Deborah – leader of solar group at Quality First Home Improvement.

916-469-2886

Telephone discussion with Professor Haddad 2-18-16. Note that Professor Haddad has interspersed some additional notes and websites.

Quality first website: *http://www.qualityfirsthome.com/*

Purpose of call: to learn from a residential solar installation expert how actual decisions are made about the sizing and selection of modules and inverters. Professor Haddad filled out an online “request for quote” and was contacted by a representative of this company. He then called the company backed and asked to speak with someone who could answer detailed questions about solar sizing, equipment matching, and costs. He was transferred to Deborah, but did not get Deborah’s last name. Deborah noted that she has been designing and selling residential and commercial solar systems for five years. She understood that Professor Haddad was preparing class notes for UCSC and went into more detail than she typically would with a potential customer.

**Inverters**

String inverter – mounts on the outside of home/garage. Heavy and bulky.

Microinverters – most installers are now using these. Avoids the shading problem. Her company uses Enphase Energy – 96.5% efficiency rating.

Installers/distributors know how to match microinverters with panels. Expertise needed to make a good match.

*California Solar Initiative* website– tells which microinverters are approved through the state.

<http://www.gosolarcalifornia.ca.gov/csi/index.php>

Pick panels and inverters and calculate using CSI-EPBB.

**Azimuth**

To properly estimate power needs, one needs to calculate the Azimuth – direction the roof is pointed.

**SolMetric** website – set up an account, give address of home and it will provide the Azimuth Also see:

http://www1.solmetric.com/cgi/insolation\_lookup/go.cgi

best azimuth is 180 degrees – due south. Or from there further west. (increase the number past 180).

A panel is generally 3.5 by 5.5 feet. Calculate # panels possible on a roof – leave 3 feet from ridge and sides (this is required as walkable space for fire fighters). Landscape or portrait sizing is ok. Modules can’t be placed over vents. Also make allowances for tree shade, chimneys.

Solar World modules – see the video on the website – strong and durable.

17-18 percent efficiency is really good for residential panels.

**Residential Electricity Panels**

Typical home has a main power panel of 100 amps.

Using a Solar World module, 16 panels can go on one 20 amp breaker. If one has a 125 amp panel you can put in two 16-panel strings.

There is a main bar – can’t go over that amount of amperage – called “bussing the bar.”

**Payback time**:

So many different aspects –

* financing %;
* module cost;
* starter vs. 100% system.
* # people in the house,
* expected increase in load?
* Expected increase in power cost?
* Utility rate structure

Could be 3-20 years.

Leasing system is going away – leasing one’s roof. Compromises the warranty of the roof. Renting roof space; don’t own it. No incentive to put on best modules. Also ties up the main panel. Panel upgrades are expensive if there are trenching costs.

PGE has “110% rule.” It doesn’t want residential production to go past 110% of the home’s demand – homeowner can’t produce more than one demands.

BH comment: PG&E Residential home – 2-3 cents per kWh when you square up at the end of a 12-month period.

In PG&E territory – better to aim for 100% based on the cost of power.

Elsewhere – better to stay out of the upper price tier, but the cheaper tiers are cheaper than installing PV. But if the electricity prices go up, then the value of a larger system goes up.

**Residential preferences – what do people care about when making their purchase decisions:**

Aesthetics – don't want panels on the front of the house. Ugly. Want black modules even though. Don’t care about efficiency.

Sizing the system – optimizing the net present value of the system by selecting the right system size and configuration.

**Determining the number of solar panels to install**

First determine the demand for power. Figure out how much power should be generated over a whole year to meet demand.

Take a record of 12 month of residential usage in kWh. E.g., 4621 kWh/year for a single family dwelling. This comes from monthly utility bills.

Divide by 365 to get consumption per day. = 12.66 kWh/day

Divide by average full daylight hours per day, which is roughly 5.5. = 2.3 kW. (note that only the mid-day hours are “full” daylight hours, the rest [mornings and late afternoons] are partial daylight hours that add up to full daylight hours.)

This gives the kW of power you need to meet 100% of your 12-month power needs.

Next determine the number of panels needed to generate this much power.

Choose a panel. E.g., Solar World Protect SW 285 Mono.

Then divide that by the number of panels. Convert the STC to PTC. STC stands for Standard Test Conditions – the nominal faceplate value. The Solar World Protect SW 285 Mono is *285 Watts (STC)*. PTC stands for either “PVUSA Test Conditions” (Photovoltaics for Utility System Applications Test Conditions), or “Performance Test Conditions.” It is considered to be more accurate than STC, and is always lower. It can be found at this web site and elsewhere: http://www.gosolarcalifornia.ca.gov/equipment/pv\_modules.php

It uses more “realistic” test conditions, such as variable wind, more extreme temperatures.

The PTC rating for the Solar World Protect SW 285 Mono is 257 on this website (Deborah used 259.1).

**X** (number of panels) x 257 Watts (PTC for the specified panel) x 0.965 (efficiency rating of the microinverter) = 2.3 KW (desired production from above)

**X** = 9.27 panels, or 10 panels rounded up.

(BH note: The PTC tests panels at more typical temperature and wind conditions than STC but does not account for azimuth and tilt and shade. An additional factor should be included for these. Let us assume there is no shading of the panels and only focus on orientation (direction the face of the panel is facing) and tilt (0 degrees tilt would be flat on the ground, 90 degrees would be straight up like the wall of a building).

There is a tilt and orientation factor (TOF) at the website: http://www1.solmetric.com/cgi/insolation\_lookup/lookup.cgi

For Monterey, assuming a tilt angle of 20% and azimuth of 235 degrees, the TOF is 92.8%.

Now the calculation is:

**X** (number of panels) x 257 Watts (PTC for a specific panel) x 0.965 (efficiency rating of the microinverter) x 0.928 (TOF or losses from non-optimal orientation to sun) = 2.3 KW (desired production from above)

**X** = 9.99 panels, or 10 panels rounded up)

So rounding up, one needs a system with **10 panels** in either instance (with or without TOF).

**Cost – vs. 5 years ago.**

Material costs have gone down. Permits and time frame for construction has changed – gone up. Jurisdictions are making more money off of solar installations. Elk Grove PV permit used to cost 1 dollar. Now it is $220.

Electrical code changes require effort to follow the codes and change material costs to meet new requirements.

**Next big thing**

Tesla Battery. There is a class at Tesla preparing solar installers for the batteries. It will make full independence from the grid possible.