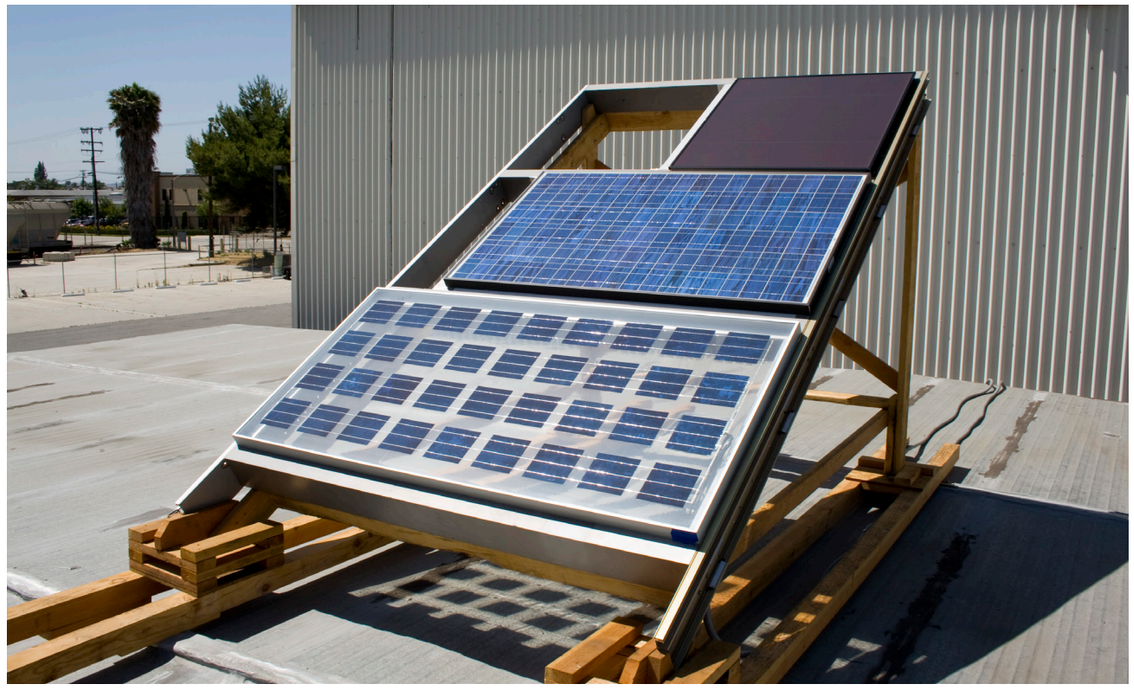
Building-Integrated Photovoltaic (BIPV) Testing

Late last year Enclos began planning a comprehensive study of existing and emerging building integrated (BIPV) technology, complete with a functional testing rig sporting many different types of BIPV panels. The tests are currently under way at the Pomona factory.

Figure 1 (opposite page). Test frame mounting racks located in Pomona, California.

Figure 2 (below). Assembled PV products on mounting frames located in Pomona, California.



Included in the study are no less than five solar panel technologies, each with unique potential as a BIPV product. The first panel chosen was a standard photovoltaic panel made from crystalline silicon. This type of solar module can be mounted vertically as a spandrel panel or in a tilted orientation to serve as a window shading device. The panel of choice was the [Product 1], a US-made module chosen for its low cost and superior performance. The second type of panel used in the study is commonly referred to as “PV-glass.” For this type of module, the traditionally opaque backsheet is replaced by a second layer of glazing, creating a glass-glass laminate with crystalline PV-cells in the interlayer. The cells are spaced out to create some transparency in the module. While similarly sized to a traditional panel, PV-glass produces less power due to the purposeful spacing of the solar cells. The semi-transparent result is applicable for both vision and spandrel areas, and also commonly appears as overhead glazing in atriums and canopies. The combined benefit of the technology is an allowance of some daylight into the space while simultaneously blocking a portion of incident radiant energy and producing electrical energy. The chosen panel was the [Product 2], picked because it is one of the only off-the-shelf modules available for this technology. This allowed for both a lower purchase price and the ability to purchase only a small quantity of panels. The third technology is amorphous silicon. For these panels, the silicon is vapor deposited on a substrate, creating what is commonly known as “thin-film” solar. This process allows for a smaller volume of silicon to be used, reducing the cost of the panel. However, the energy conversion efficiency is lower than with crystalline silicon, meaning each panel produces less electrical power than a similar-sized traditional panel. The flat color and uniform appearance of thin-film solar create superior visual aesthetics, making it a fine spandrel product as well as a shading device. The thin-film panel used in the study is a [Product 3] module, chosen for its low cost and compatibility with monitoring equipment. The panel, like the two mentioned earlier, is framed, making installation in to the testing rig a simple process for all three panel types.

The [Product 1], [Product 2], and [Product 3] panels are assembled at the Pomona factory on various frames with different tilt angles. Still on the way are three panels from [Manufacturer 4], a world leader in BIPV products. All three panels utilize thin-film amorphous silicon. The first panel is similar to [Product 3] in that the silicon is opaque. However, unlike the framed [Product 3] unit, the [Manufacturer 4] panel is an unframed glass-glass laminate with the silicon in the interlayer. This creates a very visually appealing product that can function as any type of non-vision glass. The other two [Manufacturer 4] panels contain thin film silicon that has been laser etched to create some transparency. The units let about 10% of incident light through, behaving and looking very similar to tinted glass. One unit is laminated and the other is an IGU, both applicable as vision glass in a facade unit.

For the three panel types already at the factory, special testing mounts have been built to perform the energy tests. There are three rigs – one vertical, one horizontal, and one at the optimum solar angle for the area of 30 degree above horizontal. By testing each panel type at the different orientations, we can better understand factors such as the power loss when installing a panel vertically on a facade versus optimally on a roof. We can also compare different technologies against each other to see which perform best under certain conditions.

