



Design Considerations for Architects and Builders

Planning on installing a photovoltaic (PV) system on your client's new building? The following information will help make the installation go smoothly, keep the cost to a minimum, and optimize the performance. Though it may not be possible to meet all the criteria listed here, everything that can be incorporated in the design will benefit your client when it comes time to install the system. The following considerations apply to both new construction and post construction additions. Thank you for including solar PV in your design.

Solar Array Placement and Orientation:

1. Area Needed

- Contiguous unobstructed roof space equal to 20 to 25% of total house square footage should be available on a South Facing Roof (SFR)
- 100 square feet of space per kW of modules is needed.
- An unobstructed contiguous rectangular area is best. Square footage will need to be increased if the roof design includes hip roofs, dormers, valleys, skylights, chimneys, vents, DWV vents, or other obstacles to work around.

2. Roof Orientation.

- The ideal angle of inclination at this latitude is **30 degrees**. There is a 3% loss of sun exposure on angles ± 15 degrees from 30 degrees. However, as any surface steeper than 30 degrees becomes difficult to work on, we recommend angles between 15 to 30 degrees from level to optimize panel output and minimize installation costs. This inclination will also favor the summer sun, optimizing year around performance.
- The most beneficial orientation for panels is to the **southwest**: From 15 degrees east of south to 45 degrees west of south. This will favor the afternoon sun and allow for peak performance under time-of-use rate plans. Other orientations can work but yield fewer economic benefits.

3. Shading Problems.

- Shading significantly decreases performance and increases costs. Ideally, shading should not be present on the panels between 9 a.m. and 6 p.m.. A minimum of 6 hours of mid-day sun is best for economic performance.
- Avoid placing obstacles like chimneys and vents on the SFR. Design all roof penetrations for the north-sloped roofs, when possible. If it is necessary to place obstacles on the SFR, place them as close together, and as close to the roof ridge, as possible.
- Shading from surrounding vegetation should be eliminated or minimized. Branches that extend over the panels will also shed debris that will increase maintenance and inhibit performance.
- Placing panels near walls, overhangs or other parts of the building can shade the array and decrease performance.

Equipment Location: The work needed to integrate the panels to the rest of the electrical system has the greatest impact on the cost of the solar installation.

1. **Main Service Panel (MSP).**

- Place the MSP as close to the array as possible
- Flush mounting the MSP makes it more difficult to access the service box and therefore increases installation costs.
- Leave space in the service panel for at least 2 breakers reserved for the solar system tie-in.
- It is possible to tie into a sub panel located somewhere else in the house, but some additional cost will be incurred.

2. **Inverter and Disconnects.**

- In addition to the solar panels on the roof, the system includes an inverter, an AC disconnect, and, sometimes, a DC disconnect and combiner box.
- Inverters function best when they are kept cool. Exterior mounting is preferred: breezeway, north side of the house, or any site not exposed to direct sunlight or direct heat. Mechanical rooms with heat producing equipment often lead to overheating as do confined spaces. Large garages that do not get too hot are fine.
- An area approximately 3' by 3' is needed to mount the equipment.
- Equipment should be located as close to the MSP as possible.
- Avoid placing the inverter on a wall of a room normally occupied during the middle of the day. On hot days some inverters run a small fan to keep cool. Though normally not too noticeable, it can be disturbing to sensitive ears.

3. **Wiring Considerations:**

- A conduit path must be run from the panel mounting area to the equipment mounting location. This is often where added cost can be avoided if designs are done with the solar needs in mind.
- Keep wire runs as short as possible to minimize wiring materials and installation time. This will also allow for smaller wire sizes to be used and, ultimately, a lower price tag for the owner.
- If no attic space is designed under the panel mounting location, conduit will need to be installed prior to closing in the roof.
- High voltage DC wires are run from the solar panels to the DC disconnect box located at the inverter. Pre-installing the conduits in the walls can significantly improve the aesthetics of the system.
- Ultimately, the wiring will terminate at the MSP or a sub panel. The relative location of the equipment determines the effort needed to do the solar installation.

A Final Note: Often it is not known at the time of design if a solar system will ultimately be part of the plan. By considering the needs of a system at the design stage, the option can be left open for the owner to later add solar in the most cost-effective way possible. We hope that this information will help designers and builders make the best choices for their clients who have expressed an interest in including solar in their home design. Please contact us at 707-829-8282 if you have any questions regarding this information.