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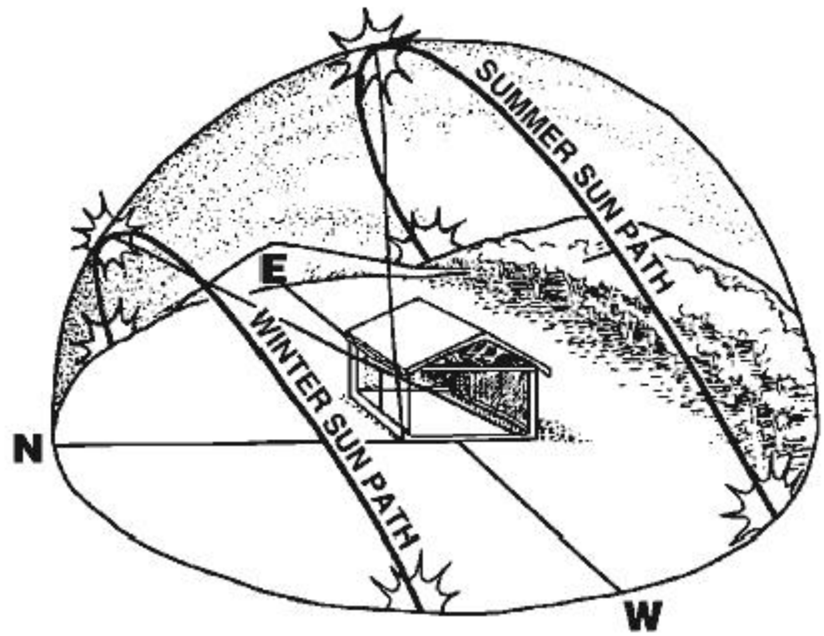
Solar trackers - Solar Choice

9-11 minutes

NB: Some of the information about Solar Feed-in Tariffs and return on investment in this article may be out of date. See our Solar Feed-in Tariffs page for up-to-date information on state-by-state programs. A good way to maximise the output of your solar PV system is to have it mounted on a solar tracker. Solar trackers can boost the electrical output of your PV system significantly, allowing you to earn more income from the feed-in tariff. However, as discussed in this article, the economics of solar trackers are more suited to large installations, and are actually more dependant on the level of feed-in tariff assistance offered then geographical location.

What is a solar tracker?

A solar tracker is a device that tracks the sun as it moves on its path through the sky during the day, exposing your PV cells to an increased amount of sunlight and hence producing more electricity. This is because PV cells work best when they are directly facing the sun. The angle of the sun in the sky changes throughout the year as the tilt of the earth relative to the sun alters. In summer the sun is high in the sky and is also in the sky for longer as it travels through a longer arc length. In winter the sun is lower in the sky and is around for a shorter time as it travels through a shorter arc.



Variation of the sun's path during the day and the seasons

This effect is accentuated the further you are away from the equator. In Tasmania the days are very long in summer, and very short in winter. In Darwin there is much less variation.

How does a solar tracker work?

A solar tracker is a mechanical device that works by following the sun on its path during the day. There are two different types of mechanisms that are most commonly used " active trackers and passive trackers. **Active trackers** are directed toward the sun by electrical circuitry in the form of light-sensing photosensors. Motors and gear trains are then employed to direct the tracker as commanded by the photosensors to the sun's direction. Active trackers contain electrical components and hence use a small amount of power. **Passive trackers**use a hydraulic mechanism that responds to the heat of the sun. A low boiling point compressed gas fluid is driven to one side or the other by the sun's heat, creating gas pressure and thereby moving the mechanism along. Passive trackers generally do not consume any power. Typically, active trackers are more accurate then passive trackers, and hence favoured for uses where a pinpoint degree of accuracy is required, for instance where concentrating solar collectors are used. For solar PV applications the accuracy of passive trackers is more than sufficient.

What happens when the sun is obscured by cloud?

On cloudy days your solar cells still produce energy as there is still light, although their performance is obviously reduced. In such situations the solar tracker will, by acting on the same principles, orient itself optimally to pick up the most reflected ambient light. Once the sun starts shining again, it will re-orient itself to face it.

What types of solar trackers are there?

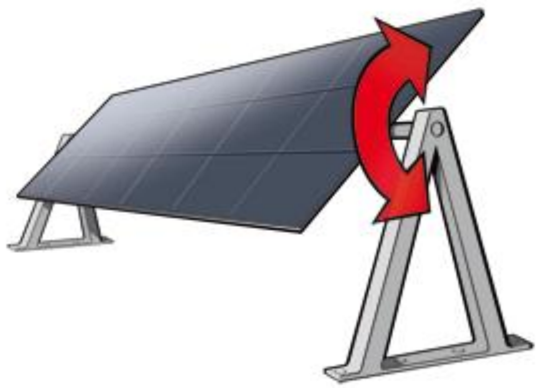
There are two main types of solar trackers, single-axis and two-axis.

Single-axis

Single-axis solar trackers follow the sun from sunrise to sunset as it moves in the sky through the day from east to west. They are called a single-axis trackers as the mechanism only rotates in one plane around a single axis. The axis can be oriented so that the cells stand up at a tilt (called a polar axis) or lie flat (called a horizontal axis). Horizontal axis' are more suitable for small latitudes (locations in the tropics and closer to the equator " i.e. northern Australia), whilst polar axis are more suitable for larger latitudes (locations far from the equator " i.e. southern Australia).

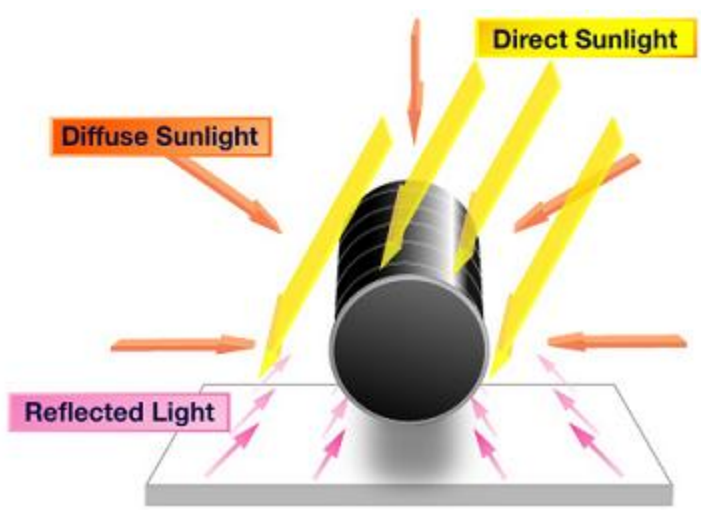
Polar type single-axis tracker

The advantages of single-axis trackers are that they are less complicated, and thus less expensive. As can be seen in the figures below, single axis trackers capture much of the benefit of solar tracking. In locations closer to the equator where the sun's arc through the sky is less variable through the day and through the seasons, single-axis trackers are particularly effective.



Horizontal type single-axis trackers

Single-axis horizontal trackers are also structurally more rigid and stable, and hence less likely to be damaged during storms. In addition to the normal single-axis options, a new solar PV technology has been developed called Tubular solar, where the shape of the cells themselves are cylindrical, allowing the cells to capture the maximum amount of light as the sun goes through it's daily cycle.



Single-axis tubular solar technology

Dual-axis

Dual-axis, or two-axis, trackers follow the sun completely. The two axes of rotation allow the tracker to position the solar cells directly perpendicular to the sun's ray all the time. As they are able to adjust for the sun's height as well east to west rotation dual-axis trackers fully adjust for seasons as well as adjusting to face the sun as it sits low in the horizon at sunrise and sunset, and high in the sky in the middle of the day.

Dual-axis solar tracker

Dual-axis trackers capture the full extent of the sun, but they are slightly more complex and hence a little more expensive. Dual-axis trackers make more of a difference at greater latitudes (more southerly in Australia) where there is substantial seasonal variation in the sun's height and arc.

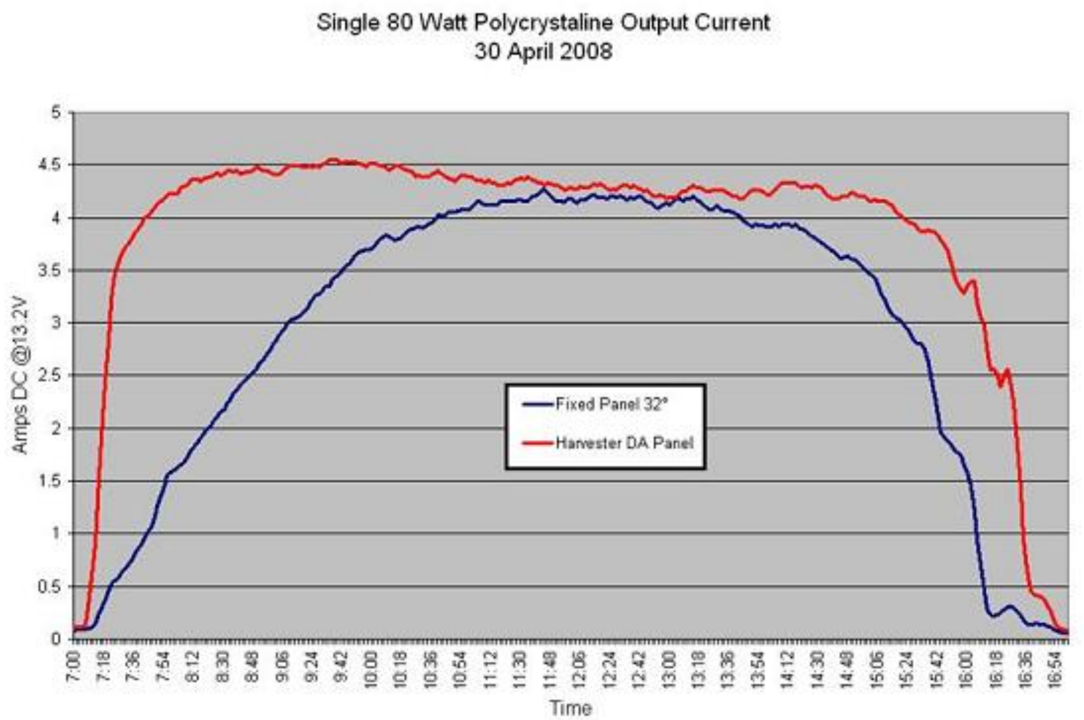
Disadvantages of solar trackers

- An added upfront cost to your solar installation
- Generally require some maintenance
- Moving parts and added complexity come with the usual pitfalls of risk of breakdown
- Structurally less rigid then permanent mounts and hence can

be vulnerable to storm damage

Performance of solar trackers in Australia

A solar tracker increases the performanc of solar PV panels in the shoulder periods of the day, where a static fixed mount panel would only receive obscured exposure. This can be seen in the graph of two side by side solar panels, one mounted on a tracker, the other static, below.



Comparison of solar tracker and static solar panel performance

The modelled performance of solar trackers for various locations around Australia is shown below. The modelling has been undertaken using the PVWatts Performance Calculator for Grid-Connected PV Systems designed by the Renewable Resource Data Center, part of the US National Renewable

Energy Laboratory. The figures below take all of the necessary factors into account, including meteorological factors such as average cloud cover and temperature loss factors.

As the table shows below, installing a single-axis solar tracker will boost your energy output in Sydney over the year by 20%, 25% for a dual-axis tracker. **Yearly average increase in energy output (kWh) due to single-axis and double-axis solar PV tracking systems**

Yearly average increase in energy output (kWh/year for a 1kW system) for a fixed mount, single-axis and double-axis solar PV system

*Fixed mount baseline figures from the Clean Energy Council (see article How much energy will my solar cells produce?)

Economics of solar trackers

As the table below shows, a single axis tracker will increase your solar energy income in Sydney by $177 each year per kW of installed capacity, or $220 each year per kW for a dual-axis tracker. It is important to note, however, that the key factor in the economics of solar trackers is the feed-in tariff rate offered. **Additional income generated by the use of single-axis and double-axis trackers due to increased energy production (assumes all the extra generation is sold at the corresponding feed-in tariff rate)**

Case study 1 " 10kW dual axis solar tracker installed in Sydney

Upfront cost of a dual axis 10kW tracker – $20,000 Additional yearly income from tracker – $2,200 Payback time “ approx 9 years Profit (16 years @ $2200) – **$35,200**

Case study 2 “ 1.5kW dual axis solar tracker installed in Sydney

Upfront cost of a single-axis 1.5kW tracker – $4,000 Additional yearly income from tracker – $330 Payback time “ approx 12 years Profit (13 years @ $330) – **$4,290**

Case study 3 “ 1.6kW single axis solar tracker installed in Sydney

Upfront cost of a single-axis 1.5kW tracker – $3,000 Additional yearly income from tracker – $266 Payback time “ approx 11 years Profit (14 years @ $266) – **$3,724** The above examples show that the economics of solar trackers greatly favour large installations, where the cost per kW of installed capacity for the tracker becomes much lower. For large installations (around 10kW), where the purpose of the system is to generate large amounts of power and feed-in tariff revenue, solar trackers are a very attractive option. As 10kW is the feed-in tariff capacity limitin most states, fitting a solar tracker will allow you to maximise your generation income where no other means are available.

For small 1.5kW installations the upfront cost of a tracker is high, and the payback period is long. In reality, investing the same amount on additional solar cells would yield higher generation volumes, more income, as well as greater environmental benefits.

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