in 2009 with a forecast 2.0 GW, but the Government there has now reduced the tariffs for 2010 by 8% for rooftop systems, which will reduce the 2010 demand.

The countries that are increasing include:

- Italy, that has recently introduced a new Feed-in Tariff that will drive demand to a forecast 1 GW in 2010;
- Individual states in the United States are introducing Feed-in Tariffs and driving local demand that is forecast to provide a country wide new installs of 1 GW in 2010;
- China, with a forecast domestic demand in 2010 of 0.5 GW; and
- Japan, with a forecast demand of 0.7 GW this year.

A full list of forecast demand profiles is provided in the table below.

Overall, there is forecast to still be a 50% increase in global demand although this increase is less than the increase in global supply capacity.

Country Specific Demand Growth Forecasts

	Demand Forecasts (in MW)					Annual Growth Rate			
	2007A	**2008A**	**2009E**	**2010E**	**2011E**	**2008A**	**2009A**	**2010E**	**2011E**
Europe									
Belgium	18	48	100	125	130	167%	108%	25%	4%
Czech Republic	3	51	80	90	110	1600%	57%	13%	22%
France	16	33	250	340	600	106%	658%	36%	76%
Germany	1,328	1,860	2,000	2,000	2,300	40%	8%	0%	15%
Greece	2	20	35	100	100	900%	75%	186%	0%
Italy	70	338	473	1,000	1,100	383%	40%	111%	10%
Portugal	10	20	40	50	100	100%	100%	25%	100%
Spain	640	2,460	125	500	500	284%	-95%	300%	0%
Rest of Europe	20	50	120	140	200	150%	140%	17%	43%
Europe Total	2,107	4,880	3,223	4,345	5,140	132%	-34%	35%	18%
North America									
Canada	10	25	30	50	60	150%	20%	67%	20%
USA	220	360	500	1,000	1,200	64%	39%	100%	20%
North America Total	230	385	530	1,050	1,260	67%	38%	98%	20%
Asia									
Australia	20	50	70	130	200	150%	40%	86%	54%
China	20	30	100	500	1,000	50%	233%	400%	100%
india	20	40	50	100	200	100%	25%	100%	100%
Japan	230	230	500	700	1,000	0%	117%	40%	43%
Korea	60	280	100	130	165	367%	-64%	30%	27%
Asia Total	350	630	820	1,560	2,565	80%	30%	90%	64%
Rest of the World									
ROW Total	110	230	400	520	700	109%	74%	30%	35%
Global Total	**2,797**	**6,125**	**4,973**	**7,475**	**9,665**	**119%**	**-19%**	**50%**	**29%**

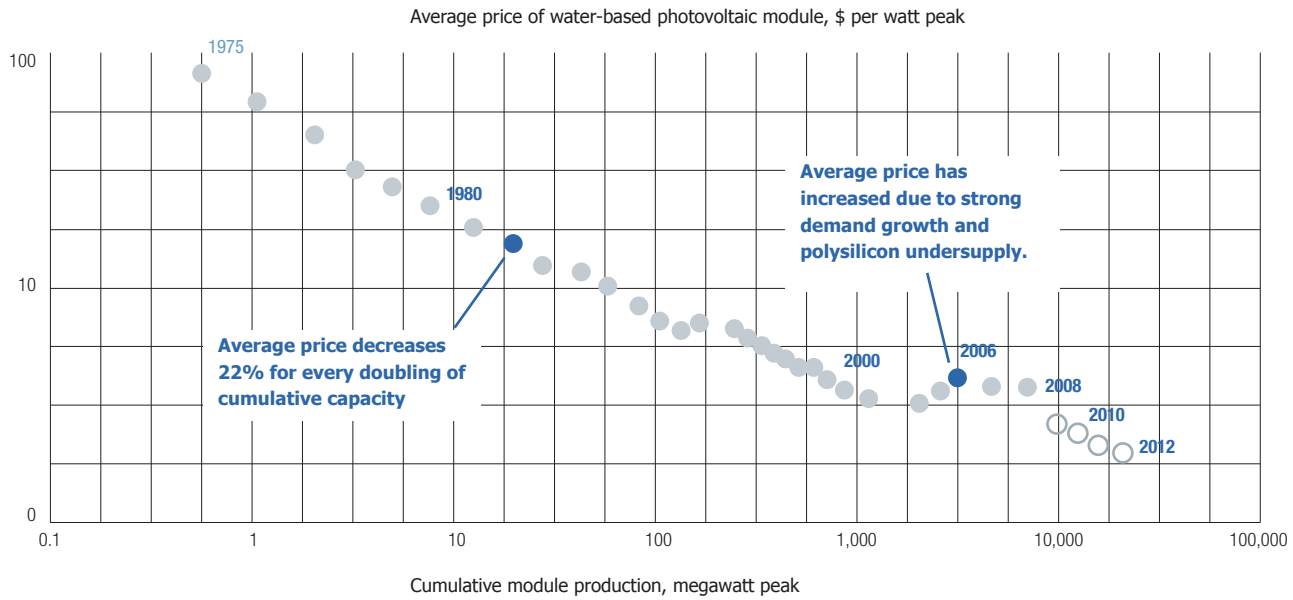
Pricing Analysis

Supply price is expected to stabilise during the second half of 2010. Prices will continue to fall in the first half however before bottoming out. The emergence of cheaper Chinese imports will continue to bring pricing pressure into the market while China will also continue to improve its technology in more advanced systems continually gaining ground on Germany and Japan.

Australia should begin to move away from being a highly price driven market towards the end of 2010 and into 2011. Pricing will also continue to be impacted in 2010 by the strengthening of the Australian dollar and the increased supplies of polysilicon.

In terms of price parity with fossil fuels, while some parts of the world may be close to achieving this in 2010 it is unlikely that this will occur in Australia before 2012 given the very low cost of fossil fuelled electricity in Australia and the delay in the pricing of carbon. At a global level, according to McKinsey, as shown in the diagram below, the economics of the solar market are improving, benefiting from innovations and cost reductions. The average price initially decreased with the efficiencies realised from significant cumulative capacity. Prices increased with the silicon shortages earlier this decade, but prices have come back down now this issue has been resolved. Pricing quoted is in US dollars.

The Economics of Solar Power: The Learning curve



Source: McKinsey Quarterly Website

Technology Trends

The key emerging global technology expected to impact Australia in the next two to three years is Building Integrated Solar Photovoltaics (BIPV). With the renewed interest in solar energy that is developing across the board, BIPV technology has progressed to third-generation systems, whereby solar modules are being fully integrated into the building envelope and are therefore able to replace conventional building materials. It is this generation from which the largest opportunities will likely emerge, because these products can be applied to a variety of settings including roofs (roof-integrated photovoltaics or RIPV), walls, facades, and windows.

Regulatory Trends

Regulation in the industry will continue to drive strategy for its players in 2010. The REC scheme in its current form may be changed given feedback from larger industry firms in order to replace the issuing of non-additional "phantom credits".

More certainty around legislation would enable foreign investment to be encouraged for large projects and provide a more stable market conditions to avoid the "boom and bust" cycles that have plagued the industry to date.

It is possible that the states will move towards gross feed-in tariffs. Whilst ruled out as a political impossibility only a year or two ago, gross feed-in tariffs are now legislated in New South Wales and the ACT. The New South Wales scheme only provides a seven year payment period after which the panel owner will receive no guaranteed payments. The seven year period has been calculated to enable home owners to pay off their PV systems and make a small return. This is in contrast to the 20 year ACT payment scheme which will provide long term payment guarantees and may therefore attract third party investors rather than householders.

Any move towards gross feed-in tariffs is likely to follow the NSW scheme with limited returns but sufficient payments to pay back the cost of the installed units.

2010 may see some other states move in this direction. If this occurs then the emergence of a national gross feed-in tariff will be likely to follow in late 2011 or 2012.

As part of the federal government's Clean Energy Initiative (CEI) the Australian Centre for Renewable Energy (ACRE) has recently been established to become a one stop shop for all renewable energy businesses, while helping to commercialise the sector in Australia. ACRE is designed to complement the investment made through the Australian Solar Institute (ASI) and industrial scale demonstrations through the Solar Flagships Scheme. It made funding recommendations to the Department of Resources and Energy received under the original Renewable Energy Demonstration Program guidelines in November 2009. Successful companies under this program were MNGI Pty Ltd (Petratherm), Geodynamics Pty Ltd, Victorian Wave Partners Pty Ltd and the Hydro-Electric Corporation (Hydro Tasmania).

The explosive growth experienced by the industry has also raised questions regarding industry standards. Some stakeholders feel that regulation in this area has not kept up with industry growth. Instances of poor installation and bad customer service seem to be occurring more frequently.

Industry Forecast for 2010: Australian PV Trends for 2010

	PRICING TRENDS	
1	Supply Price	Supply price is expected to continue to fall over the first half of 2010 as companies continue to deplete inventories and global oversupply provides the negotiating power to buyers. This is combining with reduced demand in Spain and, to a lesser extent, Germany offset by growing forecast demand in countries including Italy and the US. The estimates of the price decrease over the first six months of the year average at about 5%. The price will then stabilise during the second half.
2	Exchange Rates	The forecast steady or slightly strengthening US dollar exchange rate will mean that this global impact will be passed through fully to the Australian market
3	China	The emergence of cheaper Chinese imports will continue to bring pricing pressure into the market. China may also experience the emergence of supplier consolidation during 2010.
4	Price Parity	In terms of price parity with fossil fuels, it is unlikely that this will occur in Australia before 2012.
	DEMAND TRENDS	
1	Overall Demand Growth	Demand in the Australian market will continue to increase in line with the REC scheme.
2	Commercial Systems	Many players will focus on the commercial sector to achieve growth and margin increases in 2010.
3	New South Wales	NSW will experience enormous growth behind the launch of its gross feed in tariff on 1 January 2010. The NSW Government has forecast that 10,000 units will be installed in NSW in 2010, equal to the entire installed capacity in the State.

	SUPPLY TRENDS	
1	Just-in Time	Supply chain management will be crucial in 2010.
2	Ongoing Supply Constraints	Supply shortages for inverters and panels may continue into the first quarter of 2010.
	REGULATORY TRENDS	
1	'Phantom' Credits	The REC scheme in its current form may be changed in order toallow for 'phantom' credits that are created to be returned to the market.
2	Possible Introduction of REC Price Floor	Some industry stakeholders believe that there is the potential for the introduction of a floor pricing mechanism might to be introduced to help stabilise REC pricing. This however is not a widely held view.
3	Gross Feed-in Tariff Gaining Momentum	National gross feed-in tariffs are unlikely to be introduced in 2010, but the concept appears to be gaining momentum. Other states may introduce gross feed-in tariffs on the back of NSW and the ACT.
4	Foreign Investment Increasing	More certainty around legislation will enable foreign investment to be encouraged for large projects.
5	Improved Industry Standards	The monitoring of industry compliance and standards will also improve as the Office of the Renewable Energy Regulator (ORER) is starting to inspect and audit industry standards and installation compliance.
6	Solar Flagships	The recently launched Solar Flagships Scheme will provide opportunities for the larger industry players to look at introducing larger 20 to 30 MW projects.
	MARKET TRENDS	
1	Order Backlog Starting to Run Out	The back log of orders from the discontinued $8000 federal rebate scheme will clear towards the middle of 2010. Under current rules all systems approved under SHCP must be installed within 9 months of receiving approval to get rebate. The final batch of approvals (some 60,000) was released in early October 2009. That means all installs must be completed by end of June 2010.
2	Competition on Price	Two distinct business models market appear to be emerging as the industry matures. Firstly one focussed on price competition as its source of advantage exercised by attempting to extract abnormal profits in the short run. The companies following this model are focussed on how to best meet the current and growing demand they are experiencing. These additional profits will disappear during 2010 potentially driving retailer consolidation.
3	Competition on Brand	The second model is being adopted by those taking the position of long run industry participants. They have developed a sustainable model based on differentiating themselves from their cheaper rivals through consistently building brand equity as a source of competitive advantage. This competitive advantage is delivered by such factors as high quality standards, products, customer service levels and through providing a consistent message to their target markets.
4	Flight to Quality	This "flight to quality" has been emerging in many more advanced overseas markets and is expected to occur here. This will be exacerbated in the residential market as a wealthier demographic of consumer occurs given the REC scheme is not means tested and is output based, providing a larger rebate for purchasing a larger system. Whilst this does not necessarily drive higher quality systems, it does alter the customer demographic that may also drive higher quality systems being demanded.
5	Marketing and CRM Systems Become Essentials	Highly developed marketing brand plans and sophisticated customer relationship management (CRM) systems will become essentials rather than advantages as the market consolidates.

1. Australian PV Market Status

In 2009, the Australian solar photovoltaic (PV) market has continued to go through the boom and bust cycles that have been common for the last several years. These have been largely been driven by changing regulatory regimes but have also been impacted by changing supply prices and varying exchange rates. This has led to a difficult business environment for PV businesses, where it has been essential to adapt quickly and have flexible strategies to ensure risks are minimised and opportunities maximised. This changing environment has enabled the growth of new market entrants seizing the opportunities presented. The ongoing change however will mean that companies will need to continue to innovate to prosper in 2010.

Some of the consequences of this changing environment during 2009 have included the collapse of Solar Systems, a significant developer of large-scale concentrated PV and the closure of the BP Solar manufacturing plant. However the BP plant has been sold to Silex Solar Pty Ltd and restarted on 2 November 2009. Silex Solar Pty Ltd also announced it's acquisition of Solar Systems on 9 February 2010 and intend to revitalise the project.

Market Penetration

Whilst the federal government's REC program has only been operating for a few months, the stakeholder interviews conducted for this report have revealed that most firms are tracking well against the overall industry growth rate. However, given the recent emergence of many new entrants into the sector it seems that some of the larger and/or more established rivals may well have lost market share during 2009. Many of these new entrants are competing primarily on price and are importing cheaper Chinese products. Industry stakeholders believe that these new entrants are generally making small profit margins. Some of the incumbent players have felt obligated to react to this price challenge, while others have chosen to take a longer term position and to provide a higher quality service. Some of the new entrants have been offering panels at no cost to the consumers and this has raised concerns regarding installation and maintenance standards from incumbents.

Off-grid installations still make up the majority of the installed PV capacity accounting for approximately 70 percent of the market according to one industry source. This is due to the off-grid systems generally being larger in capacity than the on-grid ones. However on-grid systems have been growing their share of the installations over the last few years driven by Government subsidies. Given the current regulatory environment, it seems likely that on-grid systems will increase their share rapidly as support is focussed on grid-connected residential systems.

Sources of Supply for Australian Panels

Many firms spread their risk by purchasing panels from a combination of sources in Germany, Japan, China and now India. In addition, some companies also prefer to purchase from large, diversified suppliers that are involved in industries other than just PV. For example, approximately only 10 percent of Kaneka's production is PV related. German and Japanese suppliers in particular are considered to provide high quality, reliable and long lasting products.

Supply chain management has also been crucial. Given the recent growth in the industry and as no manufacturing base remains in Australia, lead times must be tightly managed on receiving stock in line with installation schedules. Several firms have also been experiencing recent supply shortages for both inverters and panels.

China is having an increasing impact as a source of supply. Given China's ability to produce highly competitive products at all price points, it is emerging as a producer of both unbranded entry level technology and branded higher quality stock. Some stakeholders stated concerns about the long run sustainability of some of the unbranded suppliers. In particular, stakeholders raised potential challenges relating to warranties and ongoing maintenance with the likely upcoming supplier consolidation. China currently has well over 200 suppliers which it is expected will experience significant consolidation as production continues to grow and the industry matures.

Japanese and German companies such as SMA are considered to be the current source of market leading inverter technologies. Some of the Chinese manufacturers appear to be catching up in terms of quality development for panels but they are still generally considered to be lagging in terms of inverter development.

Australian Market Leaders

Industry stakeholders see Solar Shop, Clear Solar and Suntech as market leaders in Australia. At a global level, German companies IBC and Q-Cells, producers of high quality mono- and multi-crystalline silicon photovoltaic cells are considered stand outs. Conenergy and Sunpower also emerged from the discussions as being highly regarded.

Installation Statistics

The Solar Homes and Communities Plan started out as the Photovoltaic Rebate Program offering $4,000 rebates in 2000. By the time the Photovoltaic Rebate Program was changed in November 2007, the program had helped to install 10,000 solar systems and was receiving an average 153 applications per week.

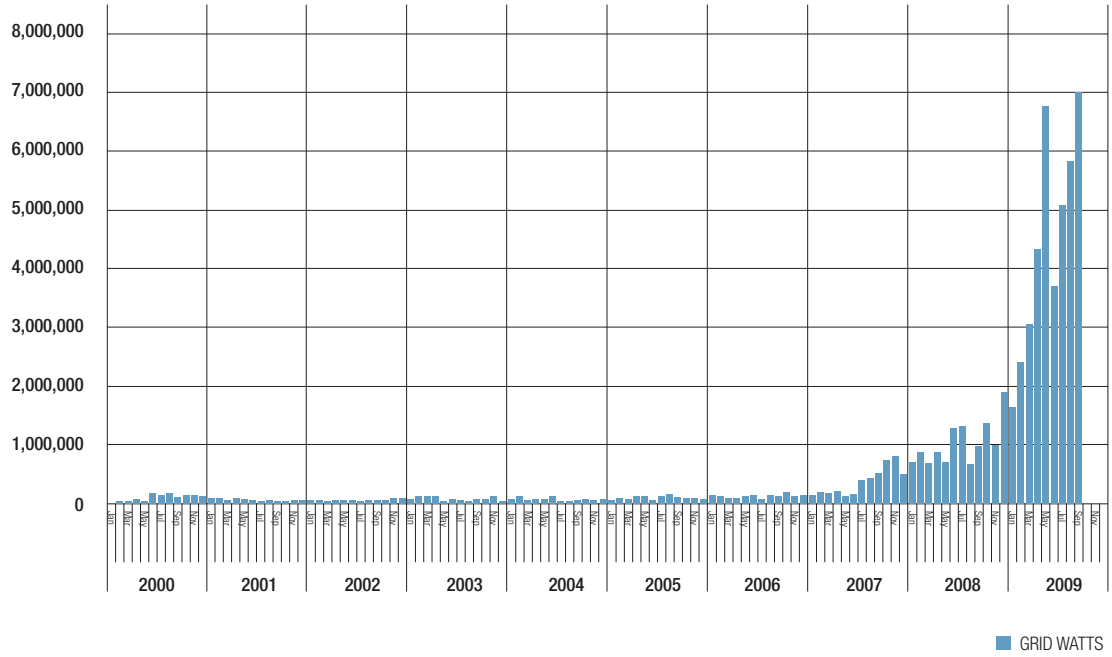
As part of the Rudd Government's election commitments, the program was allocated $150 million to provide increased rebates of up to $8,000 to 15,000 homes over five years. In May 2008, a means test was placed on the solar panel rebate to ensure support was provided to the homes that most needed it. The number of applications for the rebate grew from 420 per week in May 2008 to approximately 6,043 per week in May 2009.

The following bar chart shows the number of systems installed for the duration of the program up until September 2009 both on and off grid, with on grid obviously making up the overwhelming majority given the highly urbanised nature of the Australian population. Victoria has achieved the highest level of overall installations, while NSW clearly experienced the largest number of off grid installations. Given the population levels of each State, South Australia has installed systems at a rate greater than the national average whereas New South Wales is lagging. This has been largely driven by the state based feed-in tariffs, which are discussed more fully in Section 5 of this report.

Number of Systems Installed by State to September, 2009

Source: Department of the Environment, Water, Heritage and the Arts Website

Watts Installed by Month to September 2009



Source: Department of the Environment, Water, Heritage and the Arts Website.

The above graph shows the total number of watts installed by month for the duration of the program up until September 2009. It can be seen that take up was fairly flat until the federal government doubled the rebate in 2007 and then explosive growth has occurred in 2009.

Stakeholder Views of Regulation and Standards

The enormous amount of regulation in this sector drives what many stakeholders see as a boom and bust cycle. As a result many see these regulations as driving commercial strategy.

Some stakeholders see the long term uncertainty around legislation is holding back the development of major projects in Australia, especially those that are to be funded by foreign investment. Therefore while foreign players may see Australia as being a significant opportunity from a climatic perspective, the lack of consistent government support and political disunity makes them reluctant to make any significant commitments. Furthermore, some of the larger stakeholders feel recent policy has been focussed too heavily on residential roof top systems at the expense of larger systems. This is in contrast to Germany and Spain where larger developments have been seen.

The explosive growth experienced by the industry has also raised stakeholder questions regarding industry standards. Some stakeholders feel that regulation in this area has not kept up with industry growth. Instances of poor installation and bad customer service seem to be occurring more frequently and the industry needs to move rapidly towards self-regulation and auditing of installations standards. Until the recent industry growth, it has largely been too small and too fragmented for effective auditing and standards to be implemented. This situation has now changed and the stakeholders interviewed for this report felt that it was essential for the industry to now move forward with quality standards quickly to maintain its good reputation. The Office of the Renewable Energy Regulator has been tasked with a compliance function for the industry and will reportedly be looking not only at installation numbers but also safety and installation quality matters.

National Solar-Panel Rebate for Australian Homes

The $8000 national solar rebate was abolished in June 2009 primarily due to a greater than expected uptake which was having adverse effects on both government expenditure and quality standards. According to Environment Minister, Peter Garrett, when the scheme was abolished there was a backlog of 63,000 orders. The remaining 60,000 approvals were released in October 2009.

A number of stakeholders were left with additional stock on hand due to the premature closure of the scheme and have now been off-loading these at reduced prices through the last quarter of 2009. This has brought further pricing pressure on to the market and will continue to do so in the first half of 2010 until this excess inventory has been cleared.

The SHCP has now been replaced by the Solar Credits element of the Renewable Energy Target. This has created a performance based mechanism as opposed to a flat rebate and is no longer means tested. This is expected to lead to a larger percentage of wealthier households participating in the scheme and a demand for larger high quality systems.

Solar Cities - a Vision of the Future

Australia's Solar Cities are Adelaide, Alice Springs, Blacktown, Central Victoria, Moreland, Perth and Townsville.

Solar City locations

Source: Adapted from the Central Victoria Solar City Website

Each Solar City will integrate a unique combination of energy options such as energy efficiency measures for homes and businesses, the use of solar technologies, cost reflective pricing trials to reward people who use energy wisely and community education about better energy usage in an increasingly energy-reliant world.

The information will be analysed to see how different members of a community can best reduce energy consumption, and how governments, industries and individuals can support wise energy use. In particular, the program aims to:

- demonstrate the environmental and economic effects of combining cost reflective pricing with the widespread use of solar technology, energy efficiency and smart meters; and
- find out what barriers exist regarding energy efficiency, electricity demand management and the use of solar technology, among businesses and householders in different parts of Australia and test ways to deal with these barriers.

Solar Cities' consortia in each location are working with industry, businesses and their local communities to rethink the way they produce and use energy. The Alice Solar Cities project in the Northern Territory has championed several iconic projects as a critical component in their strategy of becoming a national and international showcase for sustainable living and the use of renewable energy, including the installation of the largest roof mounted PV system outlined in the adjacent text box.

The Alice Solar Cities project also includes the Solar Centre that is trialling a number of different technologies and comparing their performance. Further details of this project and some of the output is provided in Section 4 of this report.

Australia's Largest Roof Mounted PV System

Australia's largest roof mounted PV system has been switched on at the Crowne Plaza Hotel in Alice Springs through the Alice Solar City. The 305 kW iconic project includes over 1320 photovoltaic (PV) panels and will generate enough power to meet 40–80 per cent of the hotel's daily energy needs.

The solar PV system tops off significant energy and water efficiency measures already undertaken by Crowne Plaza such as energy efficient lighting, flow reduction shower heads and automatic air conditioning controls.

Hotel guests can learn about the system and see the energy being generated on displays at the Sustainability Corner in the hotel foyer or on the internal television channel.

Crowne Plaza Alice Springs 305 kW PV installation

(image courtesy of Crowne Plaza)

Source: Australian Government Solar Cities Website.

National Solar Schools Program

As of 15 October 2009, The National Solar Schools Program has been suspended to any new claims. More than half of all Australian schools have registered to participate, and more than 1,800 schools have been approved for funding to install a wide range of renewable energy and energy efficiency measures.The demand for funding from the program has been very high, and the department has now received enough claims to meet the program's full budget allocation in 2009-10. As a result, the program has been 'temporarily' suspended to new claims.

The program's next tranche of funding will be available in July 2010. However, schools can lodge new claims from May. All claims submitted to the program before 15 October 2009 will still be processed this financial year and the department believes more than 700 additional schools should receive funding in 2009-10.

Renewable Remote Power Generation Program (RRPGP)

The Renewable Remote Power Generation Program was closed to new applications except in Western Australia on 22 June, 2009. According to the Department of the Environment, the program saw a significant increase in applications primarily due to a dramatic rise in diesel prices in 2008 and this was the reason for its closure. The WA Government have however announced that the funding through their Remote Area Power Supply (RAPS) and Renewable Energy Water Pumping (REWP) programs is nearly committed so it is unlikely that many further projects will proceed under these schemes in 2010.

The scheme benefited applicants by combining renewable energy, predominantly solar, with diesel generation and through the use of an inverter and a battery bank to provide 24 hour power. The scheme was able to cover half the capital cost of solar generators which, generally being larger installations, cost tens or even hundreds of thousands of dollars.

The closure of this scheme is unfortunately forcing residents in outback areas to revert back to diesel generators and hastening the decline in off-grid power generation. This was a key focus for certain industry stakeholders. These stakeholders believe that the off-grid market in Australia is being ignored at the expense of the on-grid and attribute this to the fact that most off-grid activity occurs in remote and regional constituencies with few voters.

New Technology Development

Stakeholders concurred that there has been a lack of genuine government support for new technology development. The lack of support means that funding technology development is left to venture capital and the public capital markets. The former is of a limited supply in Australia and latter are not well placed to understand and manage the risks associated with early stage developments. Many Australian technology developers therefore ultimately head overseas for funding support.

Market Consolidation

As the industry approaches the maturity stage in its industry lifecycle, two significant business models appear to be emerging which will lead to a market consolidation of rivals. Firstly a more premium, sustainable model is being pursued by those firms who have taken a position of being long term industry players, many of whom have been established in this market for some time.

These companies are attempting to extract a competitive advantage through achieving a price benefit compared to many of their less expensive competitors. Their competitive advantage is derived from adopting a strategy of a constant focus on developing their brand equity in this market and therefore using this positioning to differentiate from their rivals.

The second model appears less sustainable and seems to be adopted by many of the new entrants into the industry. It is a price driven model where consumers are offered the lowest price and companies survive on lean margins. These companies are focussed on meeting the current demand and appear to be generating strong cash flows with this increasing demand. Market forces will eventually dictate that these companies will be acquired by their more established rivals as abnormal profits (i.e. those profits currently available above their capital outlay) disappear due to increased competition in the market. Many feel this will start to occur during the second half of 2010.

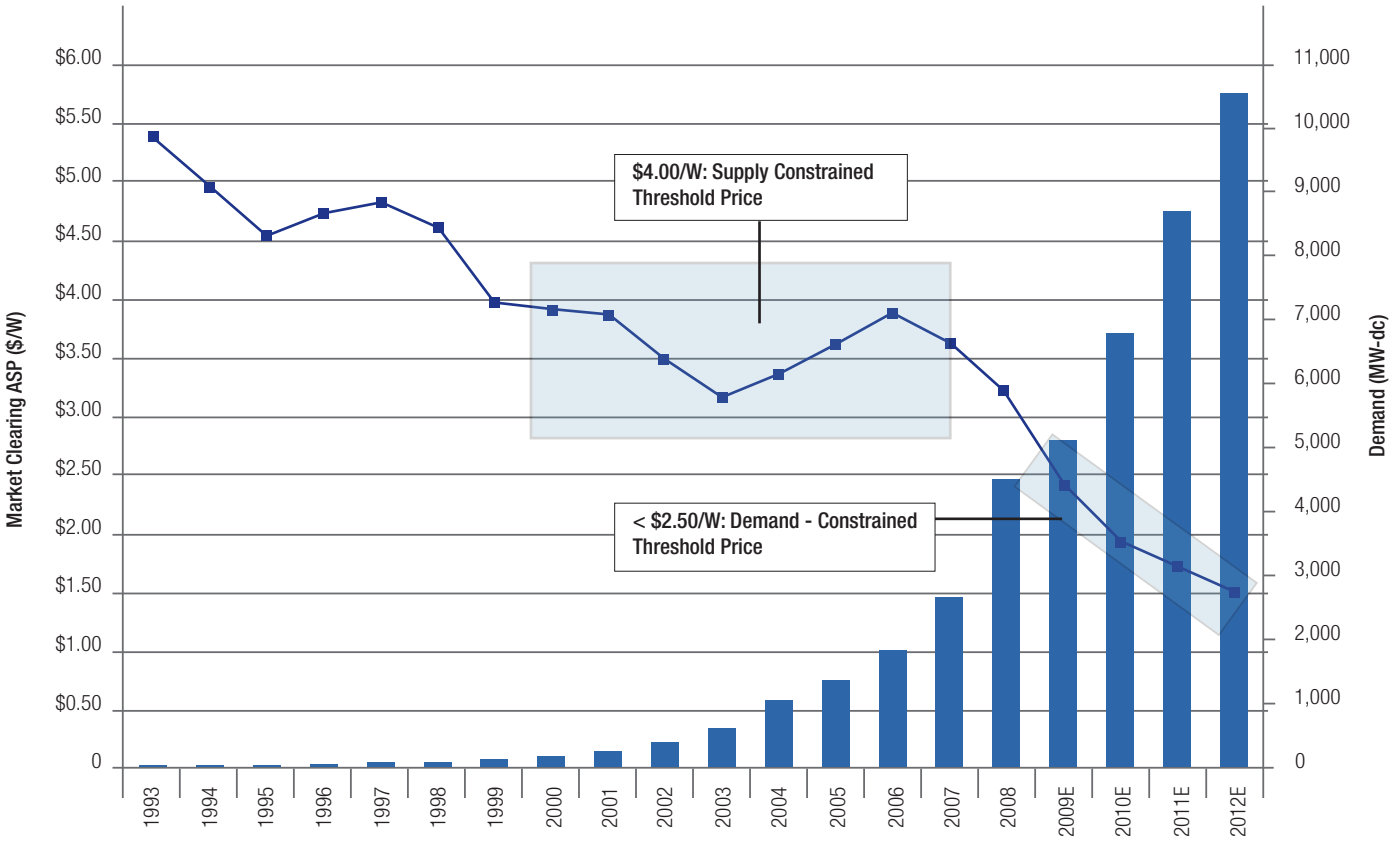
2. Overseas Market Trends

The solar PV industry is in considerable flux. Overbuilt manufacturing capacity, stagnant inventory and weak global macroeconomic conditions have significantly altered long held industry fundamentals. Polysilicon, in scarce supply over the last four years, is now readily available. Inventories have become bloated and prices have fallen sharply across every step of the value chain.

Players with sub-optimal cost structures are being tightly squeezed, forcing some to outsource production to contract manufacturers. The balance of power has shifted from module producers to project developers, leading to a scramble towards downstream integration by many upstream companies. Consolidation is beginning to rear its head with news of acquisitions, mergers and even insolvencies likely to be the main global story for 2010.

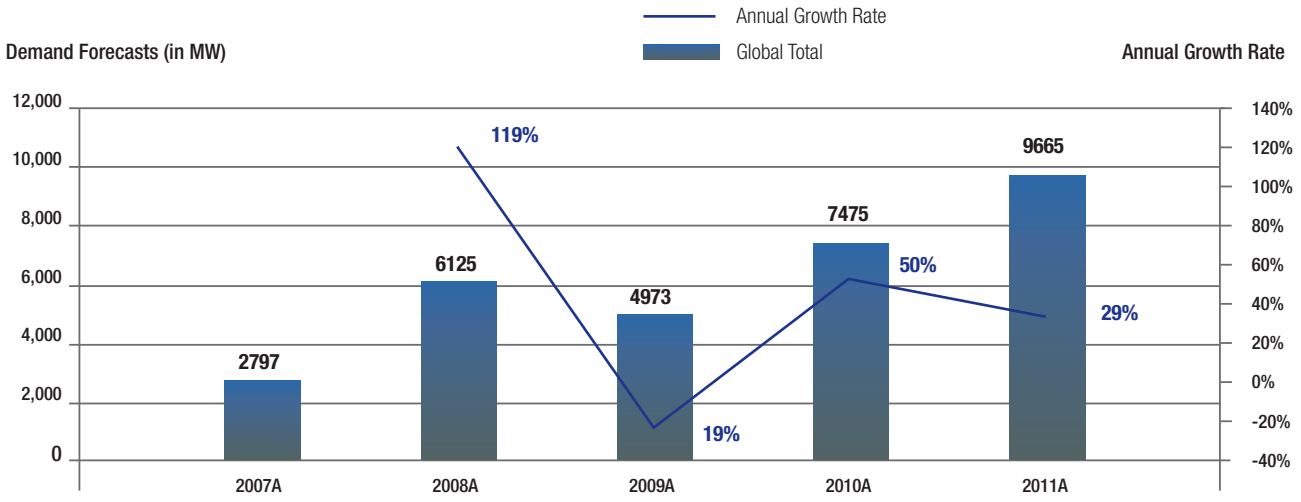
Research provides reasonably consistent figures for growth projections. There are however many different research houses and each of the forecasts vary to some extent. Three examples of demand forecasts follow. Research provides reasonably consistent figures for growth projections. There are however many different research houses and each of the forecasts vary to some extent. Three examples of demand forecasts follow.

Market Clearing Module Average Sell Prices (ASPs) in US$ and Annual PV Demand, 1993–2012



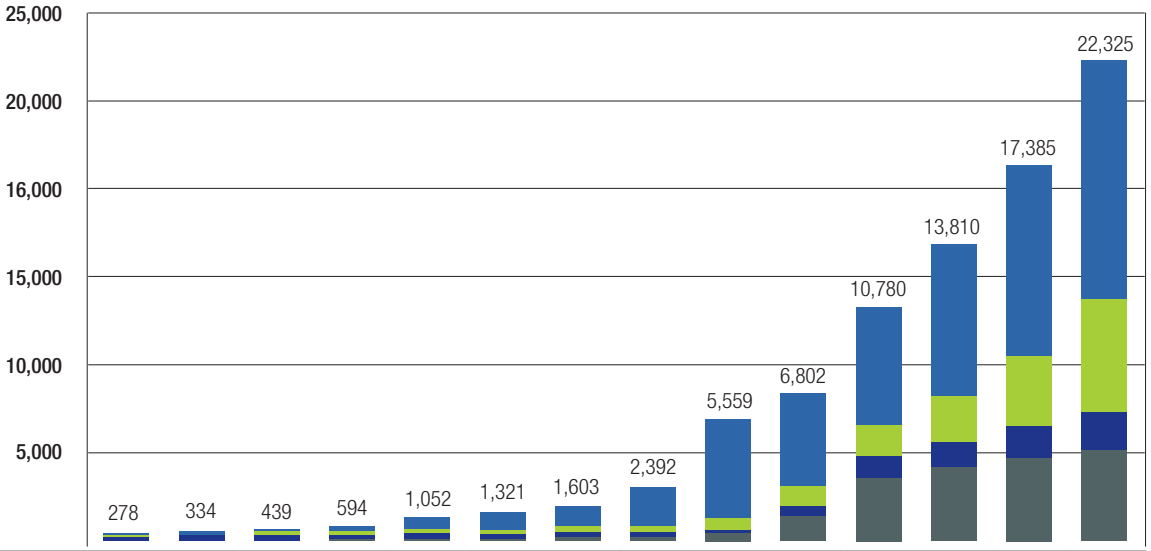
Source: GTM Research and The Prometheus Institute

Global Solar Shipments



Source: Yuanta Research

Global Annual PV Market Outlook per Region (Policy Driven Scenario)



MW	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009E	2010E	2011E	2012E	2013E
Europe	50	96	106	210	637	906	975	1,768	4,503	4,302	5,490	7,110	8,785	10,925
Rest of the World	94	75	104	98	53	12	196	207	485	800	1,300	2,100	3,200	5,200
Japan	112	135	185	223	272	290	287	210	230	500	1,000	1,200	1,500	1,700
USA	22	29	44	63	90	114	145	207	342	1,200	3,000	3,400	3,900	4,500
Total	278	334	439	594	1,052	1,321	1,603	2,392	5,559	6,802	10,790	13,810	17,385	22,325

Source: European Photovoltaic Industry Association

A Global Integrated Model of Supply and Demand

Between 2000 and 2008, module prices fell at an average annual rate of 2 percent while demand grew at an average of 51 percent per annum. The resulting industry revenue growth in excess of 35 percent annually attracted both private and public capital.

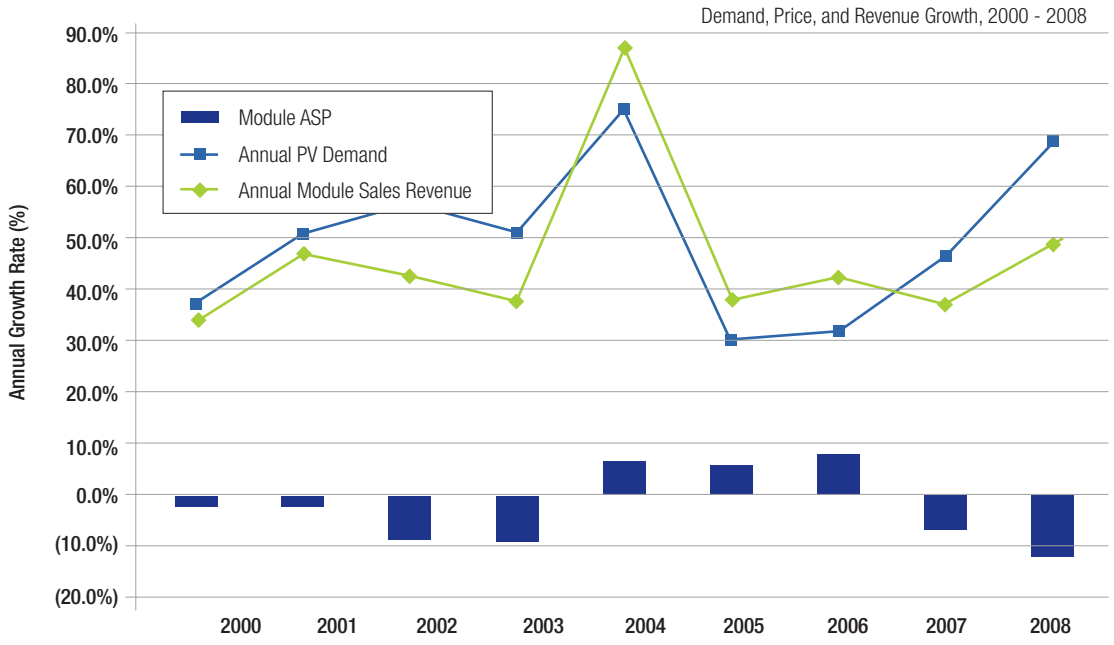
This capital was used to both expand manufacturing capacity and increase market share. Whilst there were some predictions of a manufacturing oversupply, the traditional static models of the PV market failed to predict the dramatic market turn from supply-determined pricing to demand-determined pricing and its consequent market implications.

Even in the presence of price supports, project developers have always utilized a returns-based analysis in deciding whether to build a project. In the supply-constrained market of 2005 to 2008, when feedstock and module manufacturers were struggling to keep up with policy-based demand, project developers often enjoyed handsome returns and were eager to increase installations. Price supports in Germany and Spain attracted the vast majority of the global module supply at the highest price that would allow the projects to remain viable. This increased the module prices globally and made it more difficult for unsubsidised PV markets to economically compete for the limited available supply.

Today - partly due to demand issues in Spain and Germany and partly due to economic malaise and banking problems - the world is no longer constrained by module or feedstock supply. With global demand growth roughly flat from 2008 to 2009 and a doubling of feedstock and module production capacity over the same period, the world has almost instantly shifted to a demand-constrained market. The analysis of a buyers' market must use a buyers' metric. Today, what sets the price in the global PV market is no longer the maximum price to allow projects to proceed, but the minimum price that can be paid that will maximize the project IRR for the customer. In an oversupplied market, finance-constrained project developers look to buy modules from suppliers willing to sell at marginal costs to enable their new manufacturing facilities to be utilised.

Forecasting module manufacturing cost declines driven by a build-up in polysilicon and wafer production, as well as the inability of cell and module companies to reconcile lower prices with high-cost manufacturing presents only one side of this evolving market state. Failure to account for project economics leads to a miscalculation of incremental demand and the resulting market-clearing module prices. Manufacturers relying on incomplete analysis are likely to make uninformed decisions, exacerbating overproduction and the build up of excess inventory, squandering precious financial resources that will be required to compete in the new margin-compressed and highly competitive PV market.

Annual Growth Rates for Average Sell Price (ASP), Demand and Revenue, 2000-2008



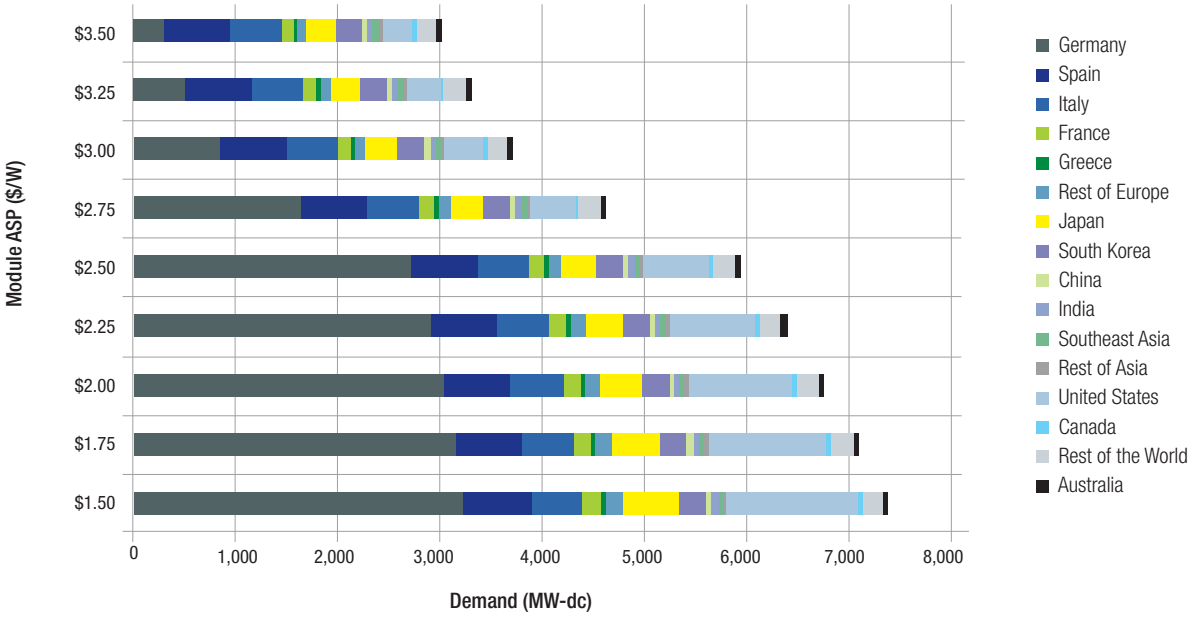
Source: Greentech Media

As the world changes to the buyers' perspective, the critical questions facing the industry become:

1. To what extent have manufacturers ceded the power to determine module pricing to project developers?
2. How fast can and will module prices fall?
3. What are the impacts of declining prices, changing incentives and deteriorating economic conditions on project, country-level, and global demand?
4. Which companies and technologies will survive in a demand-constrained market? Which ones will fail?
5. When and where will grid parity emerge? What will the market's response be to this condition?
6. What markets will absorb module oversupply and when will this occur?

These questions have serious implications for budget allocations, marketing strategies and pricing decisions. The figure below captures the market's complexity by showing global and country-level demand curves for 2010 using aggregated "stacked" global demand. The resulting demand curve is derived as a line through the endpoints of these stacks and the costs per watt are shown in US dollars. The second diagram shows how Italy, the US, China and Japan are considered to see significant demand growth in 2010 compared to 2009.

Global Base Case Demand Stack, 2010



Source: Greentech Media

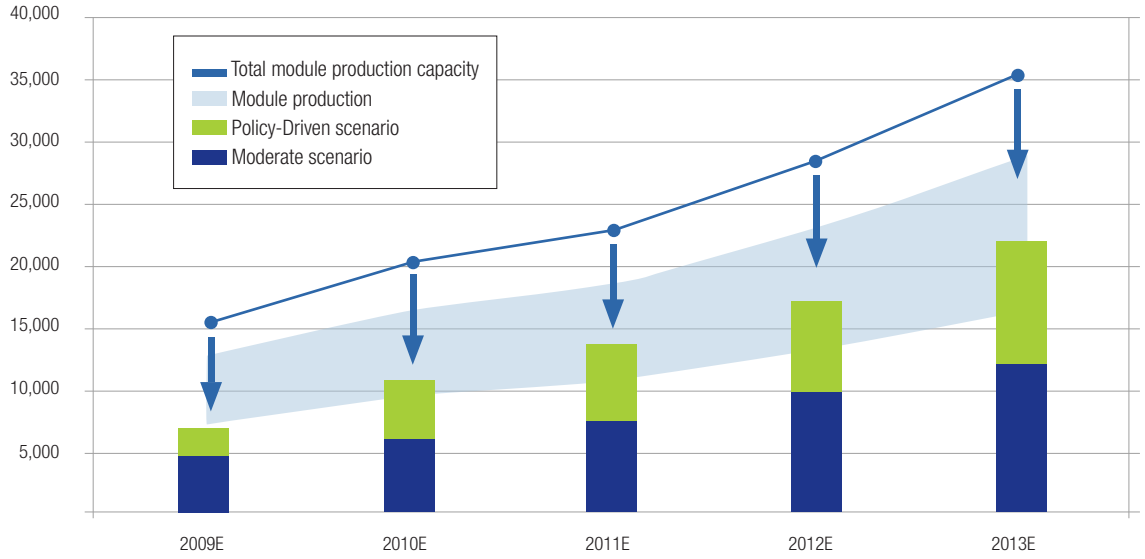
Country Specific Demand Growth Forecasts

	Demand Forecasts (in MW)					Annual Growth Rate			
	2007A	2008A	2009E	2010E	2011E	2008A	2009A	2010E	2011E
Europe									
Belgium	18	48	100	125	130	167%	108%	25%	4%
Czech Republic	3	51	80	90	110	1600%	57%	13%	22%
France	16	33	250	340	600	106%	658%	36%	76%
Germany	1,328	1,860	2,000	2,000	2,300	40%	8%	0%	15%
Greece	2	20	35	100	100	900%	75%	186%	0%
Italy	70	338	473	1,000	1,100	383%	40%	111%	10%
Portugal	10	20	40	50	100	100%	100%	25%	100%
Spain	640	2,460	125	500	500	284%	-95%	300%	0%
Rest of Europe	20	50	120	140	200	150%	140%	17%	43%
Europe Total	2,107	4,880	3,223	4,345	5,140	132%	-34%	35%	18%
North America									
Canada	10	25	30	50	60	150%	20%	67%	20%
USA	220	360	500	1,000	1,200	64%	39%	100%	20%
North America Total	230	385	530	1,050	1,260	67%	38%	98%	20%
Asia									
Australia	20	50	70	130	200	150%	40%	86%	54%
China	20	30	100	500	1,000	50%	233%	400%	100%
india	20	40	50	100	200	100%	25%	100%	100%
Japan	230	230	500	700	1,000	0%	117%	40%	43%
Korea	60	280	100	130	165	367%	-64%	30%	27%
Asia Total	350	630	820	1,560	2,565	80%	30%	90%	64%
Rest of the World									
ROW Total	110	230	400	520	700	109%	74%	30%	35%
Global Total	**2,797**	**6,125**	**4,973**	**7,475**	**9,665**	**119%**	**-19%**	**50%**	**29%**

Against these demand projections, the increased supply capacity appears to provide too much capacity, keeping downward pressure on pricing as shown in the figure below.

Global Outlook – Production Capacity vs. Market

Source: European Photovoltaic Industry Association



GreenTech Media have addressed some of the critical questions (page 18) with the following analysis:

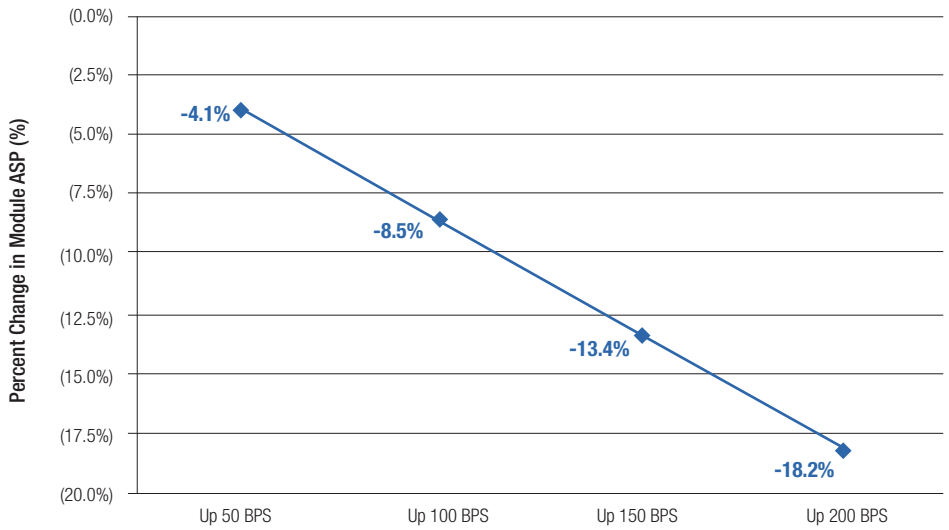
Module Prices Declining Precipitously

Global module Average Sell Prices will fall below $US 2.50 per Watt in 2009 and $US 2.00 per Watt in 2010 in the base case scenario as demand-side financing pressures force manufacturers to cut prices to move inventory and clear markets. This will force significant near-term margin compression for all manufacturers, precipitating the shakeout of high-cost, undifferentiated PV companies. For example, the sensitivity analysis presented in the next figure shows how rising real interest rates require module prices to decline in order to maintain positive equity IRRs in Germany.

Global Module Sales Revenue Falls and Fails to Recover

After a decade of annual revenue growth in excess of 35 percent, module sales revenue looks likely to fall 15 percent in 2009 as demand slows and module prices decline precipitously. In 2008, annual global revenue from modules installed surpassed US$14 billion. In 2009, annual global revenue will fall to US$12 billion with forecasted annual increases of roughly US$1 billion in the period to 2012.

Percentage Change in Module Average Sell Price (ASP) Required to Maintain Equity IRR in Germany, 2009



Source: Greentech Media

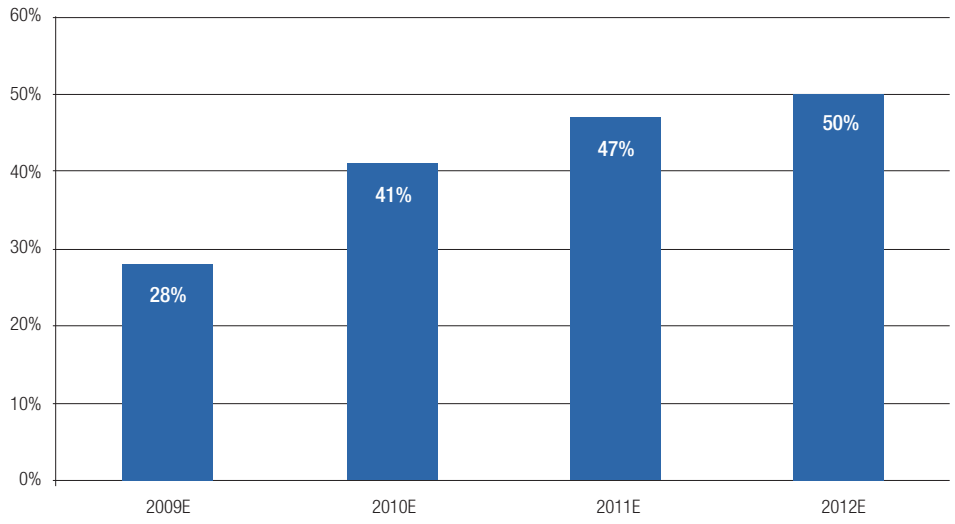
Thin Film Gains 50 percent Market Share by 2012

In a cost-plus module pricing environment where project developers focus increasingly on boosting equity returns, thin-film modules will gain market share against technologies with less desirable price and performance characteristics. But not all thin-film modules will win the market's favour; CdTe and CIGS will edge out (but not fully displace) a-Si in nearly all market scenarios. This is displayed in the following figures with annual percentage amounts based in Euros.

Grid Parity Realised in 2009/10 in some Price-Sensitive Markets, by 2011 in Price-Supported Markets (including Germany)

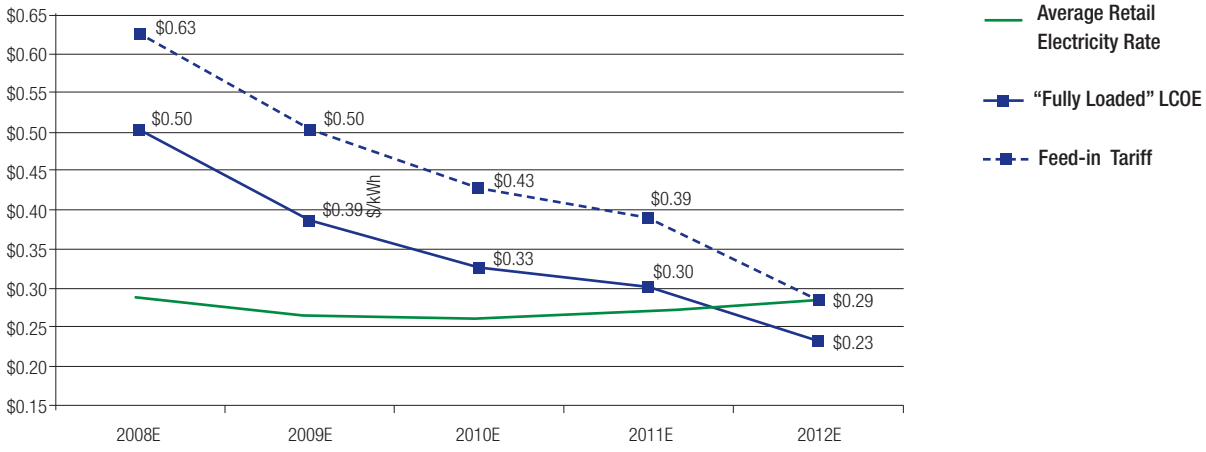
Grid parity is not a stable concept. It is influenced by a host of factors including module technology, project design, electricity rates and location. The analysis in this report shows projects in some markets reach grid parity in late 2009 or early 2010, while others break that barrier in 2011 or 2012. Residential c-Si rooftop systems in Japan and commercial thin-film rooftop projects in California should achieve this first.

Thin-Film Market Share of Supply at or Below Market-Clearing Module Price, 2009–2012



Source: Greentech Media

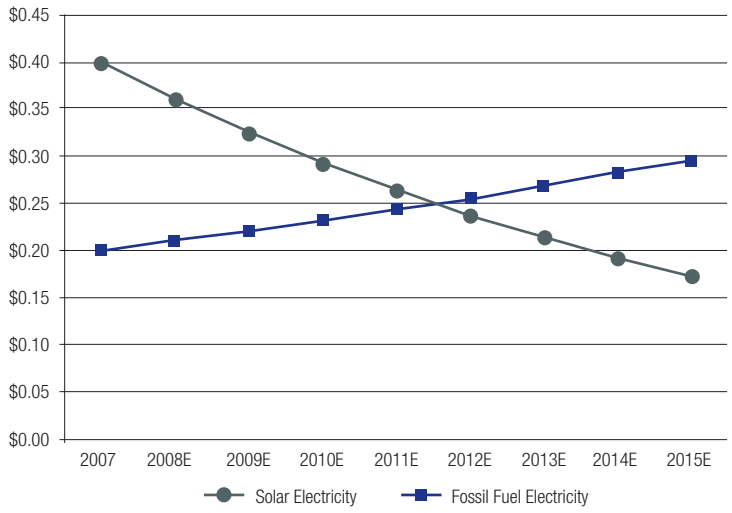
LCOE and Feed-in Tariff Rate for a 1 MW c-Si Commercial Rooftop in Germany 2008–2012



Source: Greentech Media

This view is supported by other research and is a critical issue for future PV market growth forecasts. The graph below provides Barclays Capital Research's estimate of grid parity timing in the US of late 2011 (the pricing is shown in US dollars).

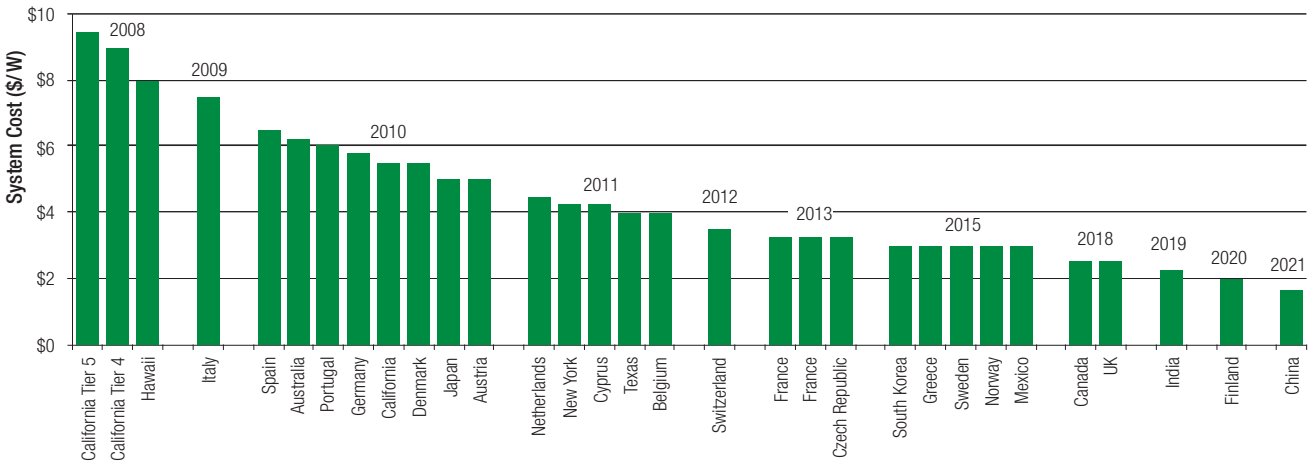
Solar Electricity Price vs Fossil Fuel Price (US$)



Source: Barclays Capital Research

Barclays Capital Research has completed further work in October 2009 looking at various global markets and the likely timing for the achievement of grid parity using current exchange rates, global average supply prices, current feed-in tariffs and other subsidies and local power prices. Australia is shown in this analysis to be one of the first to be reach grid parity in 2010. However, this result is questionable as Australia's comparative power costs are low on global standards and so would seem likely to achieve parity later than many other countries.

Solar System Price Projections for Grid Parity in Some Regions (US$)



Source: Barclays Capital Research

Market Analysis

For much of the past decade, policy-driven demand in a series of champion markets has driven the growth of the global PV industry. Between 1999 and 2003, Japan accounted for the majority of installations, overseeing the crucial downward swing in installed module prices to below US$4.00/W. In 2004, the Bundestag in Germany introduced a significant upward revision to that country's feed-in tariff, which made Germany the industry-defining powerhouse. Between 2007 and 2008, an aggressive policy expansion drove the global PV industry to the sunny plains of Spain. These policy driven step changes to demand patterns have been partially responsible for the precarious state in which the industry finds itself today.

Though policy programs in these countries have succeeded in building financial and consumer support for the PV industry, they have also created severe structural problems. The effects of this will continue to be felt by the PV market for some years. One of these problems was a calculated over-reliance on a handful of markets at the expense of consumer diversification, marketing sophistication and sales channel creation in smaller markets. In the current market, however, developing business in the secondary markets – France, Italy, Greece, South Korea, Portugal, India and others – will be crucial for the continued success of many industry participants. Each of these markets have introduced substantial policy support programs, some that even outpace those found in Germany and Spain, and each represents a new key market for the continued development of the PV industry.

In the presence of rapidly falling module and system prices, collapsing margins, difficult financing conditions and uncertain subsidies in major markets, understanding the support programs, market structures and active players in the secondary markets is a necessity for continued success.

Solar PV Markets

- World solar PV market installations reached a record high of ~6.0 GW in 2008 and cumulative PV power installed totalled ~15 GW compared to ~9 GW in 2007
- Europe leads the way with ~9 GW representing ~65% of the global cumulative PV installed capacity (with Japan and the US at 2.1 GW and 1.2 GW respectively)
- Current solar market so far dominated by small scale, residential PV installations
- Increased government support – particularly in the form of feed-in tariffs – is driving momentum in the utility scale installations (PV and Concentrated Solar Power ("CSP") in particular)
- Installed capacity estimated for 2008 of ~15 GW** - under 1% of the solar resource potential
- Compelling scale and cost characteristics
- Market growing at 40% - 50% CAGR
- Global policy support strengthened with the government stimulus packages (US, China, South Korea, etc)

Source: Standard Chartered Bank Analysis
* Source: World Energy Assessment: Energy and the Challenge of Sustainability, UN/UNDP/World Energy Council, 2005
** Source: New Energy Finance

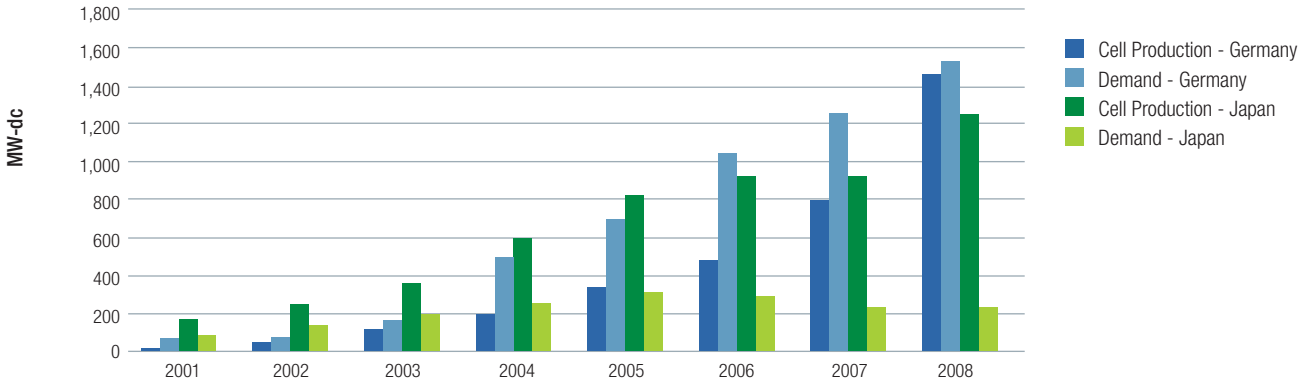
Germany

According to ABS Energy Research the cut-backs in Spain have resulted in Germany consolidating its position in 2009 as the leader in global PV markets followed by Japan and the USA. In 2008, the country added 1.5 GW to its installed capacity. No caps on the feed-in tariffs facilitated the installation of large scale commercial systems in preference to residential systems. The country saw about 2.34 GW of new solar energy generation capacity during the twelve months 30 September 2009 according to the German Federal Network Agency.

As at December 2009 and for systems less than 30 kW, Germany's Feed-in Tariff is €0.43/kWh for rooftop systems reducing to €0.33/kWh for systems over 1 MW. Ground based systems secure fixed rate of €0.32/kWh.

The tariff rates will decrease by 10% in 2010, and 9% from 2011 onwards for ground based systems and for rooftop systems over 100kW. For rooftop systems up to 100kW, the reduction will be 8% in 2010 and 9% from 2011. These reducing tariffs are likely to dampen the demand in Germany although will be partially offset by the reducing installation costs.

Germany and Japan: PV Cell Production vs. Demand, 2001–2008



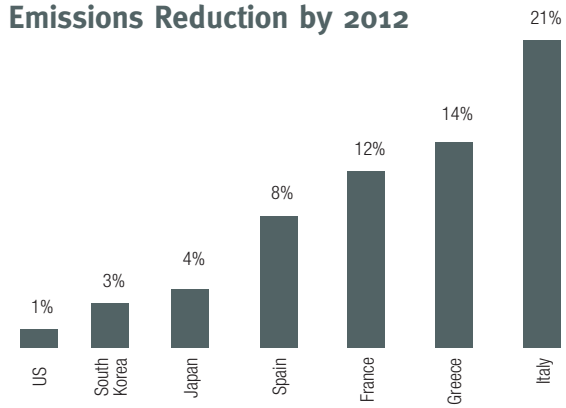
Source: The Prometheus Institute

Italy

According to Solar Plaza an attractive feed-in tariff incentive and rapidly decreasing solar module prices have made Italy the most attractive global PV market in 2010. Barclays Capital Research estimates that by 2012 Italy will become the country for which solar will be the largest contributor to carbon emissions reductions.

As at December 2009 and for systems between 1 kW and 3 kW, Italy's Feed-in Tariff varies from €0.39/kWh for rooftop and ground-based systems to €0.48/kWh for building integrated systems (BIPV). These rates reduce as the systems increase in size with systems above 20 kW securing €0.35/kWh for rooftop and ground-based systems to €0.39/kWh for BIPV.

Solar Contribution to Carbon Emissions Reduction by 2012



Source: Barclays Capital Research

Spain

According to ABS Energy Research, 2008 saw Spain become the highest selling country for solar PV sales, with 2.7 GW added, the largest volume of annual sales achieved in any country ever. Along with Germany they accounted for 75% of world sales.

As at December 2009, Spain's Feed-in Tariff is €0.32-0.34/kWh for rooftop systems above and below 20 kW respectively and €0.32/kWh for ground based systems. The Spanish system is slightly different from other feed-in tariffs in that the additional cost is largely covered by tax payers rather than consumers. This caused additional pressure on the Government struggling to contain its budget deficit and has been one of the causes for the recent reduction in feed in tariffs.

In 2009, the Spanish government announced a cap on the feed-in subsidy for solar PV installations at 500 kW. This has not only put a brake on Spanish sales but will ultimately reduce the global solar PV total in 2009. The Spanish renewable associations are forecasting that it will be at least two years before a recovery will begin.

United States

Amid such turmoil, a spate of developments has placed the United States at the cusp of this brave new solar reality. Unlike governments in other leading markets such as Spain and Germany, whose attitude towards solar has visibly soured, US policy momentum since early 2009 has been growing stronger, both at the federal and state levels. The passing of the landmark American Recovery and Reinvestment Act (ARRA) in early 2009 released billions of dollars in funding for PV generation projects through State Energy Program grants. Steep module price declines, along with the ability to access the investment tax credit, have prompted a surge of interest from U.S. utilities (SCE, PG&E, Duke, PSEG) in deploying large-scale PV.

As demonstrated by the diagram below, the expected restoration of the long-term trend of falling module and system prices is also likely to accelerate the onset of grid convergence, certainly on a subsidized basis. Although the lack of available capital still poses challenges for project development (a phenomenon that is global and sector-agnostic), there is more reason than ever before to believe that the U.S. is poised to become a leading solar market over the next five years.

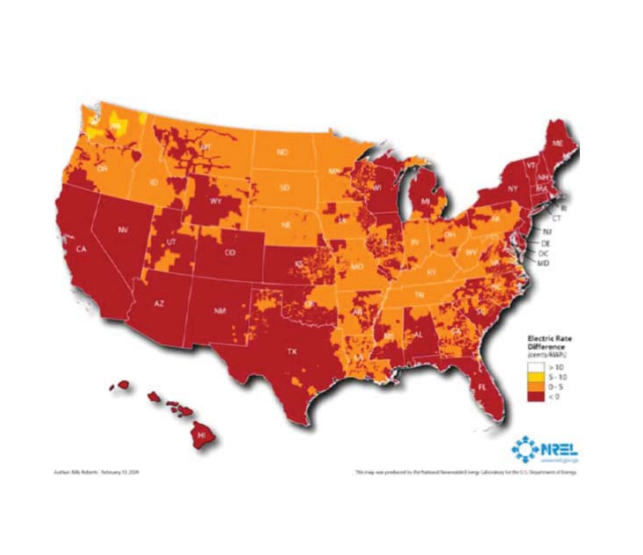
Thus far, much of the discussion between policy makers, market participants and industry observers has focused on the growth of end-markets, while precious little space has been devoted to domestic production in the US. As can be seen by the following diagram, historically, production has tended to make its home where end-demand has been located, as Germany and Japan can attest to. In both these countries, attractive subsidy programs generated strong domestic markets, whose development led to a corresponding increase in domestic production capacity. This raises the question as to how the emergence of the US as a major end-market could impact the domestic manufacturing landscape.

GreenTech Media forecast that the U.S. will contain a total of 38 PV manufacturing facilities by 2012, compared to 27 at the beginning of 2009. 20 states will have some form of manufacturing presence in PV by 2012, nine (Oregon, California, Arizona, New Mexico, Colorado, Michigan, Ohio, Massachusetts, New York, and Pennsylvania) of which are expected to have producible output in excess of 100 MW by 2012, compared to only three (Ohio, Michigan, Oregon) in 2009.

The West Coast states of Oregon and California will emerge as major manufacturing centres over the next few years, together comprising 28 percent of producible supply by 2012; 59 percent of the U.S.'s producible wafers in 2012 will come from Oregon. By contrast, California's presence hinges critically on a ramp-up of CIGS, with most CIGS-based firms having based their facilities there.

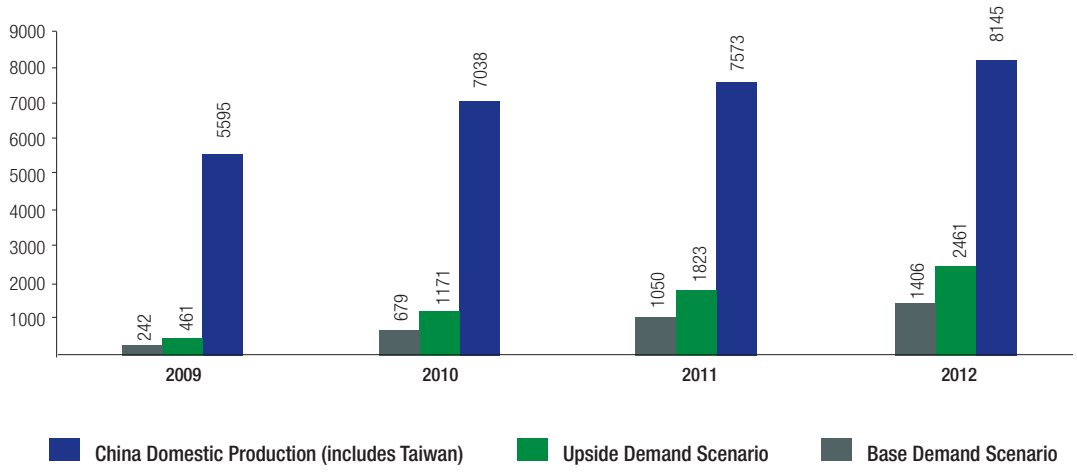
At the same time that the U.S. is attracting new PV manufacturing, a strong recent trend observed in the case of a number of established American and European firms has been to shift production to Asia, through in-house manufacturing, tolling arrangements, or contract manufacturing firms. A given firm's decision as to where to site new capacity will depend critically on its current manufacturing economics. For Asia-based producers with highly competitive cost structures but little or no access to the U.S. market, module assembly facilities in the U.S. make the most sense, while European and U.S. players with highly sub-optimal cost structures are likely to shift wafer and cell production to low-cost locations. For firms between these two extremes, incentive packages will play a critical role in evening the equation, and only states offering deals that can meaningfully close the cost gap between U.S. and Asian production will come into contention.

NREL Scenario Analysis of US PV - Grid Cost Spread, 2015 (assuming itc and 1% annualized increase in retail rates)



Source: National Renewable Energy Laboratory (NREL)

China's Domestic PV Demand Potential vs Domestic Production



Source: GTM Research

China

China is a relatively new player but has had a dramatic emergence in the international market. Its solar PV companies have developed very quickly and a number conducted IPOs in China and other countries in 2007 and 2008. A mushrooming production capacity for solar cells and modules has been accompanied by growing production and re-cycling of silicon. This is affected by the global slow-down but the Chinese industry is already well placed for the future with ambitious expansion plans. According to ABS Energy Research domestic demand in China has not kept pace and it is therefore an export orientated industry to date.

Greentech Media also believes the one constant in what many have called 'the miracle' of China's enormous economic growth over the past 30 years has been a reliance on export economies. The development of the PV industry has been no exception. Since the industry's modest beginnings in 2002, domestic cell and module manufacturers have exported more than 95 percent of their products to overseas markets – relying on the favourable energy policies of European governments to drive demand for Chinese production.

As China has rapidly vaulted to the top of global solar cell manufacturing capacity, it has done so largely due to unprecedented demand from countries like Germany, Spain, Italy, and the United States. As the financial crisis of 2008 became fully apparent however, domestic Chinese manufacturers scaled back production, laid off workers and some even stopped operations completely.

It was in this context that the Chinese government, recognizing the need to support this critical growth industry with domestic demand, began to seriously consider national solar incentives. With many other markets stalling due to a lack of financing and uncertain policy regimes, China will likely be one of the key growth markets for the solar sector in both the near and long term. Understanding the structure of the solar market in China and how it will grow will be crucial to understanding global demand trends as well as opportunities for investment and partnerships in this emerging market.

In 2007 China announced goals to install 300 MW of PV by 2012 and 1.8 GW by 2020. Given recent policy developments and project announcements, China will be well on its way to significantly exceeding those goals – and in fact is expected to announce new targets in the near future. Depending on the timing of these announcements and the success of several pilot projects, the Chinese market has very real potential to ramp well beyond 1 GW in 2011.

An example demonstrating this increasing focus on domestic demand is given through a brief overview of Canadian Solar Inc:

Company Case Study: Canadian Solar (NASDAQ: CSIQ)

Market Development View

Canadian Solar believes that the most likely market development model has solar panel companies partnering with large domestic generation companies. Unlike several of its domestic competitors, Canadian Solar feels that installation capacity could be a near-term potential limiting factor for the market (2009 and 2010).

Strategy

The company believes that it may be possible to capture both the installed capacity subsidy (RMB 20/W) as well as a potential feed-in tariff, making the commercial rooftop segment particularly appealing.

Based on the strong financing and development partnerships already in place, Canadian Solar will likely focus on utility scale project development in western provinces in the near-term. The longer term goal would likely be to leverage these relationships and scale the development model in other resource-rich areas out west, as well in and around Jiangsu province.

Projects

On 7 August, 2009, Canadian Solar announced a strategic cooperation agreement with Guodian Power, one of China's largest power generation companies. Under terms of the agreement, the two companies will jointly build, own, and operate solar projects, with initial development focused on Gansu, Ningxia, and Inner Mongolia. Guodian plans to install 510 MW of PV domestically by 2012. On 25 August, 2009, the company signed a letter of intent to develop a 500 MW project in Baotou, Inner Mongolia.

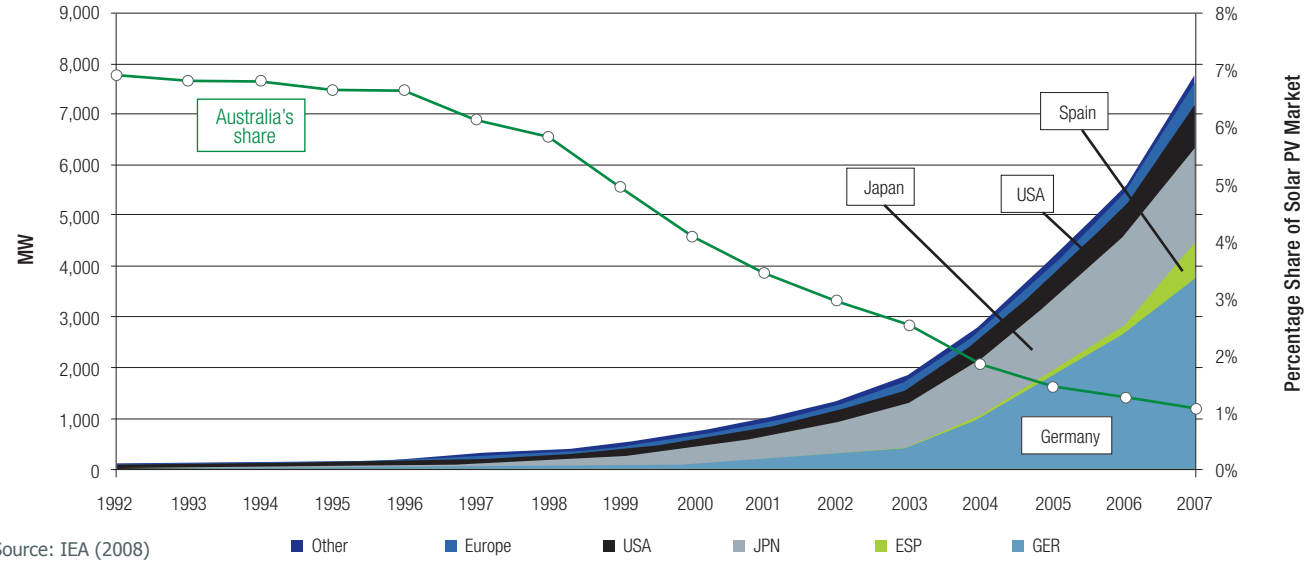
The company has a cooperation agreement with the Suzhou municipal government to aggressively grow commercial rooftop and BIPV developments in the municipality.

The company won a competitive bidding process to provide panels to 80,000 rural households in Sichuan totalling 1.6 MW as part of a program initiated and financed by the Ministry of Agriculture and the Sichuan Provincial Government. The project finished construction in April 2009.

Australia's Share of the Global Market

In terms of Australia's share of the global market, it is interesting to note that, as other markets have driven growth strongly, Australia's proportion of the global market has reduced dramatically.

Global PV Solar Installations (cumulative)

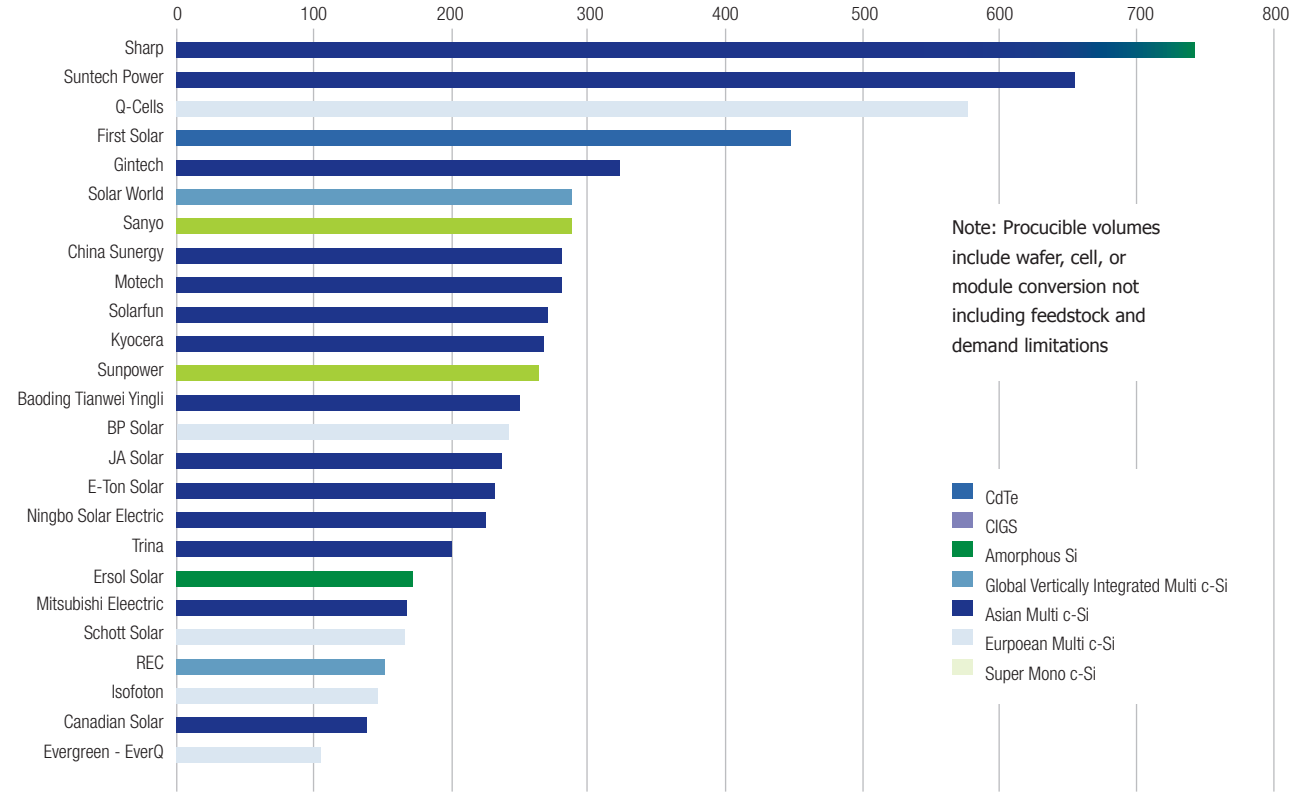


Source: IEA (2008)

Global Production Trends

The figure below displays the top 25 global cell producers in 2008, colour-coded by location and technology. As expected, crystalline silicon producers top the list of global PV cell producers. Japan-based Sharp, China-based Suntech power and Germany-based Q-Cells occupy the top three spots, being the only companies to have producible cell output levels greater than 500 MW in 2008. FirstSolar (No. 4) is the only thin-film company on the list, with CIGs and amorphous silicon producers yet to ramp up to multi-hundred MW scale.

Top 25 Global Producers in 2008 – Cells (Producible Volumes)



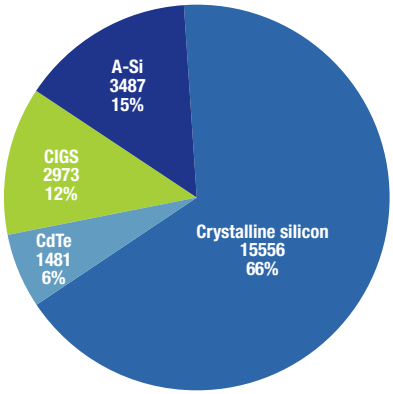
Source: Greentech Media Research

Thin-Film Producers Will Use Cost Advantage to Take Market Share

From only 5.8 percent of global production in 2005, thin film is expected to steadily gain share from crystalline silicon. Growing from 13 percent of all PV sold in 2007, to 34 percent of the producible PV in 2012, and possibly more depending on market conditions, thin film has established itself as a strong competitor in the global PV industry.

There is a projected production growth across all technologies, with amorphous silicon expected to grow rapidly (despite its low efficiency and higher upfront cost) constituting almost half of producible thin-film supply by 2012. CdTe-based FirstSolar should still maintain its current position as the leading thin-film producer in the world as it ramps up its manufacturing facilities in Germany and Malaysia. Although CIGs at scale is largely unproven at this point, many companies with substantial backing from venture capital firms or corporate parents are now beginning to see results. If a small number of these companies are able to hit scale and throughput targets, they could rapidly expand to occupy significant market share by 2012.

Global Producible Modules by Technology, 2012 (MW) (total: 23,723 MW)



Note: Producible volumes include water, cell, or module conversion, not including feedstock and demand limitations

Source: Greentech Media

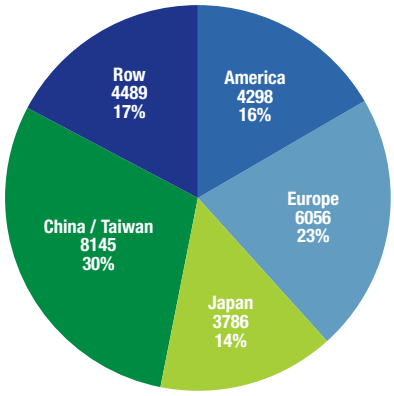
Crystalline Silicon PV: Asian Production Poised to Commoditise Generation 1 Technology

While thin film is expected to steal considerable market share from crystalline silicon-based technologies, the latter will hardly be sitting still, 66 percent of producible cells in 2012 will come from c-si production. China and Taiwan are expected to continue to be major centres for multicrystalline silicon-based cell production throughout 2010 and can be expected to constitute 50% of c-si based producible cells by 2012.

Material volumes are also expected from other Asian countries, such as India, Malaysia, Singapore, and the Philippines, as facilities owned by global giants such as REC and Q-Cells ramp up production in those countries. By 2012, Asia-based production (including Japan) is expected to account for 82 percent of global producible crystalline silicon cells, at significantly improved efficiency and cost targets from today, a far cry from the days of European dominance.

Asian producers could be considered to have an edge as far as costs are concerned over their Europe-based competitors - which could be a determining factor in a low demand world. Once polysilicon prices level out across all producers, Chinese and Taiwanese producers will be formidable producers of low-margin standard crystalline PV.

Global Producible Cells by Region, 2012 (MW) based on location of production, 2012



Note: Producible volumes include water, cell, or module conversion, not including feedstock and demand limitations

Source: Greentech Media

3. Pricing Analysis

According to the NSW government, in Australia, the average cost per KW of a PV system is $12,500 before subsidies and rebates. Industry sources say that the average cost of a 1kW system is around $10,000 although there are cheaper options, although possibly with reduced quality. Over the past two decades, the cost of manufacturing and installing a PV solar power system has decreased by approximately 20% with every doubling of installed capacity. Solar PV costs are expected to continue to decrease. PV cost reductions of 50% from 2007 levels have been predicted by the NSW government. Industry experts have suggested that within three to seven years, solar energy's unsubsidised cost to consumers could approach the cost of conventional electricity in a number of markets.

Manufacturing Costs

As can be seen in the next diagram, global manufacturing costs for PV are expected to continue to fall over the next few years and should be approaching $US1.50/W for most major technologies by 2015. Thin film should retain its advantage with regard to profit potential, especially CIGs and CdTe, even after adjusting for their lower energy-conversion efficiency. At the same time, high-efficiency monocrystalline, or "super mono" technologies will have made significant strides in improving costs, largely thanks to efficiency advancements, and will have a definite edge over thin film products in space-constrained markets.

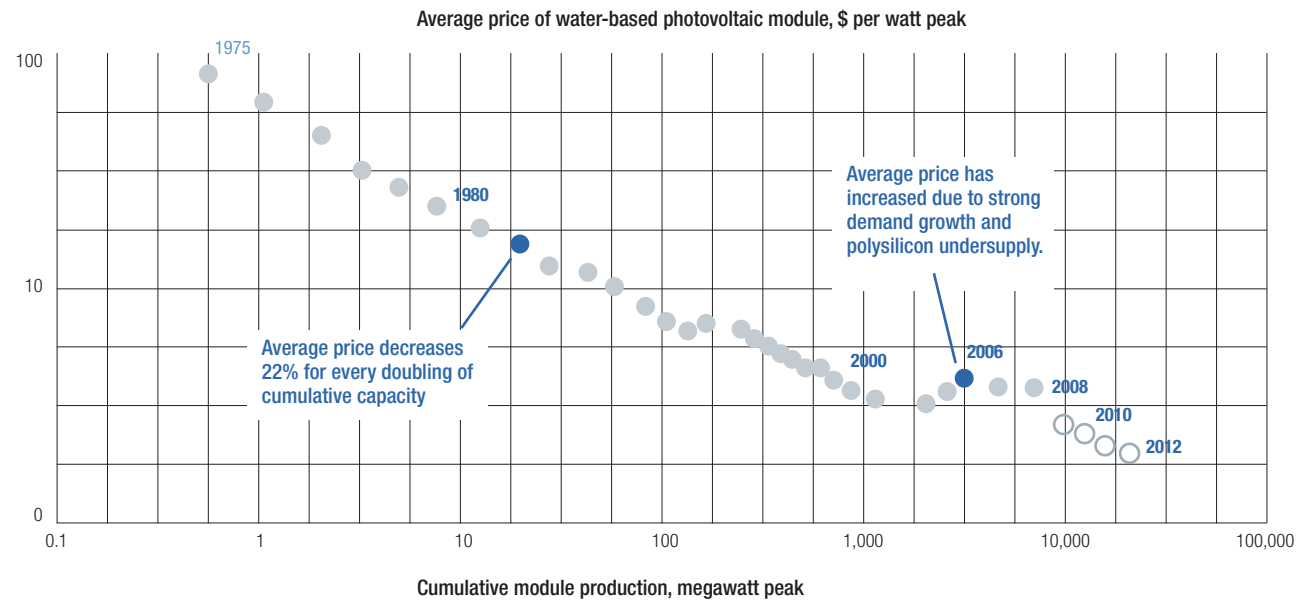
The costs for standard multicrystalline silicon PV are changing. In 2008, European producers had a meaningful advantage thanks to considerably lower feedstock prices, a result of high current spot polysilicon prices being paid by Asian producers and the better typical contract portfolios of European producers. Over time, as the polysilicon shortage eases and blended polysilicon prices for the two regions converge, Asian producers should have the advantage due to their lower labour costs. On the whole, multicrystalline silicon PV, will have to work hard to compete and survive in a high-competition, low-cost world against both higher value-added (super mono) and lower cost (thin-film) competitors.

CIGs and CdTe producers at scale should be the most competitive, even after factoring in their low efficiency relative to crystalline si. Super mono monocrystalline si-based producers should be equally strong creating profits from high customer value added and dominance in niche "space constrained markets." Large-scale Asian c-si producers and the very largest tandem amorphous-si manufacturers should also be competitive. The fate of the rest is less certain, with multicrystalline si producers who have not scaled up production sufficiently (especially European producers) facing potentially significant margin contraction in a highly crowded and commoditised market.

As can be seen from the diagram below, according to McKinsey, the economics of the solar market are improving, benefiting from innovations and cost reductions. The average price initially decreased with the efficiencies realised from significant cumulative capacity.

Prices then increased with the silicon shortages earlier this decade, but have now come back down as supply capacity has increased and demand has stabilised. Pricing quoted is in US dollars.

The Economics of Solar Power: The Learning curve

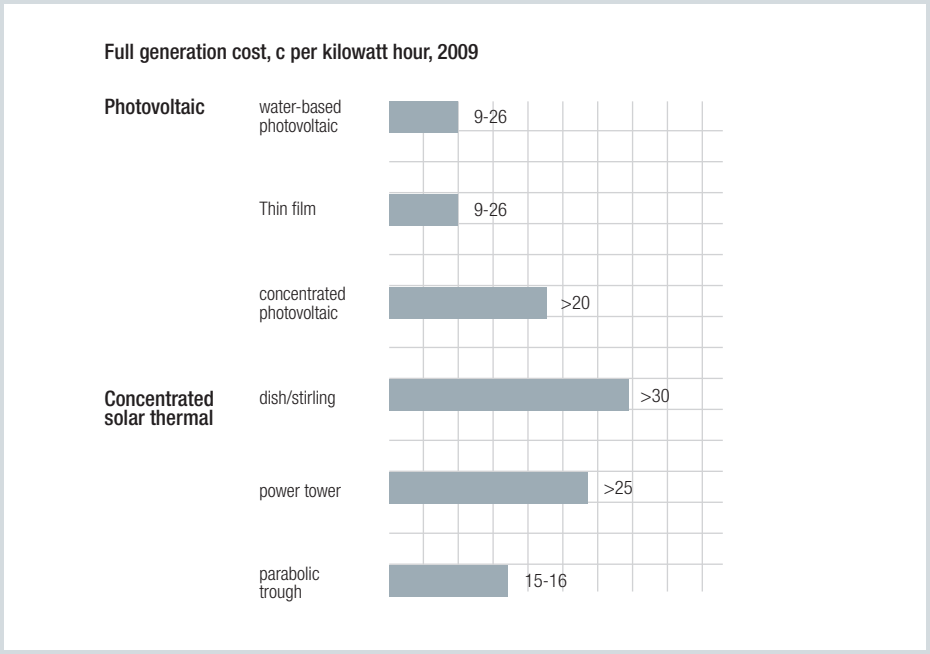


Source: McKinsey Quarterly Website

As previously outlined, there are several factors helping to reduce the costs of solar power. These include improvements in manufacturing processes, new technologies and lower component prices. The following chart shows the full generation cost by cents (US) per kilowatt hour so far in 2009. For comparative purposes concentrated solar thermal has been included.

The Economics of Solar Power: Cost Reduction Road Maps

Factors for reducing the costs of solar power includes improved manufacturing processes, new technologies, and lower, component prices

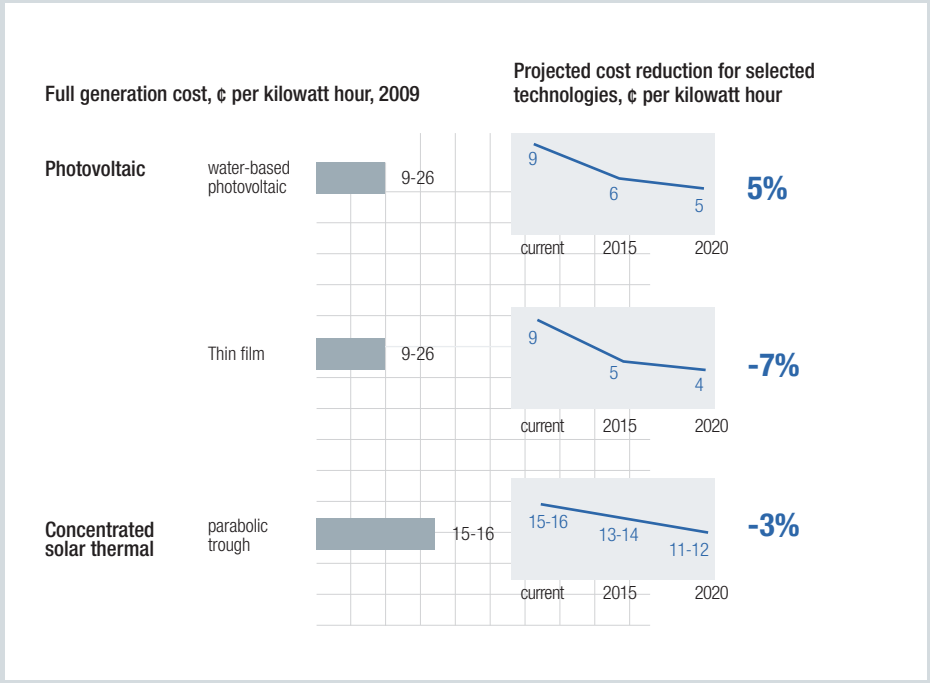


Source: McKinsey Quarterly Website

The next diagram shows the projected cost reductions for water-based PV and thin-film in regard to the PV category and again for comparative purposes parabolic trough for concentrated solar thermal through to 2020. They predict thin-film will enjoy the greatest overall reduction.

The Economics of Solar Power: Cost Reduction Road Maps to 2020

Percentage shows Compound Annual Growth Rate:



Source: McKinsey Quarterly Website

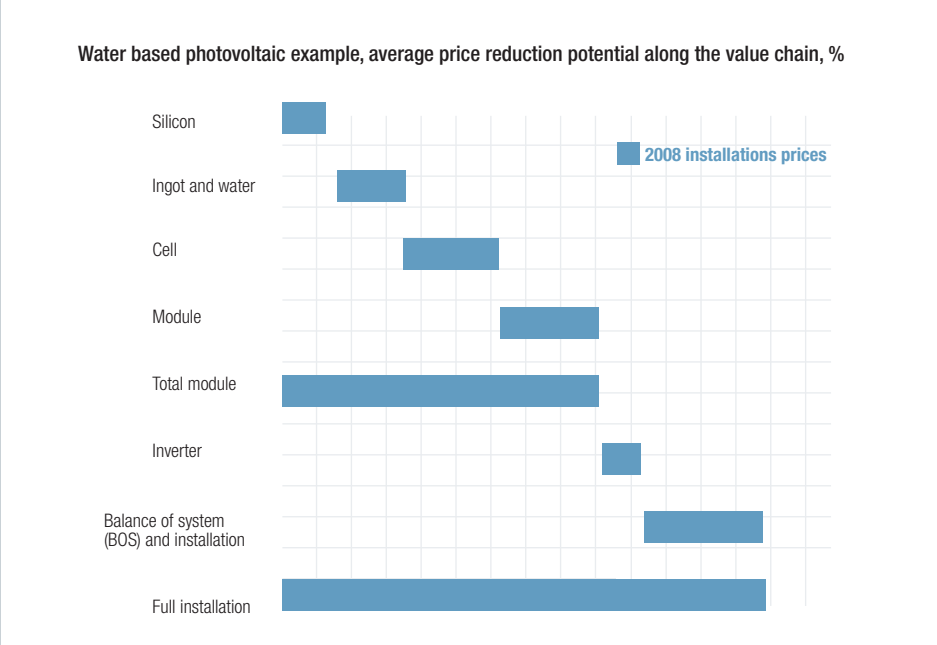
Installation Costs

McKinsey expect the full installation price for solar power to decrease by up to 60% by 2020. This will be driven mainly by module price reduction. The key drivers of this will include thinner wafers and better cell design from a technological perspective, new manufacturing technology, including increased automation and scale, as well as increasing standardisation. An increasingly competitive marketplace and silicon supply will impact margins.

The diagram below uses the example of wafer-based PV showing the average price reduction potential along the value chain. It is important to compare the potential percentage reduction of each component with its overall percentage of costs in the entire chain.

The Economics of Solar Power: 2020 Price Reduction Forecast

The full installation price for solar power is expected to decrease by 60% from 2008 to 2020 driven by module price reduction.



Source: McKinsey Quarterly Website

Exchange Rates

The analysis above has all been presented in terms of US dollars and so for the Australian market it is essential to understand the forecast exchange rate between the Australian and US dollars. There are many market forecasts of exchange rates and it is an area that is notoriously difficult to get right. One forecast published by the St. George Bank summarised its outlook with the following comments:

- **We believe the AUD has further room to appreciate over the next six to nine months.**
- **We do not rule out the AUD breaching parity; we see the conditions this time round as more conducive to parity compared with the last time markets got excited about parity in July 2008.**
- **Interest-rate expectations are an increasingly dominant driver of the Aussie dollar.**

The report also published specific forecasts for exchange rates with all major currencies. The published US-AU exchange rate is shown below.

Australian Dollar Outlook

ST GEORGE BANK EXCHANGE RATE FORECASTS effective since 13 October 2009				
	End Quarter			
	Dec 09	Mar 10	Jun 10	Sep 10
USD Exchange Rates				
	0.9600	0.9800	0.9900	0.9700

Source: Australian Dollar Outlook, St. George Bank

Source: Greentech Media

4. Technology Trends

There are many existing and emerging technologies in the PV space. Some of these have been outlined in this section. Each of the technologies has been assessed in terms of its overall assessment, its strengths and weaknesses, its availability, form and efficiencies. This provides an overview of the technology most suitable applications and its likely prospects.

Crystalline Wafer-Based Silicon

Assessment
Wafer's thickness versus efficiency affects costs as well as manufacturing techniques and labour, silicon availability until recently has been limited, driving prices to historical high levels; currently moving to oversupply and therefore lower prices

Strengths
Proven technology, modular yields durable solar cells with good efficiencies

Challenges
Silicon, a relatively poor absorber of light, necessitating wafers of considerable thickness

Availability
Constituted more than 85% of photovoltaic shipments in 2008

Materials
Uses single or multi-crystalline silicon (Si) as the light-absorbing semiconductor

Best Used
In space constrained areas such as residential and commercial rooftops, twice as efficient as current thin-film technologies for best-in-class products but more costly to produce

Form
Wafers sliced from silicon ingot (resulting cells may be interconnected into modules then collected into arrays)
Energy Conversion Efficiency
Currently 15-20%
Efficiency limit = c. 31%

Crystalline Wafer-Based Silicon Cells

Source:
Renewable Energy World Website

Thin Film Cadmium Telluride (CdTe)

Assessment
Not as efficient as silicon based photovoltaics but costs roughly half as much to produce; reducing required thickness lowers material costs significantly

Materials
Uses cadium telluride (CdTe) as light absorbing semiconductor

Strengths
Lowest cost per Wp (watt peak) production cost because of balance between ease of production and relatively higher cell efficiency

Form
Thin coating of light absorbing material deposited on substrate (can be flexible) substrates include; glass (for CdTe) and glass, polymers, or stainless steel (for a-Si and CIGS)

Challenges
Limit on module efficiency of 12-13% going forward; highest in-lab efficiency shown is more than 16%
Difficulty with production on flexible substrates
Life expectancy unknown (current manufacturers offer warranty for more than 20 years)

Best Used
Where space is not an issue (i.e. large field installations, large flat rooftops)

Energy Conversion Efficiency
Currently 12-13%
Efficiency limit = c. 16%

Thin Film Amorphous Silicon (a-Si)

Assessment
Not as efficient as silicon based photovoltaics but costs roughly half as much to produce; reducing required thickness lowers material costs significantly

Materials
Uses amorphous silicon (a-Si) as light absorbing semiconductor

Strengths
Proven technology with relatively standardised manufacturing process

Form
Thin coating of light absorbing material deposited on substrate (can be flexible) substrates include; glass (for CdTe) and glass, polymers, or stainless steel (for a-Si and CIGS)

Challenges
Relatively low cell efficiency (6-8%) depending on technology; highest in lab efficiency shown at 12%
Light included degradation of efficiency stabilising over a period of a few weeks (at levels mentioned above)
Manufacturing productivity may suffer due to slower layer deposition rates

Best Used
Where space is not an issue (i.e. large field installations, large flat rooftops)

Energy Conversion Efficiency
Currently 6-8%
Efficiency limit = 12%

Thin Film Copper Indium Gallium Selenide (CIGS)

Assessment
Not as efficient as silicon based photovoltaics but costs roughly half as much to produce; reducing required thickness lowers material costs significantly

Materials
Uses a combination of copper indium diselenide (CIS) and copper indium gallium selenide (CGS) as light absorbing semiconductor

Strengths
Highest module efficiency expected among thin film technologies (more than 13% demonstrated) starting modules efficiency in 10% range

Form
Thin coating of light absorbing material deposited on substrate (can be flexible) substrates include; glass (for CdTe) and glass, polymers, or stainless steel (for a-Si and CIGS)

Challenges
Demonstrated efficiencies depend on substrate; higher for glass (>19%), lower for plastic (<15%)
Difficulty controlling uniformity of active layer on large formats.
Inability to make modules work on steel substrates.
Commonly used EVA (ethylene-vinyl acetate) encapsulation works poorly with CIGS

Best Used
Where space is not an issue (i.e. large field installations, large flat rooftops)

Energy Conversion Efficiency
Currently 10-13%
Efficiency limit = 19%

Concentrated Photovoltaic Cells

Concentrated Photovoltaic

Assessment
Efficiency is high compared to alternatives; highest in-lab cell efficiency more than 40%; commercial cell efficiency more than 29%

Materials
Uses concentrating dish or lens focusing sunlight on high efficiency semiconductor sells with tracking mechanisms

Strengths
Potential for greater efficiency; lower cost per watt

Form
Most prominent form currently being deployed commercially uses concentrator mirror or lens PV assemblies on high accuracy tracking systems

Challenges
Very low installed base: economics not proven at large commercial scale; manufacturing process not as mature in comparison to other commercial PV well technologies

Best Used
Where space is not an issue (i.e. large field installations)

Availability
Mostly pilot stage with limited large-scale (-10MW) commercial projects

Energy Conversion Efficiency
Currently 25%

New Technologies

Assessment
3-G includes technologies working to counter loss mechanisms inherent in wafer based or thin film technologies (i.e.: reflection, thermodynamic inefficiencies, electrical resistance, and recombination); for example stacking 2 thin-film cells creates a tandem cell that can selectively pull energy from both visible and infrared portions of the solar spectrum (cells are still in development but have tremendous cost reduction potential)

Materials
New approaches to substrates, (e.g. thin film polycrystalline silicon, or solar cells based on organic dyes) technology upgrades (e.g. low cost tandem cells, hot carrier cells, multiple exciton generation (MEG), intermediate band gap and thermophotonic band technologies. Nanotechnology comes into play in many 3-G technologies, especially in creating dye-sensitised organic solar cells

Strengths
High efficiency; low photovoltaic material consumption

Form
Substrates include glass, polymers, or stainless steel

Challenges
Vary with technologies

Best Used
In space constrained areas (such as residential rooftops); twice as efficient as current thin-film technologies but more costly to produce

Availability
As yet little manufacturing experience.
Energy Conversion Efficiency
Varies among technologies

Source: Alice Solar City Source

Source: Alice Solar City Source

Building Integrated Solar Photovoltaics (BIPV)

With the renewed interest in solar energy that is developing across the board, BIPV technology has progressed to third-generation systems, whereby solar modules are being fully integrated into the building envelope and are therefore able to replace conventional building materials. It is this generation from which the largest opportunities will likely emerge, because these products can be applied to a variety of settings including roofs (roof-integrated photovoltaics or RIPV), walls, facades, and windows.

Corus is developing products for use in RIPV applications using Dyesol's DSC materials, and will be one of the first companies to commercialize its metal-based RIPV products, with early models appearing by 2011. Corus believes that many industrial buildings, which are typically covered with steel sheets, will be generating solar electricity using its solar paint. The market for this is huge as there is in excess of one billion square metres of coated steel roofs erected each year globally.

Solar windows and skylights present an exciting market opportunity given the huge window areas available to collect solar energy and the aesthetically appealing nature of these products. The transparency of these windows does change, which may be beneficial to workers' or residential dwellers' comfort, and could reduce glare and heat at the sunniest times of the day.

Konarka Technologies is collaborating with Arch Aluminum & Glass to develop solar materials to replace conventional building materials for integration into semi-transparent glass for various commercial BIPV applications. These materials are more flexible, lightweight and transparent, making them more aesthetically suitable for BIPV applications. Other active developers include Fraunhofer ISE/ColorSol Consortium, New Energy Technologies and Solarmer.

Konarka's PowerPlastic for rooftop applications is expected to be competitive in terms of both cost and efficiency by 2010. Another of Konarka's partners in BIPV is SKYShades, which itself views the installation of integrated 'solar OPV membranes' over existing sheet metal roofing systems as a substantial growth opportunity. 'Roofs' have historically been non-income earners for property owners, and now they are able to offer an installation which can generate 'clean, green' power to augment electricity needs and potentially feed into the grid. The company has been working with Konarka for the past few years and is currently demonstrating its novel structures at a factory in Brisbane, Australia, where it has installed a 200m2 solar membrane structure on the rooftop. It plans for wide-scale commercialization by the end of 2009 or early 2010.

Building Integrated Solar Photovoltaics (BIPV)

"I believe Building Integrated Solar Photovoltaics (BIPV) will begin to have a significant impact in the Australian market within the next two to three years. It will become very important in the future".

Richard Turner
Chief Executive Officer
Zen Technologies
(Power and Energy)

Source: Solar Integrated Website

Desert Knowledge Centre, Solar Centre

The Solar Centre at the Desert Knowledge Centre in Alice Springs forms part of the city's Solar Cities program. The Centre is situated as part of the 73ha Desert Knowledge Precinct site, which also houses the Desert Peoples' Centre, the headquarters for Desert Knowledge Australia and the Desert Knowledge Cooperative Research Centre (CRC).

The Solar Centre is a unique resource as it is testing numerous PV panel configurations and publishing their performance on line and in real time.

The website (http://www.dkasolarcentre.com.au) provides details of the equipment installed and the performance of each of the panels. This can be analysed in comparison to other panels and also with reference to specific weather conditions.

This provides an excellent resource for those advising consumers on the operating efficiencies of different panels. Of course the data from Alice Springs will not be accurate for other locations but it does at least provide some comparative data.

There is a wealth of performance data on this site which can be viewed in many ways. The two website extracts below show the performance of different specific panels over a 12 month period. The graphs are presented in terms of daily kWh produced for the full panels installed.

DKA Solar Centre Map

Source: DKA Solar Centre

These graphs show the annual variation in efficiency and also the variation between the technologies. For instance, the CdTe Thin Film panel varies from an average daily output of over 45 kWh in summer down to only approximately 36 kWh in winter.

It is also possible to analyse the average output of the various installed systems over specific time periods. The table below provides the average output of each of the installed systems over the two months to 1 December 2009.

These figures have been normalised to give average daily kWh produced per kW of installed capacity. This allows a more accurate comparison between the performance of different panels.

It is interesting to note that, of the fixed panels during this period, the amorphous silicon panel from Kaneka produced the most power at 6.34 kWh/kW installed and the overall best performance was delivered by the dual axis tracking system used with the Kyocera panels at 8.41 kWh/kW installed. It is also interesting to note the differences in the 'solar compass' results with the best performance being the north tilting panel at 5.82 kWh/kW installed, although this is only 5% better than the worst performing of the four panels.

It should be noted however that these results may however not be replicated at different times of the year or in different parts of the country.

Desert Knowledge Australia – Solar Centre Data
Panel Performance for the two months to 1 December 2009

DKA REF	TYPE	PANEL TYPE	INVERTER TYPE	ORIENTATION OR TRACKER TYPE	AVERAGE DAILY OUTPUT (KWH/KW INSTALLED)
1	Large Scale Tracking	Trina TSM 175D	6 x 6kW, SMA SMC 6000A	DEGERenergie 5000NT, dual axis	8.22
3	Roof Mounted Array	BP 3165	6kW, SMA SMC 6000A	True north, at 25º tilt	6.03
4	Solar Forest Hydraulic	Kyocera KD135GX	2.5kW, SMA Sunnyboy 2500	Portasol dual axis	5.89
5	Solar Forest 2 Axes	Kyocera KD135GX	5kW, SMA SMC 5000A	WattSun, A2125	8.41
6	Solar Forest 1 Axis	Kyocera KD135GX	5kW, SMA SMC 5000A	BW Solar 5 Star Tracker	8.09
7	CdTe Thin Film	FirstSolar Q12007 FS-270	7kW, SMA SMC 7000A	True North, at 25º	6.26
8	Amorphous Silicon	Kaneka GEA-60	6kW, SMA SMC 6000A	True north, at 25º tilt	6.34
9	CIGS Thin Film	Shurjo SE 60-J14, A-CGS-060	5000W, Fronius IG 60	True north, at 25º tilt	4.28
10	Back Contact Silicon	Sunpower SPR-215-WHT	6.0kW, SMA SMC 6000A	True north, at 25º tilt	6.03
11	Silicon Monocrystalline A	BP 4170	6kW, SMA SMC 6000A	True north, at 25º tilt	5.42
12	Silicon Polycrystalline	BP 3165	6kW, SMA SMC 6000A	True north, at 25º tilt	5.74
13	Silicon Monocrystalline B	Trina TSM 175D	6kW, SMA SMC 6000A	True north, at 25º tilt	6.13
14	Solar Forest Fixed	Kyocera KD135GX	5kW, SMA SMC 5000A	True north, at 25º tilt	6.31
16	Solar Compass East	BP 3165	2500W, SMA Sunny Boy 2500	25º tilt	5.54
16	Solar Compass North	BP 3165	2500W, SMA Sunny Boy 2500	25º tilt	5.82
16	Solar Compass West	BP 3165	2500W, SMA Sunny Boy 2500	25º tilt	5.58
16	Solar Compass Flat	BP 3165	2500W, SMA Sunny Boy 2500	Flat	5.76

5. Regulatory Trends

The Solar Credits Scheme as part of the new RET legislation creates incentive using a performance based mechanism as opposed to the flat rebate offered previously. It is now available to small business and community groups and applies to both solar PV and small wind turbines. The scheme is not means tested.

The change from a flat rebate encourages people to install larger systems rather than the system that costs closest to the flat rebate amount. The outcome of this will be that the system encourages the greatest overall capacity to be installed rather than the greatest number of systems.

This has changed the demographics of potential consumers, with a wealthier target market appearing more likely to be the dominant purchasers. This may require the development of a new market segmentation strategy by certain suppliers and may favour those who take a long term strategic position in the market and offer higher quality systems.

Solar Credits

The Solar Credits scheme has been introduced by the government as part of the expanded Renewable Energy Target (RET). Solar Credits allow five times the amount of RECs to be created for the first 1.5kW of eligible small generation units (small-scale solar PV, wind and hydro) for installations on or after 9 June, 2009.

In the case of systems larger than 1.5 kW, generation from the capacity above 1.5 kW will still be eligible for the standard 1:1 rate of RECs creation. The credits will however only apply to the first small scale generation system installed at an address: subsequent systems will earn RECs at the 1:1 rate. The multiplier will also reduce in size over the life of the RET as shown in the table below.

REC Multiplier under the RET Legislation

Year	9 Jun'09 - 30 Jun'10	2010-11	2011-12	2012-13	2013-14	2014-15	From 2015-16 onwards
Multiplier	5	5	5	4	3	2	No multiplier (1)

Feed-In Tariffs

A feed-in tariff is a premium rate paid for electricity fed back into the electricity grid from a designated renewable electricity generation source like a rooftop solar PV system or wind turbine. At present, feed-in tariff regulations for renewable energy exist in over forty countries around the world. Feed-in tariffs in Australia have tendered to favour small-scale rooftop solar, a situation that has distorted the market and has not allowed the industry to achieve the volumes of scale, efficiencies and cost cuts reached in countries such as Germany.

A net feed-in tariff, also known as export metering, pays the PV system owner only for surplus energy they produce; whereas a gross feed-in tariff pays for each kilowatt hour produced by a grid connected system.

The Rudd government and particularly Resources Minister Martin Ferguson, has declared its strong opposition to schemes such as feed-in tariffs at a national level preferring market based mechanisms such as the RET and CPRS. However, the overseas experience suggests a different story. Germany and Spain have emerged as world leaders as the owners of intellectual property, manufacturing and export facilities and are expected, along with China and the US, to dominate a global industry worth hundreds of billions in the coming decade.

The experience in Germany and Spain has however changed recently with reduction to the scale of installations that qualify for the Feed-in Tariff in Spain and the rates for the tariffs in Germany. This has had a severe impact on the demand in Spain and is forecast to also reduce demand in Germany in 2010.

NSW has recently introduced a 'gross' feed-in tariff system commencing on January 1 2010. Early figures from the NSW government suggest around 10,000 NSW households are likely to install panels in the first year of the scheme with over 60,000 units over the proposed seven year program. It is believed that the average household will be able to pay off their investment in around eight years. Households will be paid 60 cents per kilowatt hour and an average household system would generate annually around 2500 KWh. The scheme will have a cap of 10 kW on the size of home solar.

Other states have varying degrees of feed-in tariff as detailed in the table below.

Feed-in Tariffs by state

FEED-IN TARIFF	ACT	NSW	QLD	SA	TAS	WA	VIC
POLICY START DATE	Feed-in Tariff Commenced 1 March 2009	Feed-in Tariff Commenced 1 January 2010	Solar Scheme Bonus commenced 1 July 2008	Feed-in Tariff Commenced 1 July 2008	Feed-in Tariff to be announced. Currently only retail offering	Feed-in Tariff to commence 1 July 2010. Currently Renewable Energy Buyback Scheme	Premium Feed-in Tariff Commenced 1 November 2009.'Fair & Reasonable' Tariff (1:1) to remain
GENERATION ELIGIBILITY	Gross	Gross	Net	Net	Current retail offer – Net	Net	Premium FiT - NET
TARIFF LEVEL	50.05 cents / kWh <10kW 40.04 cents / kWh for 10-30kW	60 cents / kWh	44 cents / kWh	44 cents / kWh	Current retail offer – 20 cents/ kWh FiT - TBC	TBC	Premium FiT for Solar PV – 60 cents / kWh F&R Tariff – at least 1:1
SIZE / ELIGIBILITY	Domestic and small businesses <30kW	Domestic, small business, schools, community facilities < 10kW.	Domestic, small business < 10kW for single phase connection. <30kW for three phase connection	Domestic, small business < 10kW for single phase connection. <30kW for three phase connection	Current retail offer – no restriction. FiT - TBC	FiT – TBC Buyback – Domestic, educational <10kW	Premium FiT – Domestic, small business, schools, community facilities < 5kW. F&R Tariff – domestic and small business <100kW
DURATION	20 years	7 years	20 years	20 years	TBC	FiT - TBC	Premium FiT - 15 years
TECHNOLOGIES ELIGIBLE	Solar, wind	Solar PV Micro-wind	Solar PV	Solar PV	Current retail offer – Solar PV. FiT - TBC	FiT – Solar PV Buyback scheme – solar, wind, micro-hydro	Premium FiT – Solar PV F&R Tariff – wind, hydro, biomass, solar.
STATUS	Legislated. Stage 2 expected mid 2010	Legislated.	Legislated.	Legislated.	FiT – to be announced	FiT – announced May'09	Premium FiT – legislated F&R – legislated
WEBSITE	www.actewagl.com.au/	www.dwe.nsw.gov.au/energy	www.cleanenergy.qld.gov.au	www.climatechange.sa.gov.au	www.dier.tas.gov.au/energy	www.sedo.energy.wa.gov.au	www.dpi.vic.gov.au

Source: Clean Energy Council

As of late 2009, a review is underway of the South Australian Feed-in Tariff. This review is considering both the design of the system and the quantum of the payments. With the announcement of the NSW gross feed-in tariff it will be interesting to see whether South Australia may move towards a gross model.

Victorian households with solar power systems have been paid a feed-in tariff from November 2009. Legislation for the Victorian feed-in tariff was passed in June in 2009. Under the program, Victorian households, community organisations and small businesses who consume less than 100 MWh of electricity a year will be credited a minimum 60 cents for every unused kilowatt hour of power fed back into the state electricity grid.

The tariff will only be available until a total capacity of systems participating reaches 100 MW total capacity. PV systems larger than 5 kW in size and other renewable energy systems up to 100 kW in size remain eligible for the standard feed-in tariff. While electricity companies are only obliged to offer the 60c rate and as only a 12 month credit, some are now offering cash payments at higher rates as shown in the table below.

After previously announcing a rate of $0.60 per kilowatt hour based on a gross model starting some time in 2009, the Western Australian government rescinded the rates and conditions in June 2009 and says it will be instead introducing a net feed-in tariff model. The scheme is due to launch in Western Australia in July 2010 and it is intended that owners of systems installed since the 2008 State Government election will be eligible.

Retail Price Offerings in Victoria

Source: www.EnergyMatters.com.au

	FIT OFFER INC. GST	AVAILABILITY	CASH OR CREDIT?	PAYMENT FREQUENCY AND METHOD	ADDITIONAL FEES
AGL	68c	All premises	Cash	Payment can be received annually via EFT	$10 admin fee
ORIGIN	66c	Primary residence and eligible business and community organisations	Cash	Once annually when in credit for more than $50 via cheque	None
COUNTRY ENERGY	66c	All premises	Cash	Payment can be made every billing period via cheque	None
ENERGY AUSTRALIA	66c	Primary residence and eligible business and community organisations	Credit only	NA	None
TRU ENERGY	66c	Primary residence and eligible business and community organisations	Cash	Case by case basis (generally when over $100 credit) via cheque	None
RED ENERGY	66c	Primary residence and eligible business and community organisations	Cash	1 free refund per year via EFT / cheque	$10 admin fee after annual refund

*As at December 9 2009. Information obtained through sales consultants and data from official company websites

Solar Flagships Program

The Solar Flagships program is part of the Australian government's $4.5 billion Clean Energy Initiative (CEI) announced in the May 2009 Budget. The government has committed $1.5 billion to the Solar Flagships Program to support the construction and demonstration of up to four large scale solar power plants in Australia using solar thermal and PV technologies.

The location of each solar flagship power station will be a function of solar and grid (including connection) factors. The government's aim is to establish up to 1000 MW of solar power generation capacity which is the equivalent to an average Australian coal-fired power station.

On 11 December, 2009 the Minister for Resources and Energy, Martin Ferguson, opened the program for Proposals. Project selection is to occur over two selection rounds. The first selection round will be held in 2010 and is to select one solar thermal and one photovoltaic project, with a target of 400 MW of combined generation capacity across both projects.

The second selection round is planned to be held in 2013-14, following a review of the outcome of the first round. Preliminary proposals must be lodged with the Department on 15 February 2010. According to the Department of Resources, Energy and Tourism, The Australian Solar Institute is expected to be the vehicle through which the economic and technical learnings are shared with the Australian and global solar community. To maximise the technology demonstration and learning benefits, the first round of solar flagships will include one solar thermal and one PV project.

In recognition of the critical role state and territory governments will play in project siting and delivery, project proponents will also be required to provide evidence of state or territory government endorsement of project proposals as a part of the selection process. Queensland and Victoria, in particular, appear to have advanced proposals for the program. South Australia is assisting some project proponents with their bid preparation.

Future Trends

It is possible that the States will continue to move towards gross feed-in tariffs. Whilst ruled out as a political impossibility only a year or two ago, gross feed-in tariffs are now legislated in New South Wales and the ACT.

The New South Wales scheme only provides a seven year payment period after which the panel owner will receive no guaranteed payments. The seven year period has been calculated to enable home owners to pay off their PV systems and make a small return. This is in contrast to the 20 year ACT payment scheme which will provide long term payment guarantees and may therefore attract third party investors rather than householders.

Any move towards gross feed-in tariffs is likely to follow the NSW scheme with limited returns but sufficient payments to pay back the cost of the installed units. 2010 may see some other states move in this direction. If this occurs then the emergence of a national gross feed-in tariff might be possible to follow in late 2011 or 2012.

Many interviewed stakeholders believe that continued advocacy through the Council of Australian Governments (COAG) to be the most effective method in encouraging a move toward the national gross feed-in tariff that would provide greater market certainty.

6. Industry Forecast for 2010

Pricing Trends

1. Supply Price - Supply price is expected to continue to fall over the first half of 2010 as companies continue to deplete inventories and global oversupply provides the negotiating power to buyers. This is combining with reduced demand in Spain and, to a lesser extent, Germany offset by growing forecast demand in countries including Italy and the US.

The estimates of the price decrease over the first six months of the year average at about 5%. The price will then stabilise during the second half.

2. Exchange Rates - The forecast steady or slightly strengthening US dollar exchange rate will mean that this global impact will be passed through fully to the Australian market.

3. China - The emergence of cheaper Chinese imports will continue to bring pricing pressure into the market while China will also continue to improve its technology in more advanced systems continually gaining ground on Germany and Japan. As Australia begins to move away from being so price driven towards the end of 2010, a more mature supply relationship may emerge with Chinese producers to provide a wider spread of product quality to better meet the full market needs of Australia. China may also experience the emergence of supplier consolidation during 2010 as their industry begins to mature and given their enormous number of competitors.

4. Price Parity - In terms of price parity with fossil fuels, while some parts of the world may be close to achieving this in 2010 it is unlikely that this will occur in Australia before 2012 given the cheaper price of fossil fuel based electricity and the delay to the introduction of a price on carbon.

Demand

1. Overall Demand Growth - Demand in the Australian market will continue to increase in line with the REC scheme and the increasing awareness in the community of renewable energy as a viable alternative to fossil fuels as the technology improves.

2. Commercial Systems - Many players will focus on the commercial sector to achieve growth and margin increases in 2010. Some of these opportunities can be identified in the regional tourism sector and remote communities where they are attempting to identify alternatives to a reliance on diesel fuel energy production. Other opportunities will be based in grid connected locations on commercial premises.

3. New South Wales - NSW will experience enormous growth behind the launch of its gross feed in tariff on 1 January 2010. The NSW Government has forecast that 10,000 units will be installed in NSW in 2010, equal to the entire installed capacity in the State.

Supply Chain

1. Just-in Time - Supply chain management will be crucial in 2010. Given the recent growth in the industry and as no manufacturing base exists in Australia any longer, the long lead times must be tightly managed on receiving stock in line with installation schedules.

2. Ongoing Supply Constraints - Several firms have recently been experiencing supply shortages for inverters and panels which are expected to continue in the short run into the first quarter of 2010.

Market Consolidation

1. Order Backlog Starting to Run Out - The back log of orders from the discontinued $8000 federal rebate scheme should see most companies through 2010. Under current rules all systems approved under SHCP must be installed within 9 months of receiving approval to get rebate. The final batch of approvals (some 60,000) was released in early October 2009. That means all installs must be completed by end of June 2010. As this backlog clears and as some larger companies continue to lose market share to their cheaper rivals, it is likely market consolidation will begin to occur.

2. Competition on Price - Two distinct business models market appear to be emerging as the industry matures. Firstly, one focussed on price competition as its source of advantage exercised by attempting to extract abnormal profits in the short run. The companies following this model are focussed on how to best meet the current and growing demand they are experiencing. These additional profits will disappear during 2010 at least in the residential sector with the removal of government incentives such as the $8000 rebate scheme making this model ultimately unsustainable in the long run. Therefore retailer consolidation will begin to occur towards end of 2010 as these rivals begin to exit the industry.

3. Competition on Brand - The second model is being adopted by those taking the position of long run industry participants. They have developed a sustainable model based on differentiating themselves from their cheaper rivals through consistently building brand equity as a source of competitive advantage. This competitive advantage is delivered by such factors as high quality standards, products, customer service levels and through providing a consistent message to their target markets.

4. Flight to Quality - This "flight to quality" has been emerging in many more advanced overseas markets and is expected to occur here. This will be exacerbated in the residential market as a wealthier demographic of consumer occurs given the REC scheme is not means tested and is output based, providing a larger rebate for purchasing a larger system. Whilst this does not necessarily drive higher quality systems, it does alter the customer demographic that may also drive higher quality systems being demanded.

Marketing and CRM Systems Become Essentials

It is important to note from a strategic perspective during 2010 and beyond the critical success factors these players must adopt to realise the benefits of this advantage will evolve as the new entrants begin to depart. That is to say, those factors, such as highly developed marketing brand plans and sophisticated customer relationship management (CRM) systems that would provide an advantage previously against their rivals, will become necessary just to compete. In other words they will become essential requirements for this sustainable business model: they will no longer win the game but rather just continue to give the opportunity to participate in it.

Appendix 1

List of Stakeholders

The following companies were interviewed to provide input on the current global and Australian market trends. The responses were combined to form the views expressed in this document. Generally the views expressed were reasonably consistent. Where differing views were expressed, this has been highlighted in the analysis.

BP Solar

Clear Solar

Ergon Energy

Nu Energy

Origin Energy

RFI

Sharp

Solar Shop

Sunpower

SunTech

ZEN Home Energy

Appendix 2

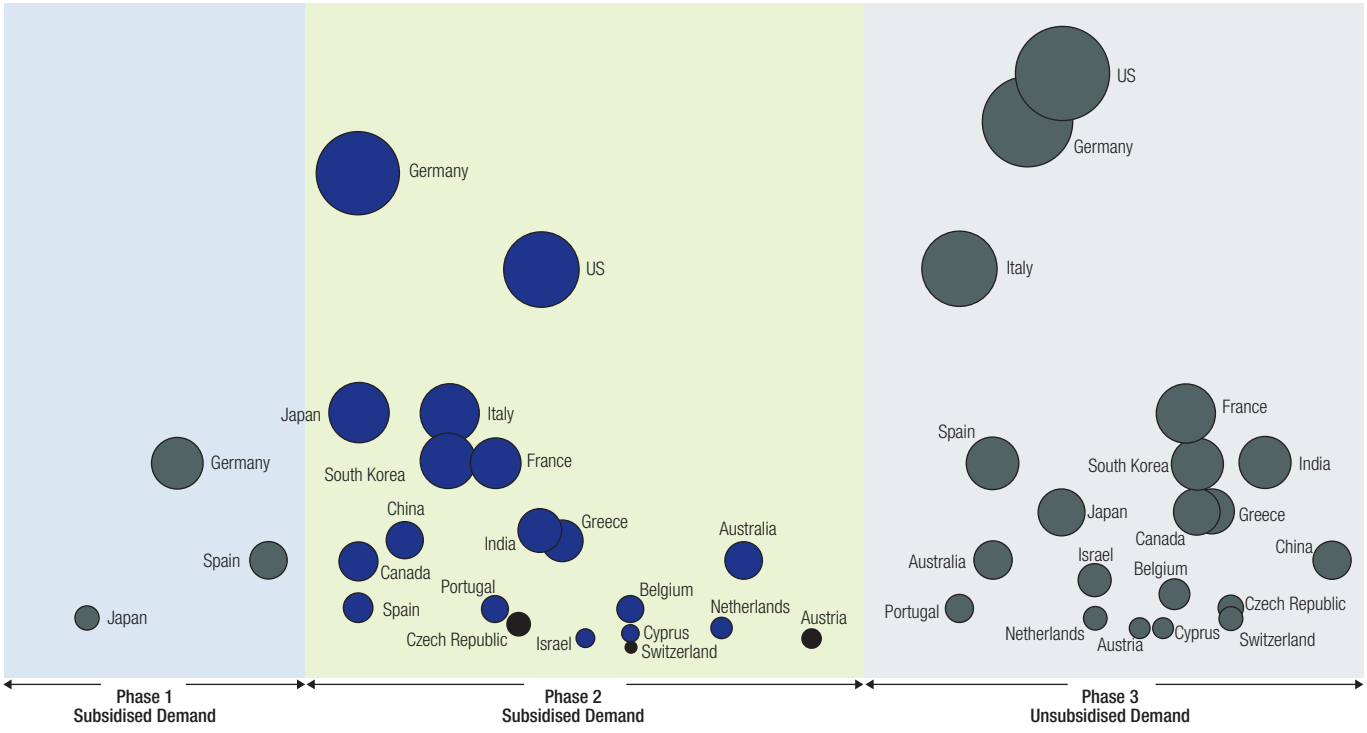
Supporting information

This appendix includes various graphs and charts that have not been used in the body of the report but provide additional information that assists in understanding the global PV market and its impacts on Australia.

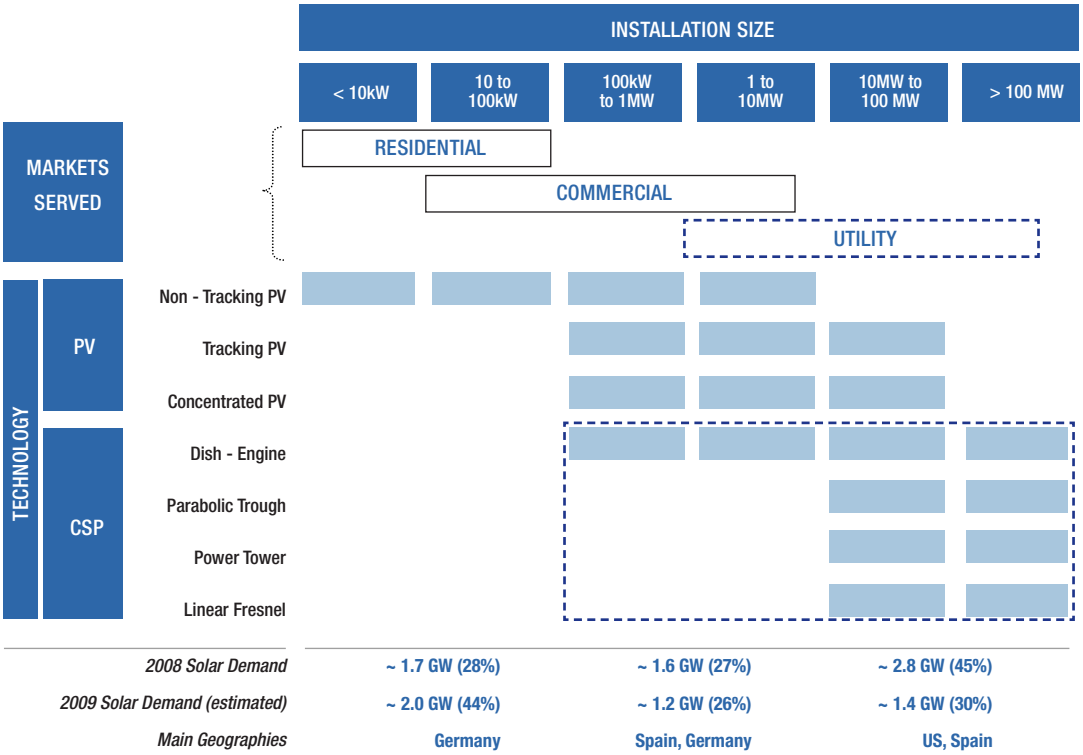
The opposite graphic provides an overview of the various sub-sectors within the global solar market and which technology is best suited to which application.

The chart below provides a pictorial description of the market demand in various jurisdictions over three stages of technology deployment. The third stage of unsubsidised demand occurs once grid parity has been achieved.

Solar Market Deployment



Barclays Capital Research



The next table details the areas in which China appears to have a manufacturing advantage over its competitors without considering silicon pricing as this is assumed to be the same regardless of panel manufacturing location. This logic indicates that China is likely to end up as the dominant panel manufacturing location.

China Silicon Advantage

Non Silicon Cost Overview

Non Silicon Cost Structure	China	Europe / U.S	Sustainable?	Notes
Cell to Module	**$0.35**	**$0.71**		
Direct Labor	$0.02	$0.14	Y	2,500RMB/mnth labor costs in China, $5K/mnth in U.S
CIF	$0.01	$0.03	N	
Factory Overhead	$0.01	$0.03	N	
Yield loss	$0.01	$0.01	N	
Materials	***$0.30***	***$0.50***		
EVA Backsheet	$0.10	$0.10	N	Same in both regions
Aluminium	$0.05	$0.10	N	Currently cheaper in China
Glass	$0.05	$0.10	N	Currently cheaper in China
Junclion Box	$0.10	$020	N	Currently cheaper in China if domestic boxes are used
Poly to Ingotl/Wafer	**$0.30**	**$0.30**		
Wafering	$0.21	$021	N	Same equipment/technology in both regions
Casting	$0.09	$0.09	N	Same equipment/technology in both regions
Wafer to Cell	**$0.25**	**$0.49**		
Consumables	$0.17	$0.17	N	$0.2 for metallization pastes, $0.05 for gases etc.
Direct Labor	$0.02	$0.14	Y	2,500 RMB/mnth labor costs in China, $5K/mth in U.S
Electricity	$0.03	$0.15	Maybe	
Yield loss	$0.02	$0.02	N	
Factory Overhead	$0.01	$0.01	N	
Total Cost (ex-depreciation)	**$0.90**	**$1.50**		
Depreciation	**$0.10**	**$0.30**		
Ingot/Wafer	$0.06	$0.18		
Cells	$0.03	$0.09		
Modufes	$0.01	$0.03		

Barclays Capital Research

US Market - Additional Information

Given the increasing importance of the US as a global player in renewable energy development and in particular solar PV some more findings on the US market are detailed below.

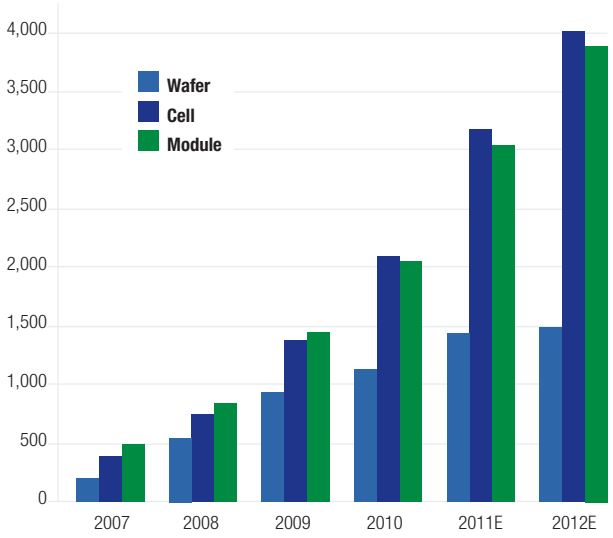
The passage of the ARRA has introduced significant incentives for PV manufacturers at the federal-level by way of the Advanced Energy Tax Credit, which is a 30 percent tax credit on the capital cost of equipment and that is set to be converted to a direct cash payment. The importance of the MTC, aside from reducing up-front capital costs will be its role in driving competitive domestic manufacturing economics by helping to lower cost spreads between U.S.-based manufacturers and manufacturers in "low cost" locations such as China, Taiwan and Malaysia that do not have to deal with labour rate floors and enjoy highly subsidized utility costs. In addition to this, the Obama administration's demonstrated urgency in mobilizing funds from the federal loan guarantee program will also benefit manufacturers.

At present, 18 U.S. states offer some form of incentive for PV manufacturing. Three major forms of incentives dominate: grants, loans, and tax credits or exemptions, although levels very significantly by state. There is a high degree of overlap between those states that offer PV manufacturing incentives and those that currently house or will be housing production facilities, although California - which has no explicit incentives for PV but will be the home of eight plants by 2012 - is a notable exception. The heftiest incentives are awarded in the form of tax credits, exemptions, and abatements, which require sufficient tax equity to be monetized. Overall, Oregon, Ohio, Michigan, and Pennsylvania stand out as having the best incentive packages.

Over and above the manufacturing incentives that have been passed into law and can be availed of by any firm, almost every PV facility in the U.S. has been able to cut one-off deals with state and local governments for packages that extend well beyond the bare minimum. This has especially been the case during 2009. These "sweeteners" include tax breaks, low-interest loans, low-cost land leases, infrastructure upgrades, and workforce training agreements that have run into the hundreds of millions of dollars.

The impact of "Buy American" provisions in the ARRA on solar manufacturing will depend on its exact interpretation. A softer interpretation requiring a fixed percentage of the cost of the module to come from U.S. raw materials and labour should not be a problem for U.S. thin-film manufacturers given their low feedstock costs and integrated manufacturing processes. In the case of crystalline silicon which has a larger value chain, it could be circumvented by using U.S. polysilicon and assembling modules domestically, spurring further investment in domestic module manufacturing by Asian and European firms. The ramifications of a more protectionist interpretation of the clause where all components and feedstocks would be required to be domestically produced could be severe given the globally interconnectivity of the PV supply chain, but such an extreme version is unlikely to be adopted.

Historical and Projected U.S PV Manufacturing Capacity (MW-dc)



Source: Greentech Media Research

The growth in domestic PV production should provide meaningful opportunities for their many suppliers by fuelling sizeable growth in material requirements, including feedstocks, glass, and encapsulants, as well as in manufacturing equipment. By 2012, the domestic PV industry could consume as much as 40 million m2 of glass, while the annual U.S. PV equipment market will stand at $952 million at this time.

A number of factors will influence the location of future manufacturing facilities. These include state incentives, power prices, the cost and availability of skilled labour, proximity to end-demand, and tax burdens. Oregon, Michigan, Arizona, Texas, Washington, and Ohio emerge as having the best overall collection of characteristics, and there is a high correlation between a state's overall performance on the above metrics and its existing manufacturing presence.

GreenTech Media highlights the following key findings:

U.S. cell and module capacity are estimated to grow at an annualized rate of 50 percent and 45 percent respectively from 2008 to 2012.

Thin film will continue to occupy a majority of production share in the U.S., constituting 2.69 GW, or 67 percent, of cell capacity by 2012.

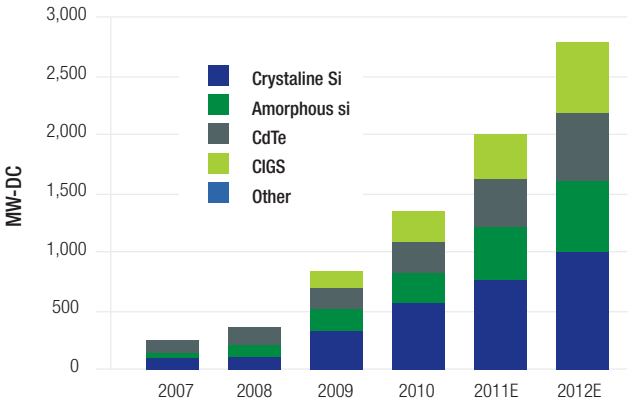
Production share in thin-film technologies will be shared relatively evenly between CdTe (18 percent), amorphous silicon (24 percent), and CIGS (22 percent).

A standout trend over the next half-decade will be the expected ramp up of CIGS capacity and production. U.S. CIGS potential or producible supply will grow from 132 MW in 2009 to 626 MW in 2012, although actual production will depend on market conditions and buyers' appetite for perceived technology risk.

At the same time, the build-out of crystalline silicon PV will also proceed at a strong pace over the next few years: crystalline silicon will still comprise the majority share for any one technology, at 35 percent of cell and module capacity by 2012.

More plants were announced in the first half of 2009 than in the previous three years combined, which serves as evidence of the gathering momentum for increasing PV plant construction in the U.S. and points to recent political and policy-related developments as a catalyst. A number of these will be owned by companies based in Europe and Asia, indicating growing interest from foreign manufacturers in entering the U.S. manufacturing market. In terms of value chain participation, there is a marked preference for building module assembly plants compared to wafer and cell facilities, which reflects the U.S.'s status as an anticipated leading end-market as opposed to a low-cost production location.

U.S. Producible Cell Output by Technology (MW-Dc)



Source: Greentech Media Research

Chinese Market - Additional Information

Greentech Media have made the following key findings regarding China:

- The structure of the electricity market in China does not allow for traditional grid parity economics for solar, at least in the near term. Base-load generation will continue to be dominated by coal, and natural gas will likely remain a non-existent generation source due to China's strategic use policy.

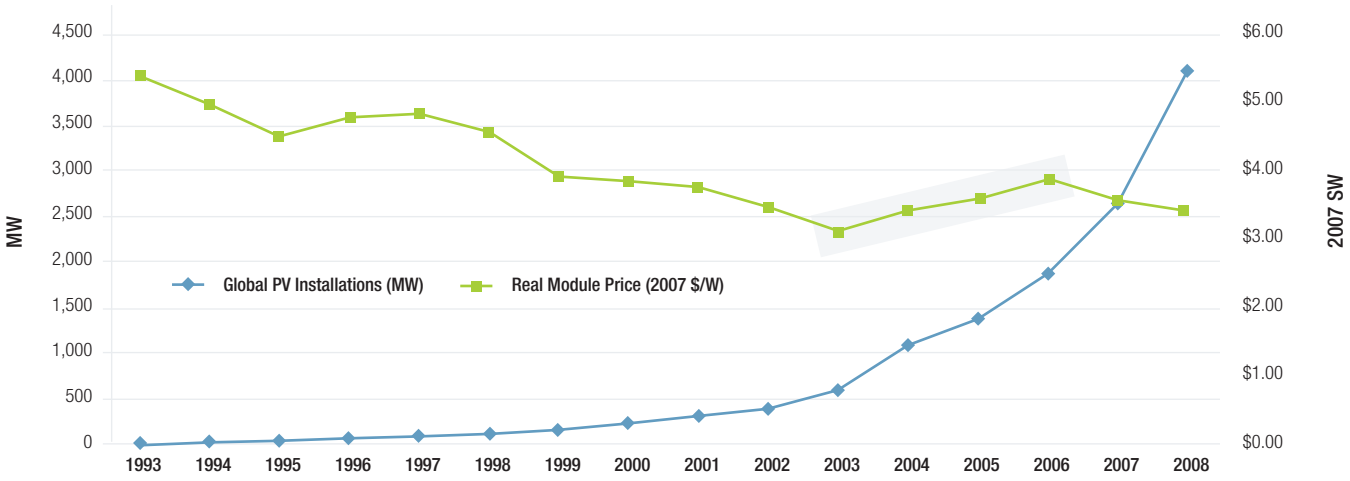
- Ultimately, the Chinese power sector wants solar electricity generation costs to approach those of wind and later coal. Because of the government's heavy involvement in the electricity sector, power projects do not have to be immediately profitable to be built. As evidenced in the wind sector, the Chinese government pushes for high amounts of installed capacity, with the long-term goal of bringing down high capital costs. This development model serves two goals: it supports domestic manufacturers and domestic economic growth, and it pushes installed capital costs of new technologies down to approach base-load capital cost.

- Local support (whether municipal or provincial) will push for project development with corresponding investment in manufacturing facilities as part of broader economic development plans. Provincial GDP growth is one of the key metrics by which Communist party leaders are measured, and so it is clearly in their interest to focus on provincial growth at the expense of any sort of cohesive national policy.

  This phenomenon will likely occur throughout the solar value chain, from domestic polysilicon production to module manufacturing. Manufacturers that have subsidiaries or invest in job creation/industry in a region will be preferred over unaffiliated companies.

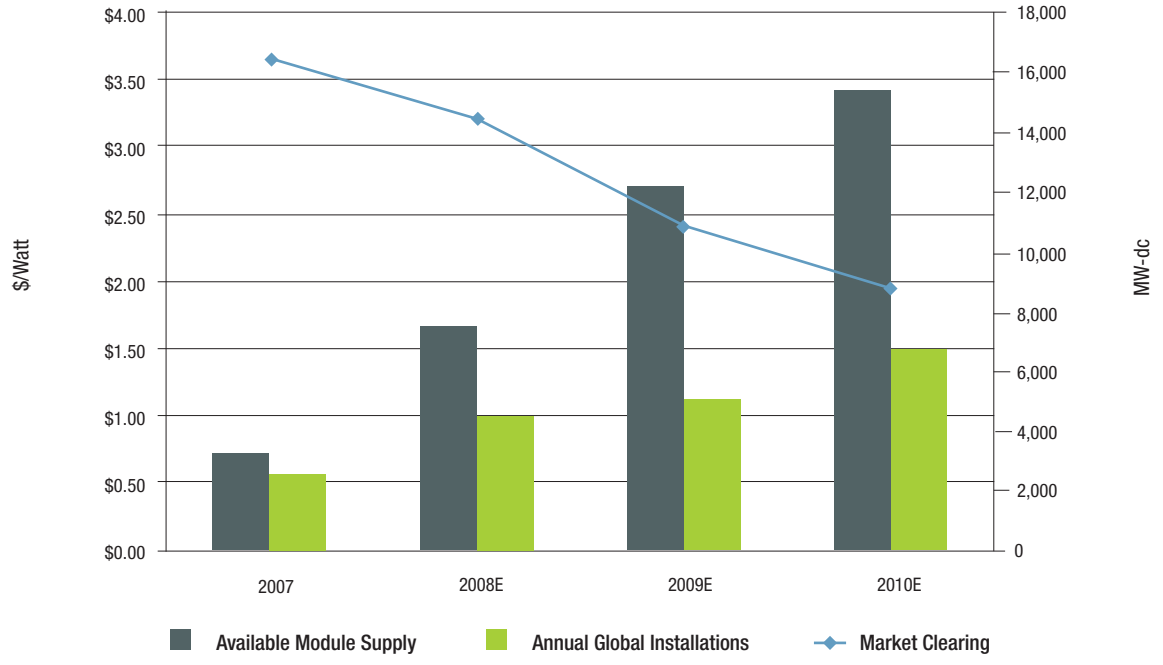
Global Market Forecasts

Real Module Prices and Annual Global PV Installations, 1993-2008



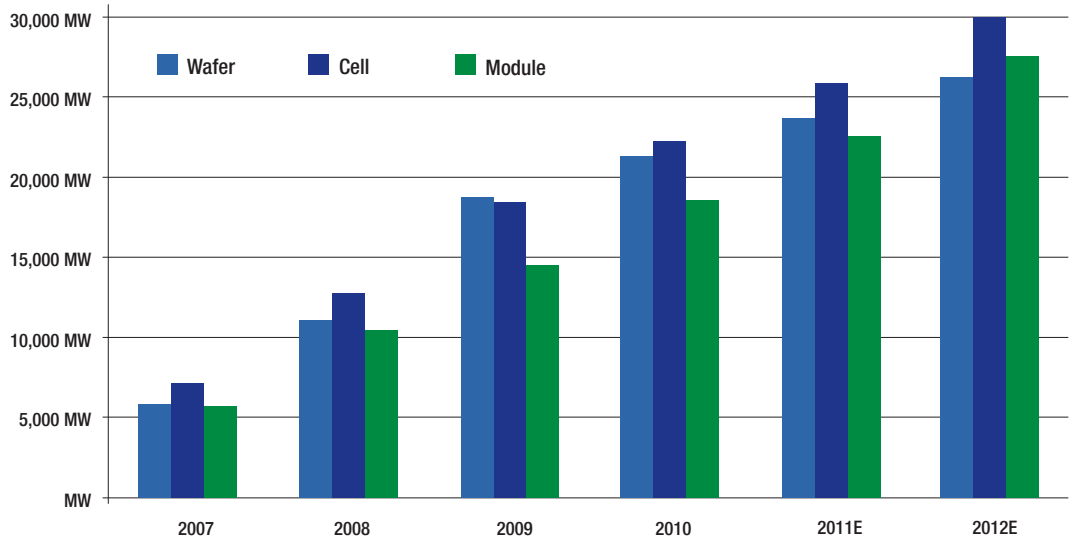
Source: Greentech Media Research

Market Clearing Module ASPs, Available Supply, & Annual PV Demand 2007 - 2010E



Source: Greentech Media Research

Historical & Projected Capacity - Wafer, Cells, Modules (MW)



Source: Greentech Media Research

Appendix 3

Australian CleanTech Profile

Australian CleanTech is a research and broking firm that provides advice to cleantech companies, financial institutions and governments at all levels. Through its work it provides a bridge between investors and the investment and regulatory requirements of cleantech projects. With extensive experience in both cleantech technology assessment and investment analysis, Australian CleanTech provides unique services that will facilitate and deliver successful Australian clean technology projects.

Research Database - Australian CleanTech has developed and maintains a database of global cleantech companies. The database contains company profiles of more than 1400 companies, over 350 of which are based in Australia. Each company is assessed on the basis of their technical, regulatory and commercial risk profiles.

ACT Australian Cleantech Index - Australian CleanTech publishes the ACT Australian Cleantech Index provides a measure of the performance of the Australian listed stocks in the cleantech sector. With over 75 companies following under the coverage of the index and with a combined market capitalisation of over $10Bn, the index presents for the first time a picture of the Australian cleantech industry's growth in a single measure.

Sydney and Adelaide Cleantech Networks - Australian CleanTech facilitates both the Sydney and Adelaide Cleantech Networks that provide opportunities for those involved with the cleantech sector to meet, learn and collaborate.

Investor Services - Project sourcing, technical assessment, investment management, delivering exit strategies, lobbying. Project Services – Development of growth strategies, sourcing funding, industry and technology research, strategic, project delivery, Intellectual Property protection strategies, securing and retaining the right people, securing Government grants, power, water and environmental credit purchase agreement negotiation, commercialising strategies, international expansion.

Government Services - policy development, policy impact analysis, economic development, facilitation of Industry Clusters, information dissemination

Recent Projects

Australian CleanTech has worked the following recent projects:

Growth Strategy – Australian CleanTech undertook a strategic review of the growth strategy of United Utilities and in particular developed scenarios for entry into other sectors and identified specific target acquisitions and projects.

Acquisition Searches - Australian CleanTech has performed acquisition searches and analysis for a private equity company and other corporations seeking to acquire cleantech companies. In particular there has been a focus water companies and technologies.Tender Management – Australian CleanTech worked for United Utilities Australia leading its tender preparation for a wastewater treatment and recycling project in Victoria.

Government Advice – Australian CleanTech has provided advice to state and local Governments on investment attraction and future skills and training requirements in the cleantech sector. Current projects include:

- Advising DFEEST on future workforce skills and assisting the department to undertake a strategic review of TAFE courses to build in the flexibility to prepare for future technology scenarios.
- Working for DTED and Flinders University on the preparation of a South Australian Cleantech Sector Capability and Capacity Study which will involve a survey of all South Australian cleantech companies.

Solar Technology and Opportunity Review – for an oil and gas company seeking to invest in large scale solar projects.

Coal Bed Methane Review – for a large French energy company seeking to invest in the Australia.

Cleantech Projects – Australian CleanTech is providing consulting services to companies seeking commercialisation, expansion and project finance. In addition, Australian CleanTech has provided the services including strategic consulting, corporate structuring, grant submission preparation, power and environmental credit purchase agreement facilitation, funding documentation preparation, financial modeling and introductions to potential investors. Clients include:

- A 180MW solar thermal and natural gas fired power station that includes a scalable desalination plant and brine capture and harvesting. The advisory role will be ongoing with a board position;
- A multiple wind farm development that utilises an innovative vertically integrated business model involving community financing and participation. The advisory role will be ongoing with a board position;
- Technology companies involved with biofuels, energy efficiency, geothermal energy, water treatment, desalination and nanotechnologies.

Events - Australian CleanTech has conceived and launched Australia's first cleantech network, the Adelaide Cleantech Network that will bring together cleantech companies seeking seed, expansion or exit capital with equity and debt financiers wanting to invest in this emerging sector. The Sydney Cleantech Network was launched in September 2009 in partnership with the ASX, Macquarie Group, KPMG, Clayton Utz and New Energy Finance.

Environmental Water – Australian CleanTech conceived and is currently developing a collaboration of both commercial and non-profit organisations that will enable individuals and companies to invest in environmental water to be able to claim to be 'Water Neutral'.

CleanFutures – Australian CleanTech conceived and is developing a joint venture to commercialise a number of nanotechnologies that is has secured from NanoVentures Australia. The technologies include a biosensor used for the real time detection of phosphate and nitrates in environmental waters, a water treatment technology and nano-composite materials.

John O'Brien

BA(Oxon), MSc, MBA, GAICD, CPEng MIEAust

John is the founder and Managing Director of Australian CleanTech and has advised numerous organizations on their options with respect to securing or making cleantech investments. He has also launched the ACT Australian CleanTech Index that tracks the performance of Australia's listed Cleantech companies, is facilitating the Sydney and Adelaide Cleantech Networks, is on the board of three unlisted cleantech start-ups, edited the book, Opportunities Beyond Carbon, is a regular media commentator and is a member of the South Australian Premier's Climate Change Council.

John previously worked for Origin Energy on growth, strategy and M&A projects in addition to being the founding secretary of the company's Operational Risk Committee. He specialized in reviewing and filtering clean energy and water industry opportunities. Through the combination and interaction of these sectors he became interested in the emerging cleantech sector and in 2004 started developing the plans for a cleantech business.

He has engineering degrees from the University of Oxford and Trinity College, Dublin and an MBA from the University of Adelaide. He has completed the AICD's Company Directors Course, is a chartered engineer with the Institute of Engineers Australia and is a member of the Australian Water Association and Responsible Investment Association of Australia.

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