Solar-Powered Street and Area Lighting Considerations

This document provides information for communities considering solar powered street and area lights. In particular it highlights the circumstances in which solar-powered street and area lighting is both a technical and cost-effective option.

Though the exact circumstances vary by the specifics of the application, solar photovoltaic (PV) powered street and area lighting generally makes the most sense when one or more of the following conditions are present:

- The cost of grid-supplied electricity would be very high (e.g., due to high electricity rates and/or difficulty in physically connecting to the electric grid).
- Required lighting levels for the installation are relatively low and/or intermittent, and local solar insolation is reliably sufficient to recharge batteries daily.

PV-powered lighting usually involves a dedicated pole, the PV panel and a battery,[1] in addition to the LED luminaire. These may come as a single integrated unit or as separate components, and installation costs vary accordingly. An often overlooked consideration is that the batteries have a limited expected lifetime (typically 5-10 years but sometimes less under hard duty such as frequent deep discharging and/or operation in very low temperature environments), which leads to ongoing operating costs due to the labor and materials periodically required to replace spent batteries. Apportioning these costs across the expected kWh to be generated over the battery lifetime is one way to compare these operating costs against standard utility rates. Initial cost can be reduced by reducing battery capacity or quality, but this generally involves tradeoffs in performance and/or lifetime (which can in turn increase the associated labor costs—often the largest component).

PV-powered lighting is best suited for isolated remote installations not requiring a high level of illumination for long periods of time, such as a pedestrian pathway or bike path away from the established electric grid. These systems are also particularly worth considering in intermittently-used applications like an isolated bus stop with regular use just after dusk and just before dawn, but with much less activity in the middle of the night. Often these situations are also ideal applications for the deployment of occupancy sensors that allow the illumination to drop to very low levels or even be switched off when no one is present.

Additional considerations include the fact that PV panels are generally larger than the luminaire itself, and are most often mounted near the top of the pole.[2] This significantly impacts the design of the system because the PV panel substantially increases wind loading. This usually means the pole needs to be more substantial and mounted to a concrete base that is larger and more deeply buried than is normally needed for grid-connected light poles.

Another, less common type of PV panel is flexible and can be wrapped around the pole. These panels can provide more surface area for solar energy collection without presenting as much of a wind load, but are also less efficient because they are not as optimally oriented towards the sun (i.e., not aimed above horizontal).

Most PV panels lose some collection ability when covered by shadows, therefore panels work best where the sun will not be blocked (e.g., by trees or buildings or terrain) for most of the hours in a day. The charge on the battery also needs to be sufficient to run the light even during periods when cloud cover, snow, dirt or other contaminants have reduced the charging rate of the panels; this can mean installing larger panels to compensate for the anticipated losses and/or a battery large enough to bridge multiple nights of operation. Dimming or part-night operation can again be an effective strategy for reducing demands on the PV-battery system.

PV-powered street and area lighting is a viable option in a number of applications but a thorough engineering design and cost analysis should be performed to ensure the illumination performance required by the application is achieved at a competitive (or acceptable) life-cycle cost.

1. Another option is a grid-tied arrangement where a PV panel feeds electricity into the grid, and through net metering reduces the monthly energy charge for the light from the utility. Other than the addition of a solar panel and related power conditioning equipment, such lights are not necessarily any different from standard units.

2. For a good illustration and additional discussion, see Figures 1 and 2 in Recommended Practices: Introduction from the Consortium for Solar Lighting.