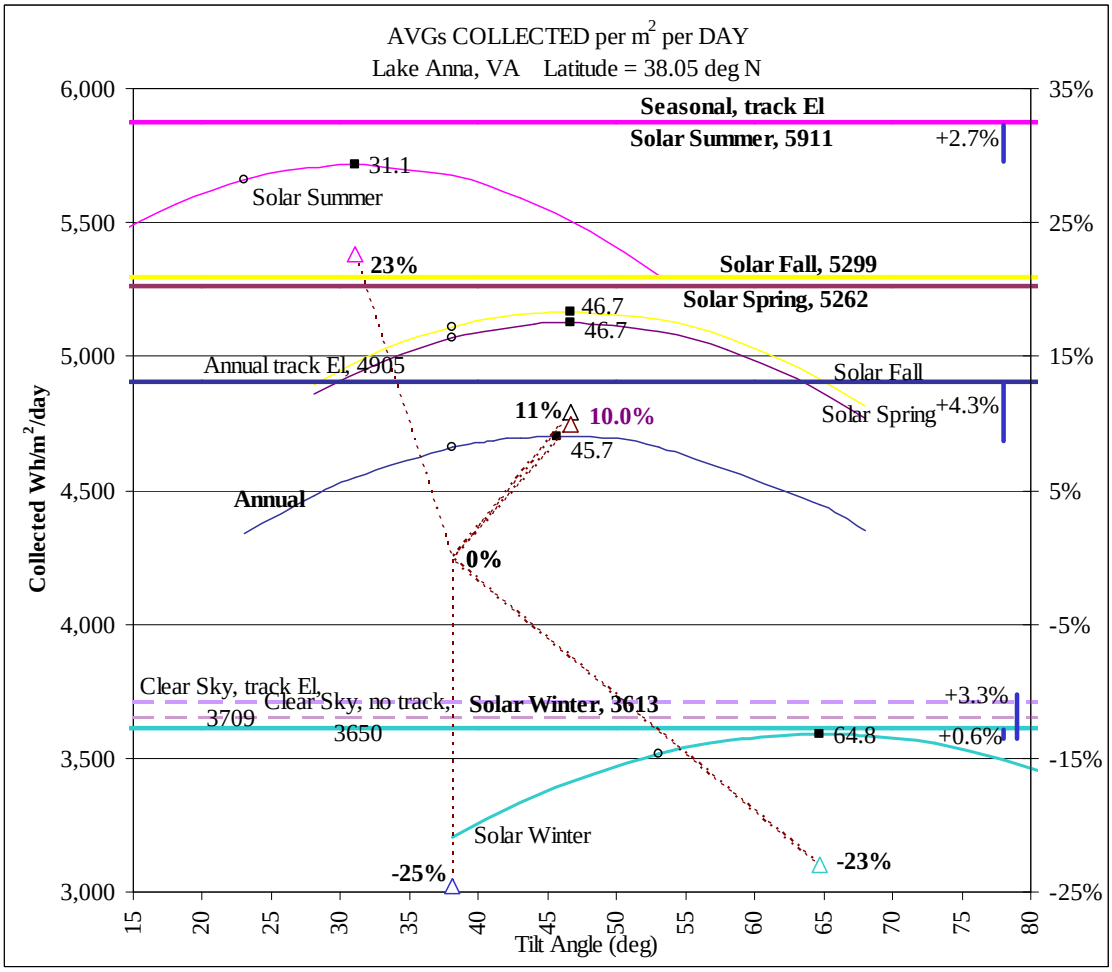
Solar Insolation at Lake Anna, VA

Summary

1. The most important observation is that Lake Anna gets 4.7 kWh per square meter each day, on average over a year.
2. For 2 panels of 64 sqft, the value of that energy to replace electric heat can be as high as $1,100 per year, as LPG fuel the value can be $800 per year, or as PV power the value is about $250 per year (assumed 20% conversion efficiency).
3. There is much variation of solar insolation, so adjusting for the seasons can be very beneficial.
4. Using the best tilt angles typically gains about 1 to 2% in each season.
5. There is considerable gain by using elevation tracking:
   about 4% for annual average but most of this can be obtained by using the fixed seasonal best tilt angles;
   about 3% average in winter, under clear sky.



[*from TILT8-Lake Anna, VA* by **SolarworX**]

Start with the **Annual** curve in the middle. The solid square is the best fixed tilt angle (45.7 deg) at Lake Anna for any flat-plate or evacuated tube collector (heat or power, or both); the hollow circle is the (NREL) industry rule-of-thumb. The annual best tilt angle is about 1% better; for 2 thermal panels of effective 64 sqft that's about 850 BTU/m^2 more each day. The extra heat collected is 312,000 BTU for the year; that's like getting more than 3 days of extra insolation.

Then look at the "Solar Winter" curve. If you use the annual nominal tilt angle (latitude), your collection would be down 25%; if you use the best tilt angle (64.8 deg) for winter you have a good improvement (2%) over the nominal angle (Lat + 15) for winter. That's like getting almost an extra 2 days of sun in winter!

The "Solar Summer", "Solar Fall" and "Solar Spring" curves also show improvements with the best tilt angles, each about 1%, or about 1 extra day of sun per season. Note the 23% more solar insolation by using the best tilt angle (31.1 deg) during summer. By using the seasonal best tilt angles, the extra heat collected is almost 460,000 BTU; that's equivalent to almost 5 days of extra insolation for the year.

The solid horizontal lines indicate the benefit of elevation tracking annually or seasonally, and the average percentage improvements for annual, summer and winter are shown. The real benefits of elevation tracking are the increased heat or power under clear sky. The dashed horizontal lines provide insolation results in clear sky, without and with elevation tracking; for example elevation tracking in clear sky in solar winter yields 3.3% gain over the fixed best tilt angle under average weather conditions.

Some ECO facts:

Solar June is the 30-day period centered on 21 June (summer solstice); solar summer is May 7 to Aug 5 (91 days).

Our Sun delivers about 1.373 kWh of energy per square meter at the mean distance between Earth and the Sun. This "solar constant" actually varies about 6.9% per year and is highest in early January, lowest in early July.

On average, Earth's surface gets about 1,000 Wh of energy per square meter; this is equivalent to about 100 Wh per square foot.

A BTU is defined as the amount of heat required to raise the temperature of one pound of water by one degree from 60 to 61 degrees Fahrenheit at a constant pressure of one atmosphere.

1 BTU = 1.054 to 1.060 kJ (kilo Joules) = 0.293071 Wh (Watt hour).

A therm is 100,000 BTU (10^5 BTU).

A ton of cooling is 12,000 BTU/h.

There are 7.48 gallons per cubic foot.

A big deal:
About 1 kWh of solar energy arrives at every 10 square feet – FREE.

A small factoid: A BTU is about the energy in a kitchen match.