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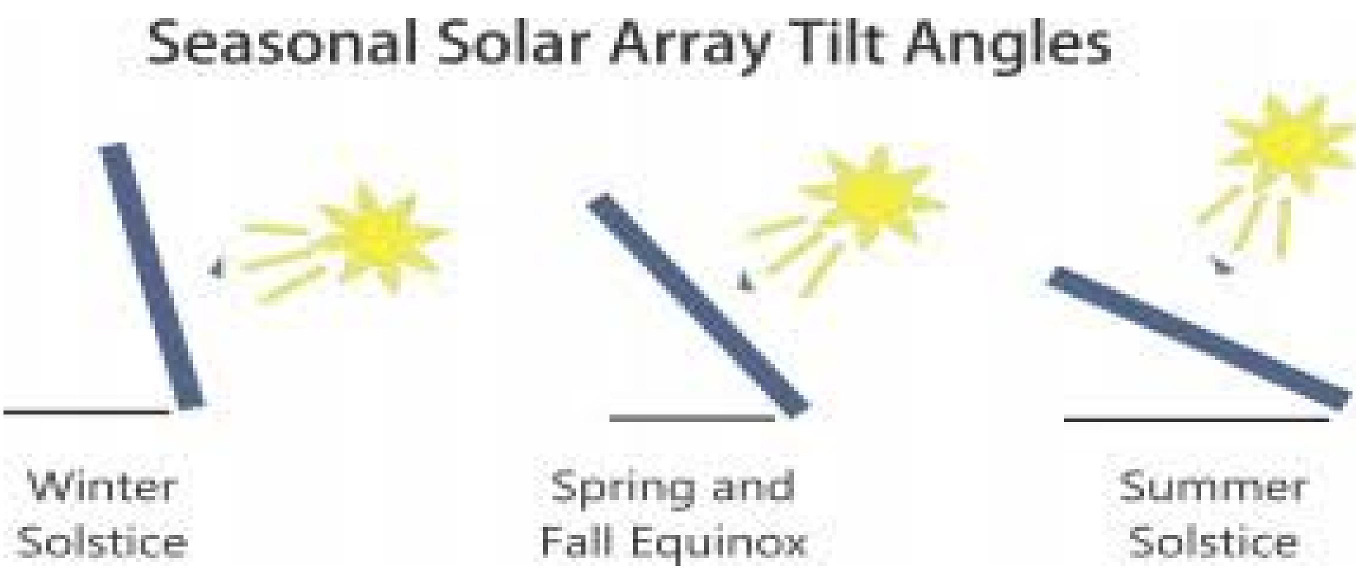
PITCH (TILT) ANGLE

We have all seen the sun dip down closer to the southern horizon in winter and rebound halfway up in spring, and fully up (although still not overhead in the USA lower 48) as far as it is going to go in summer. If you take a look at “Solar Primer” on this web page you will see the lines Tropic of Cancer and Tropic of Capricorn. The sun is directly over Cancer on the first day of summer (summer solstice) and then winds itself down to Capricorn on the first day of winter (winter solstice). It is directly over the equator on both the first day of Spring and the first day of Fall (vernal and autumnal equinoxes respectively). If you plot sun position between these two limits you will find that the sun actually traces out a pretty accurate “sine wave” over the course of a year.

For a solar panel to be most efficient it has to be pointed directly at the sun at all times. Unfortunately for us, we can only make a reasonable compromise at this pointing without a lot of motors and mickey-motion to move the solar panels to point directly at the sun during daylight hours. And, for small systems like ours, those motors and motion take nearly as much power to operate as they gain in power output. But this sort of system is a benchmark that we can measure our compromise against. There is a name for this, and it is “solar insolance”. If we define the system where we perfectly track the sun with machinery, and call it 100%, then we can measure our compromise against it as a loss of perfection in percentage.

Here is the deal. The perfectionist can climb up onto the roof and adjust the angle of the solar panel once a day in terms of small fractions of a degree each day. In construction, we call this building a house with a micrometer and the builder is called an anal fool. Or, we can adjust the angle once and leave it there permanently. In construction we call this “measure it with a boot, mark it with a crayon, and cut it with an axe”. Somewhere between these two is a reasonable compromise, and you get to define “reasonable:” for your own installation.

Here is an image of what we call a “pitch (tilt) angle.” In winter the angle is nearly 70° and in summer a bit less than 20° in these images. Halfway in between (40° or so) for Spring and Fall.



Some of the literature just says, “Make that angle between the horizontal roof and the solar array equal to your latitude plus a diddle constant” and never change it. The math says that you have dropped to nearly 70% of perfect.

Some of the literature says, “Change that angle in spring and fall to the best angle.” Now you’ve hopped up to nearly 75% of perfect.

Some of the literature says, “Change that angle four times a year.” You’ve gone up to 76% of perfect. Is that last 1% really worth climbing up on the roof in the snow and the beating sun? That’s for YOU to decide.

Some of the literature gives equations for every day of the year. My momma didn’t raise no fool. Do that sort of picking flyspecs out of the pepper if you wish.

Here are the equations. I’m going to use L as your latitude.
My latitude here at Grass Valley Intentional Airpatch is 39.2240556°. Again, taking things out beyond zero decimal places is foolishness. L (Grass Valley) = 39° for the examples.

> Single best (never change it) angle = (0.75 * L) + 3°.
> Example: (0.75 * 39) +3 = 32° Cant that sucker up 32 degrees from rooftop flat and weld it into place.
> Efficiency? About 70% of perfect.

> Change it around April 1st and September 1st every year?
> Summer Angle = (0.90 * L) – 20°. Winter angle = (0.90 * L) + 20°.
> Example (0.90 * 39) -20° = 15° in the summer and (0.90 * 39) +20 = 55° in the winter.
> Efficiency about 75%.

> Change it around March 15th and August 15th for Spring and Fall respectively, Summer on April 15th and Winter on October 15th.
> For Spring and Fall, angle = L – 2° (Example 39 – 2 = 37°
> For Summer, angle = (0.9 * L) -24 (Example (0.9 * 39) – 24 = 11°
> For Winter, angle = (0.9 * L) +24 (Example (0.9 * 39) +24 = 59°
> Efficiency about 76%

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