Solar panel buyers guide

There are many solar panels on the market, but which one is suitable for your needs? Lance Turner takes a look at the options.

This buyers guide covers photovoltaic panels, which produce electricity directly from sunlight to power houses (on and off the mains grid), water pumps, and remote communications systems.

In its most common form, a solar panel consists of a number of photovoltaic cells connected together. These cells are usually coated in a plastic such as ethylene vinyl acetate (EVA) and sandwiched between layers of glass and/or plastic, or sometimes plastic and metal. The collection of cells is usually surrounded by a metal or plastic frame for strength and to allow easy mounting of the panel. A junction box is often mounted on the back of the panel to allow easy electrical connection, though some panels have flying leads for connection.

Where glass is used as a covering for solar panels, it is usually low-iron glass, to allow as much light transmission as possible, thus maximising power output.

Many panels have glass on the front and a plastic, such as Tedlar, on the back to seal the panel. There are also panels that are designed to replace windows and other glass panels in architectural uses, and they may have glass on both sides of the cells, depending on their intended use. This allows the home owner to offset some of the cost of the solar panels, as the panels themselves double as building materials. The PV Solar Energy roof tiles and some of the ASI series panels from RWE Schott Solar fall into this category.

PV applications

Most other solar panels are designed to be mounted on external frames, themselves mounted to a building's roof or other frame, such as a solar tracker, but there are also flexible stick-on panels that can simply be stuck to suitable roofs or structures.

The different technologies

There are three common types of solar cells: monocrystalline, polycrystalline and thin film.

Both mono and polycrystalline cells are made from wafers cut from blocks of silicon, which are then modified by a process known as 'doping'. This involves heating the cells in the presence of boron and phosphorus, which changes the structure of the silicon in such a way as to make it a semiconductor. This is the same method which is used to make computer chips.

Once the wafers have been doped, they then have a fine array of electrically conductive current-collecting wires applied to each side of them.

Thin film technology uses a different technique, and involves the deposition of layers of different materials directly onto metal or glass. The most common thin-film panels are the amorphous silicon type, which are found everywhere from watches and calculators right through to large mains-grid connected PV arrays.

Flexible panels are a spinoff of amorphous technology. These are manufactured on a plastic or thin metal substrate and can be rolled up or attached to curved surfaces. They are commonly used for camping and boating, but are generally quite expensive on a dollar-per-watt basis, although larger ones designed for mounting on buildings are competitive with conventional rigid panels.

As far as material use is concerned, crystalline panels use a great deal more semiconductor material than an equivalent output thin film panel. This is because a lot of material is lost in the process of cutting the silicon boule or billet into slices (wafers). The cutting is done with a diamond saw, which may well have a blade thicker than the resulting wafers, so more than half of the silicon may be lost in this process.

Amorphous panels don't have this problem and so may use less than 1% of the semiconductor material as a crystalline panel. An example is the Kaneka thin film modules. These have an active material thickness of just 0.3 micrometres. Compared to a typical crystalline cell thickness of 100 to 200µM, this is as little as 1/600th of the silicon, and that doesn't take into account the silicon wasted by the cutting process for crystalline cells.

Why is silicon use such an issue? There are two reasons. The first is the embodied energy of the silicon—it takes a lot of energy to make the highly-purified silicon used in solar panels. The second is the fact that high-grade silicon suitable for this sort of use is often in short supply due to the demand for it in both solar cells and integrated circuits, which keeps the price higher than it should be. The miniscule amount of silicon used in thin film panels should allow them to be more cost effective, and you have to wonder why this isn't the case at the moment, although the high demand for solar panels in general most likely has a lot to do with it!

Panel ratings

There are a number of different ratings on solar panels, so let's have a look at what they are and what they mean.

Rated (peak) power: This is the maximum sustained power output of the panel, assuming a level of insolation (strength of light falling on the panel) of one kilowatt per square metre. In general, the solar panel's rating is the rated peak power.

Nominal voltage (Vn): The system voltage that the panel is designed to be used in. A 12 volt panel is designed for a 12 volt system, but will produce voltages well above 12 volts. Some panels can be rewired to suit six or 24 volt systems. Other panels are designed for

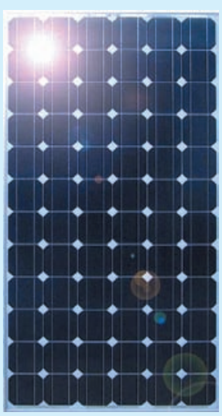
Solar panel types

There are three common technologies used in solar panels, all of which are based on the common element silicon, which makes up a large proportion of the earth. Note that the panels below are not shown to scale.

Monocrystalline cells are made from a thin slice or wafer cut from a single large crystal of silicon. The cells are then doped and the fine current collecting wires printed on or in the surface of the cell.

Generally monocrystalline cells have the highest efficiency, but this comes at a price. This type of cell takes more energy to make than any other, and so has a greater energy payback period, though this is usually still within five years.

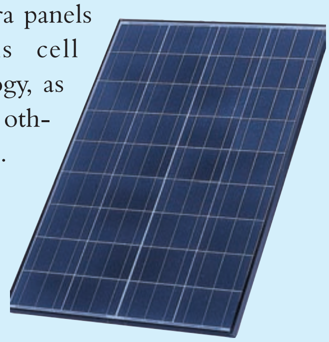
A number of manufacturers make monocrystalline panels, including BP Solar and Sharp Solar.



Polycrystalline cells are made from thin wafers of silicon cut from a large cast billet. The billet is not a large single crystal, but many crystals clumped together, hence the name.

Polycrystalline cells are usually slightly less efficient than moncrystalline cells, but because they are square, can be fitted into the rectangular frame of a solar panel with high space efficiency, although polycrystalline panels are still slightly larger than monocrystalline panels of the same rating. Polycrystalline cells must also have current collecting grids printed onto them.

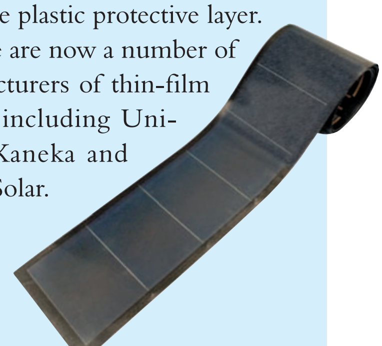
Kyocera panels use this cell technology, as do many other panels.



Amorphous/thin film panels involve deposition of very thin films of silicon or other materials directly onto a substrate such as glass or stainless steel. This technique produces a cell with a lower efficiency than the cut wafer varieties, but has the advantage of eliminating the need for inter-cell connections.

Uni-Solar makes triple-junction, nine-layer thin-film amorphous panels with a much higher efficiency than the older types. The layers of silicon are deposited directly onto a stainless steel substrate and are then coated in a flexible plastic protective layer.

There are now a number of manufacturers of thin-film panels, including Uni-Solar, Kaneka and Schott Solar.



grid-interactive systems, and have nominal outputs of 48 volts or even higher.

Voltage at peak power (Vp): This is the voltage measured across the panel when the panel is producing peak power.

Current at maximum power (Im): The maximum current available from the panel at peak power.

Open circuit voltage (Voc): The maximum voltage available from the panel with no load attached. This is usually around 21 volts for a 36 cell, 12 volt unit.

Short circuit current (Isc): The current obtained when the output of the panel is short circuited with an insolation level of 1000 watts per square metre at a panel temperature of 25°C.

Temperature at rated power: This is the temperature that the solar panel manufacturer rates their panels at. Most panels are rated to put out their maximum power at 25°C, which is a rather unrealistic figure given that the panel temperature under typical Australian conditions can be up to 70°C. Figure 1 shows how cell temperature affects power output for crystalline panels.

Current-voltage (IV) curves: These are graphs of output voltage versus current for different levels of insolation and temperature. They can tell you a lot about a panel's ability to cope with temperature increases, as well as performance on overcast days. Examples of IV curves can be seen in Figure 1.

Obviously, the most important ratings when doing calculations for a power system are the voltage and current at maximum power. A system is rarely calculated using panel wattage ratings, as this is a function of both the voltage and current. Some panels are rated at slightly higher or lower voltages than others, and this affects the amount of current available.

The open circuit voltage and short circuit current ratings are important from a safety point of view, especially the voltage rating. An array of six panels in series, while having a nominal 72 volt rating, can output over 120 volts DC—more than enough to be dangerous.

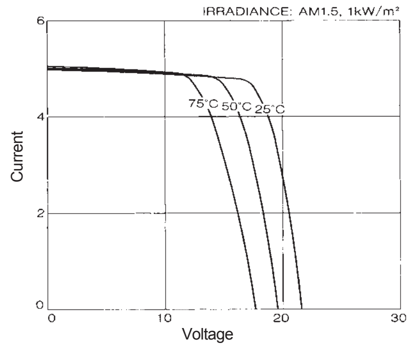


Figure 1. These curves, for a typical 80 watt polycrystalline panel, show how power output is affected by increasing temperature. This needs to be taken into account when buying panels.

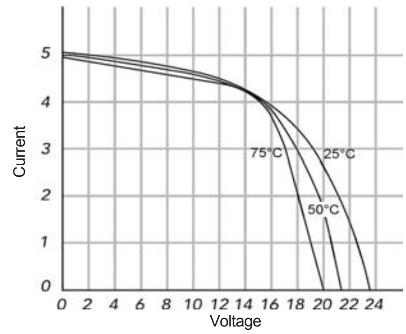


Figure 2. The IV curves for a 64 watt amorphous panel. Note how the maximum power point at the knee of the curves barely moves with increasing temperature.

Self-regulating panels

There has been much debate about self-regulating panels over the years. Self-regulating panels have fewer cells, and hence less output voltage, than normal ones—typically 32 cells instead of the 36 found in most 12 volt panels. Basically, a self-regulating panel will not give the performance under all conditions that a panel with higher voltage will.

A self-regulating panel will often not have enough voltage to allow for drops in the wiring and regulator, so they rarely run at their peak power point. Also, because of their reduced voltage, performance will suffer on overcast days.

Some manufacturers claim that no regulator is required with these panels. This is wrong in most cases, as even a self-regulating panel can bring a battery voltage up to 17 volts or so, which is clearly overcharging it. The only situation where you may be able to use a self-regulating panel without a regulator is when it is attached to a large battery and is only being used to keep the battery topped up.

Heat and shading

These are two factors that can greatly affect solar panel performance. In general, solar panel performance decreases as temperature increases, and a panel rated at 25°C will not perform as well when operating at the temperatures experienced in most parts of Australia. A typical operating temperature in summer can be up to 60°C or higher.

Some companies also supply ratings for temperatures higher than 25°C, so check to see whether these are available. Also bear in mind that, generally, thin film panels perform better when hot than crystalline panels do, and in many cases a thin film panel will perform as well or better than a crystalline panel which is rated at up to 10% higher wattage. For example, a Uni-Solar 64 watt panel will often perform as well as a 70 watt crystalline unit on an 'overall energy produced per year' basis.

Shading affects different panels in different ways. The reduction in performance of the crystalline panel types, even when a single cell from a panel is shaded, is quite considerable.

Amorphous panels often perform somewhat better, especially panels which have bypass diodes built into each cell. Also, because amorphous panels usually have cells that are long and thin, they are less likely to have individual cells fully shaded by birds and debris buildup.

However, shade falling on the panels should be eliminated if at all possible—there is not much point investing large amounts of money in power generating equipment if you don't allow it to do its job!

Embodied energy

This is the amount of energy required to produce the panel in the first place and includes all energy used to make every part of the panel, including cells, frame, cable or junction box and assembly. Some panels, especially the thin-film units, will repay their energy 'debt' within a year or two, while others, especially monocrystalline panels, take a lot longer—up to five or six years. However, all panels on the market will produce more energy than they use over their lifetime, if installed and used correctly.

What to look for

You need to buy a panel that has the correct ratings in both voltage and current, with consideration given to their performance as determined by their IV curve. You also need to look for a few other things when buying, such as construction quality, frame type and panel shape and weight. Some panels may be more suited to your roof shape than others, especially when used on small buildings such as sheds or outdoor toilets.

Panel quality is very important. Many of the small amorphous panels manufactured in Asia are of variable quality—some last many years, others die a quick death—so be wary of these.

Any solar panel worth buying will come with quite a long warranty. If the manufacturer doesn't have enough faith in their product to offer a good warranty, then why would you buy it? Most panels come with a warranty of at least five years, and some warranties are up to 25 years. We have chosen not to include any panel with less than a two-year warranty in this guide.

Warranties come in different forms. Some are just a power output warranty but don't cover things like construction quality, while others are a bit more comprehensive. Ask questions before you hand over any money.

Another factor is whether the panels are made locally. As far as we know, BP Solar, Conergy and PV Solar Energy are currently the only local solar panel manufacturers. Origin Energy is working on their Sliver cells, but they are not yet available.

About the table

The table in this article lists all of the panels suitable for solar power systems that we were able to find. It includes all of the important information, including maximum power voltage and current (usually rated at 25°C) cell type, and panel construction and dimensions, including weight. Also included are recommended retail prices including GST, and the cost of each panel in dollars per watt. However, prices should be taken with a grain of salt. Many dealers will offer panels at lower cost, so don't settle for the first price you are given—ring around! ✯

About this buyers guide

ReNew buyers guides are intended to provide general information about the types of devices available on the Australian market. They are not intended to be a Choice magazine style testing review of each device, as we do not have the resources to test each make and model available.

ReNew does not endorse any particular device over other similar units, and the appearance of information and photos of particular products should not be seen as a promotion of that device over any other.

Brand (made in)	Model	Rated power (watts)	Voltage at max power	Current at max power	Cell type	Cell temp at which maximum power is tested at	Construction	Size (L x W x T)	Weight (kg)	Warranty (years)	RRP Inc GST ($)	Cost per Watt ($)	Time to recover embodied energy (years)	Rated lifetime (years)	Comments
BP Solar (Hong Kong) BP Solar Australia ph:1800 802 762 www.bpsolar.com.au	HX 2M	2	16	0.135	Polycrystalline	25, corrected	Glass, EVA, Polyester	275 x 145 x 23	0.5	12, 2	103.00	51.50	2 to 4 for complete system, less for module only	25+	Envirocashback of 50 cents per watt available on all systems greater than 115W in power. Ask your BP Solar retailer for details and pricing.
	HX5M 6V	5	16.5	0.57				269 x 251 x 23	0.8		147.00	29.40			
	SX305M	5	16.5	0.3				269 x 251 x 23	0.8		126.00	25.20			
	SX310M	10	16.8	0.6				421 x 269 x 23	1.5		183.00	18.30			
	HX10M 6V	10	16.8	0.6				421 x 269 x 23	1.6		225.00	22.50			
	SX320M	20	16.8	1.2				501 x 421 x 23	2.5		304.00	15.20			
	SX320J	20	16.8	1.2				502 x 424 x 50	3		304.00	15.20			
	SX330J	30	16.8	1.8				594 x 502 x 50	3.9		378.00	12.60			
	BP 340J	40	17.3	2.3				655 x 537 x 50	5.75	25, 12, 5	488.00	12.20			
	BP 350J	50	17.3	2.9				839 x 537 x 50	6		572.00	11.44			
	BP 365J	65	17.6	3.7				1111 x 502 x 50	7.2		740.00	11.38			
BP Solar (Australia) BP Solar Australia ph:1800 802 762 www.bpsolar.com.au	BP 380J	80	17.6	4.55				1209 x 537 x 50	7.7		840.00	10.50			
	BP 3125J	125	17.3	7.23				1510 x 674 x 50	12		1295.00	10.36			
	BP 3125S	125	17.3	7.23				1510 x 674 x 50	12		1295.00	10.36			
	BP 3165S	165	35.1	4.6				1593 x 790 x 50	15.4		1639.00	9.93			
	BP 3165J	165	35.1	4.6				1593 x 790 x 50	15.4		1639.00	9.93			

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Conergy (Australia) **Conergy Pty Ltd** **ph:1300 551 303** **www.conergy.com.au**	Solar-Port SP100-12	100	17	6	Polycrystalline	25	EVA embedded cells, tempered glass, satin finished marine grade aluminium	1080 x 870 x 35 (open) 565 x 870 x 75 (closed)	15	5	1430.00	14.30			Portable solar power suitcase.
Conergy (China) **Conergy Pty Ltd** **ph:1300 551 303** **www.conergy.com.au**	JM 030	30	18	1.77	Polycrystalline	25	EVA embedded cells, tempered glass, aluminium frame	666 x 412 x 33	3.6	25, 12, 5	374.00	12.46			Fly lead.
	Q 130 MI	130	17.5	7.43	Monocrystalline			1482 x 676 x 35	12		1430.00	11			MC IV connection.
	S 170 M	170	35.6	4.8				1580 x 808 x 35	15.5		1782.00	10.5			
	SC 170 MA	170	35.5	4.79				1575 x 826 x 46	16.3	25, 5	1782.00	10.5			MC III connection.
	S 175 M	175	35.8	4.9				1580 x 808 x 35	15.5	25, 12, 5	1804.00	10.3			MC IV connection.
	SC 175 MA	175	36	4.86				1575 x 826 x 46	16.3	25, 5	1804.00	10.3			MC III connection.
Conergy (India) **Conergy Pty Ltd** **ph:1300 551 303** **www.conergy.com.au**	Q 5 P	5	16.5	0.31	Polycrystalline	25	EVA embedded cells, tempered glass, anti-reflective coating, aluminium frame	300 x 185 x 22	0.7	25, 10, 5	77.00	15.4			J Box connection.
	Q 10 P	10	16.5	0.91				385 x 340 x 22	2.2		148.50	14.85			
	Q 20 PA	20	16.5	1.22				500 x 340 x 22	2		264.00	13.2			
Conergy (Japan) **Conergy Pty Ltd** **ph:1300 551 303** **www.conergy.com.au**	C 125 PI	125	17.2	7.3	Polycrystalline	25	EVA embedded cells, tempered glass, anti-reflective coating, aluminium frame	1499 x 662 x 46	14	25, 2	1375.00	11			MC III connection.
	C 167 P	167	34.6	4.83				1575 x 826 x 46	17		1749.00	10.4			
	C 175 M	175	35.4	4.95	Monocrystalline			1575 x 826 x 46	17		1804.00	10.3			
GE Energy (USA) **Solar Sales Pty Ltd** **ph:(08) 9477 5888** **sales@solarsales.com.au** **www.solarsales.com.au**	GEPV-200	200	27.1	7.4	Polycrystalline	25	Glass, EVA, Tedlar	1485 x 981 x 35	17.7	25	1732.00	8.66			
	GEPVc-170-ms	170	36.5	4.65	Monocrystalline			1588 x 796 x 35	14.6		1470.00	8.65			
	GEPV85	85	18.4	4.8				1201 x 483 x 35	8.2		972.00	11.44			
Jaiwei (China) **Solar Sales Pty Ltd** **ph:(08) 9477 5888** **sales@solarsales.com.au** **www.solarsales.com.au**	JW-GO100	10	16.5	0.61	Polycrystalline	25	Glass, EVA, Tedlar	435x265x26	20.6	25	$80.00	8.00			
	JW-G1700	170	36.5	4.41	Monocrystalline	25	Glass, EVA, Tedlar	1576x798x35	16.5	25	$1,250.00	7.35			IEC 61215.
Kaneka **(Japan)** **Solar Shop** **155 Payneham Road** **St Peters SA 5059** **ph:(08) 8362 9992** **sa@solarshop.com.au** **www.solarshop.com.au**	GEB	60	67	0.9	Amorphous		5mm glass/Tedlar/ aluminium frame	950 x 960 x 40	13.9	25	583.00	9.72	1.6	Same as for crystalline	Rated at +10%/-5%. Better temperature coefficient than crystalline. Excellent shade tolerance.
	PLC	13	16.5	0.79				495 x 465 x 38	2.9	10	180.00	13.85			Electric fences, gates, pond pumps, automotive battery maintenance, etc.
	PLD	26	16.5	1.58				950 x 465 x 38	5.5		300.00	11.54			A good panel for telemetry and irrigation systems.
	PLE	50	16.5	3.03				952 x 920 x 38	13.5		565.00	11.30			Good for campers and boaters.
Kyocera Solar (Japan) **Kyocera Solar** **www.kyocerasolar.com.au**	KC200GT	200	32.9	8.21	Polycrystalline	25	Cells are encapsulated between tempered glass cover and an EVA pottant with back sheet.	1425 x 990 x 36	18.5	20	2171.00	10.86	<1.5 years when installed in Japan. Less in Australia.	25+	Grid tie module.
	KC175GT	175	29.2	8.09				1290 x 990 x 36	16		1900.00	10.86			
	KC130GT	130	21.9	8.02				1425 x 652 x 36	12.2		1411.00	10.85			
	KC130TM	130	21.9	8.02				1452 x 652 x 56	11.9		1411.00	10.85			
	KC85T	87	21.7	5.34				1007 x 652 x 56	8.3		992.00	11.40			
	KC65T	65	21.7	3.99				751 x 652 x 56	6		774.00	11.91			
	KC50T	50	21.7	3.31				640 x 652 x 54	5		596.00	11.92			
	KC40T	43	21.7	2.65				526 x 652 x 54	4.5		528.00	12.28			
Mitsubishi Heavy Ind. (Japan) **Ecosouth Solar Electricity** **ph:(08) 8371 5655** **info@ecosouth.com.au** **www.ecosouth.com.au**	MA-100	100	108	0.93	Amorphous	25	Glass, EVA, Tedlar	1412 x 1112 x 35	21	20	785.00	7.85	2.1	30+	Four parallel fly-leads for connection. Grid-connect. Stand-alone supply with suitable regulator.
Powertech (China) **Jaycar Electronics** **ph:1800 022 888** **techstore@jaycar.com.au** **www.jaycar.com.au**	ZM-9073	10	21	0.66	Polycrystaline		Aluminium frame with tempered glass.	406 x 286 x 23	1.5	20 year performance	149.00	$14.90	Variable - Depends on climate and usage	25+	-
	ZM-9074	20		1.4				651 x 296 x 23	2.4		$239.00	$11.95			
	ZM-9076	65		4.7				1217 x 546 x 35	8.5		$549.00	$8.45			
	ZM-9078	80	21.6	4.9				1217 x 546 x 35	8.5		$699.00	$8.74			
	ZM-9079	120	22.2	7.37				1494 x 678 x 35	12		$1,050.00	$8.75			
PV Solar Tile (Australia) **ph:(02) 9558 0512** **info@pvsolar.com.au** **www.pvsolartiles.com**	PVST 167	167	34	4.9	Poly	~50	Powder coated aluminium, Santoprene sealing and UV resistant plastic.	~1600 x 870 x 15	18	Manufacturers warranty on PV component. Frame warranty 15 years	POA	-	2-3 years	30+	Available with a range of PV brands and sizes – see web site.
	PVST 175	175	34	5.15	Mono										
	PVST 85	85	17	5				~1200 x 600 x 15	9						

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SCHOTT Solar (Germany) SCHOTT Australia Pty Ltd Unit 1, 9 Rodborough Road NSW 2086, Frenchs Forest Ph:(02) 8426 1607 www.schott.com/solar and Going Solar ph:(03) 9348 1000 retail@goingsolar.com.au www.goingsolar.com.au	ASE-165-GT-FT/MC	170	36	4.71	Polycrystalline	47	Glass, Tedlar, aluminium frame, thermoplastic cell embedding	1620 x 810 x 50	15.5	25	1500.00	8.82	4.7	25+	
	ASE-165-GT-FT/MCI	169	36	4.7		NA					1491.00	8.82			New product with MAIN isotext cells (MCI), available from October 2007. Specifications subject to change with increased performance, evaluation of NOCT in progress.
	ASE-165-GT-FT/MCI	173	36	4.81							1526.00	8.82			
	ASE-220-GT-FT/MCI	≈220	≈30	≈7.33	Polycrystalline	NA	Glass, Tedlar, aluminium frame, thermoplastic cell embedding	1685 x 993 x 50	≈20	25	1940.00	8.82	4.7	25+	As above, but available from April 2008.
	ASE-260-DG-FT	260	57.1	4.55	Polycrystalline (EFG)			1605 x 1336 x 50			2314.00				Double-glass modules, using energy-saving cell manufacturing technology.
	ASE-260-DG-FT	268	57.2	4.69							2385.00				
	ASE-275-DG-FT/MC	275	59.1	4.65	Polycrystalline	45	Double-glass, aluminium frame.	1605 x 1336 x 50.8	41	25	2450.00	8.91	4.7	25+	Suitable for ground-based arrays in tough environments.
	ASE-275-DG-FT/MC	285	59.7	4.77							2540.00				
	ASE-300-DG-FT/MCI	≈300	≈40	≈7.33	Polycrystalline	NA	Double-glass module	1685 x 1313 x 50	≈42	25	≈2700.00	8.91	3.7	25+	New product, available from August 2008. Specifications subject to change with increased performance, evaluation of NOCT in progress.
	ASI-F 32/12	39.3/32.2	16.8	1.92	Amorphous thin-film	49	Encapsulated, framed	1005 x 605 x 34	6.2	20	300.00	9.32	2.5	20+	Wp indicated is initial/stabilised.
	ASI-F 90	106/86	17.8/16.8	5.9/5.12		NA		1108 x 1308 x 50	19		780.00	9.06			Evaluation of initial power and NOCT in progress.
	ASITHRU-30-SG	33/27	36	0.75	Amorphous thin-film	49	Double glass with PVB foil	1000 x 600 x 10/22	14	20	430.00	15.92	2.5	20+	Wp indicated is initial/stabilised.Thickness of module is without/with connector button.
	ASIOPAK-30-SG	39.3/32.2		0.89				1000 x 600 x 10/22	14		390.00	12.11			
	ASIOPAK-1-L	35/29	68	0.43	Amorphous thin-film	49	Laminate	1027 x 627 x 17	27	20	Prices on application.		2.5	20+	These products are building-integrated photovoltaics on architectural glass. ASI-Glass is available in a range of specifications, dimensions and designs. Used for external façade and overhead glazing.
	ASITHRU-1-L	31/25		0.37				1027 x 627 x 17	27						
	ASITHRU-1-IO	31/25		0.37			Double glazing	1018 x 624 x 34	29						
	ASIOPAK-2-L	71/58		0.85			Laminate	1027 x 1204 x 17	54						
	ASITHRU-2-L	61/50		0.74				1027 x 1204 x 17	54						
	ASITHRU-2-IO	61/50		0.74			Double glazing	1018 x 1201 x 34	57						
	ASIOPAK-3-L	106/87		1.28			Laminate	1027 x 1781 x 17	80						
	ASITHRU-3-L	92/75		1.11				1027 x 1781 x 17	80						
	ASITHRU-3-IO	92/75		1.11			Double glazing	1018 x 1777x34	84						
	ASIOPAK-4-L	141/116		1.71			Laminate	1027 x 2358 x 17	106						
	ASITHRU-4-L	122/100		1.48				1027 x 2358 x 17	106						
	ASITHRU-4-IO	122/100		1.48			Double glazing	1018 x 2354 x 34	112						
	ASIOPAK-4x-L	140/114	72	1.59			Laminate	1204 x 2004 x 17	105						
	ASITHRU-4x-L	117/96		1.33				1204 x 2004 x 17	105						
	ASITHRU-4x-IO	117/96		1.33			Double glazing	1195 x 2001 x 34	112						
Sharp (Japan) Sharp Australia ph:1300 13 55 30 www.sharp.net.au	NTR5E3E	175	35.4	4.95	Monocrystalline	25	Tempered glass laminate, box section aluminium frame. Lead wire with MC connectors.	1575 x 826 x 46	17	25	1490.00	8.51			13.5% module efficiency. Lead wire with MC connector. PET backing sheet.
	NEQ7E3E	167	34.6	4.77	Polycrystalline			1575 x 826 x 46							
	NDL3EJE	123	17.2	7.16			As above with junction box.	1499 x 662 x 46							
	NE80EJE	80	17.1	4.67				1200 x 537 x 46	9.5		720.00	9.00			12.6% module conversion efficiency. Nominal 12 volt output. Fitted with junction box. PET backing sheet.
SunPower (China) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	SPR-090	90	17.7	5.1	Monocrystalline	25	Glass/Tedlar.	1038 x 527 x 46	7.4	25	1083.00	12.03	-	40	Area efficiency of 16.5%.
	SPR-200	200	40	5				1559 x 798 x 46	16		2463.00	12.32			Area efficiency of 16.1%. All black.
	SPR-210	210	40	5.25				1559 x 798 x 46	16		2498.00	11.90			Area efficiency of 16.9%.
Suntech (China) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	STP010s-12	10	17.2	0.58	Monocrystalline	25	Glass, EVA, Tedlar	310 x 368 x 18	1.5	25	155.10	15.51	-	-	-
	STP020s-12	20	16.8	1.19				656 x 306 x 18	2.5		282.70	14.14			
	STP040S-12	40	17.2	2.32				537 x 665 x 30	4.5		536.80	13.42			
	STP060-12	60	17.4	3.45				771 x 665 x 30	6.2		790.90	13.18			
Uni-Solar (USA) ARRID Ph: 1300 663 563 sales@arrid.com.au www.arrid.com.au	US-5	5	16.5	0.3	Amorphous	25	Framed module.	491 x 206 x 47	1.1	10	119.00	23.80	1.5	20	Non glass construction, virtually unbreakable. Better hot weather performance compared to crystaline modules.
	US-11	10.3	16.5	0.62				491 x 383 x 47	1.6		219.00	21.26	1.5	20	Ideal for battery charging. Bypass diodes between each cell to enhance performance in part shade. Better hot weather performance compared to crystalline modules.
	US-64	64	16.5	3.88				1366 x 741 x 47	9.2		640.00	10.00	1.5	40	
	ES-62T	62	15	4.1				1258 x 793 x 39	10.9		700.00	11.29	1.5	40	Ideal as grid interactive panels supplied with quick connections. Fewer cells than US series.
	ES-124	124	30	4.1				2459 x 793 x 32	20.5		1250.00	10.08	1.5	40	
	PVL-68	68	16.5	4.13			Adhesive laminate.	2849 x 394 x 2.5	4.1	20	700.00	10.29	1.5	40	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules. Must be applied by Uni-Solar approved installation technician.
	PVL-136	136	33	4.13				5486 x 394 x 2.5	7.7		1290.00	9.49	1.5	40	
	UNI-PAC 10 12V	10.5	17.6	0.6			Cells sewn into nylon fabric.	1168 x 495 x 2.5	0.95	5	690.00	65.71	1.5	8	Non glass construction, virtually unbreakable. Better hot weather performance compared to other modules.
	UNI-PAC 10 24V	10.5	35.2	0.3				1168 x 495 x 2.5	0.95		690.00	65.71	1.5	8	
	UNI-PAC15	15.8	17.6	0.9				1207 x 711 x 2.5	1.5		990.00	62.66	1.5	8	
	UNI-PAC 34	34	17.6	1.9				1473 x 845 x 2.5	2.1		1220.00	35.88	1.5	8	
USG Energy (India) NENSYS New Energy Systems, Ph: 1300 660 735 sales@nensys.com.au www.nensys.com.au	U5-5	5	17.5	0.29	Monocrystalline	25	Glass/Tedlar	405 x 175 x 22	0.9	15	72.60	14.52	-	20	High efficiency monocrystalline solar cells. Certified to IEC61215, ISO9001:2000. Some models will be assembled in Australia.
	U5-10	10	17.5	0.57				430 x 255 x 22	1.3		123.20	12.32			
	U5-25	25	17.4	1.43				550 x 449 x 35	3.4	20	267.30	10.69		33	
	U5-40	40	17.5	2.28				635 x 550 x 35	4.4		391.60	9.79			
	U5-50	50	17.4	2.83				1014 x 406 x 35	4.8		471.90	9.44			
	U6-50	50	17.1	2.92				1298 x 329 x 35	5.7		479.60	9.59			
	U5-75	75	17.4	4.28				1205 x 535 x 35	7.4		675.40	9.01			
	U5-80	80	17.5	4.57				1205 x 535 x 35	7.4	25	698.50	8.73			
	U6-120	120	17.4	6.76				1436 x 650 x 35	11.3		1040.60	8.67			
	U5-155	155	34.9	4.44				1600 x 800 x 35	15.4		1316.70	8.49			
	U5-160	160	34.9	4.57				1600 x 800 x 35	15.4		1349.70	8.44			
Webel (India) Solar Sales Pty Ltd ph:(08) 9477 5888 sales@solarsales.com.au www.solarsales.com.au	SP20	20	17	1.18	Monocrystalline	25	Glass/Tedlar.	530 x 430 x 52	3	25	323.00	16.15			
	SP65	65	18.05	3.6	Monocrystalline	25	Glass/Tedlar.	1083 x 500 x 34		25	892.00	13.72			