IMSA Journal Issue: September/October 2007

Solar-powered Traffic Systems Put You in the "Green" While Saving "Green"

By Joe Wise, Solar Traffic Controls

What does reduction of your carbon footprint, site remediation costs and solar-powered traffic devices have in common? Combining them puts you in the "green" monetarily and environmentally for a win-win project.

Most people are aware of climate change issues associated with carbon emissions. Many government agencies are looking for practical and economical ways to reduce their emissions. Converting fleets of city, county and state vehicles to run on biodiesel fuels (reprocessed vegetable oils) is expensive and impractical.

Solar-powered traffic systems can impact this problem in a practical and cost-effective manner. However, this has not been a factor in the selection of solar-powered equipment.

Traditionally, an agency will consider using solar-powered equipment for two reasons. The primary reason is availability of power to the equipment (Wise, Joseph. "Solar Flashers: An Urban Alternative for Traffic Control" IMSA Journal, January/February 2003). Quite often, an agency may have power only a few feet away from the application site yet the cost of getting the power to the site is prohibitive due to remediation issues. These remediation issues can include the cost of repairing landscaping and sprinklers; replacement of decorative concrete; repair of roadways and sidewalks; and the requirement to manually dig for power due to underground obstacles. The cost alone justifies installing solar power.

The second reason for going solar are delays obtaining power. High growth rates in cities around the country have increased lead times to several weeks, even months. Typically, solar projects can be shipped within a few days or weeks; thus allowing agencies to meet schedules for deployment of traffic equipment with minimal delay.

Going forward, the "green" impact will become a factor in deciding to go solar as well. Many states are looking at, or already have, mandates to actively reduce emissions through the use of alternative energy technologies. Therefore, every potential project will need to be scrutinized for compliance. For example, the purchase of picnic benches may prompt buying equipment made from recycled materials (plastic lumber) rather than new materials since the recycled materials generally take less power to produce thus indirectly reducing emissions. When purchasing flashing beacons or radio repeaters, the option to go solar to run the equipment will make more sense as it's the most logical way to include a direct "green" component in the project, thus allowing the agency in charge to meet mandated objectives for reducing emissions.

School Zone - Mesa, AZ

There is a host of municipal, county and state agency projects which can be completed in a "green" compliant manner. Included are flashing beacons for school zones; continuous duty flashers; high water and fire station flashers; preemption repeater systems; traffic sensor and camera systems; in-roadway lighting systems (IRWL); radio repeater systems; trail and park lighting; monument sign lighting; transit shelter lighting; picnic area lighting and irrigation control systems.

What can solar really save from a carbon emissions standpoint and what is the energy payback time for going solar? To date there have been no comprehensive studies of these topics as they relate to traffic projects. However, there exist several studies pertaining to utility inter-tied residential systems. Through some extrapolation one can reach a rough estimate of the energy payback time and the reduction of carbon.

Start with some basic assumptions between comparing the savings of a solar-powered system against an equivalent AC powered system.

(i) Both systems will use a typical "A" pole mounting structure with a break away base.
(ii) Both units will consist of dual 12-inch amber LED flashers with all lamps rated at 20W and controls drawing 2W.
(iii) Assume the solar power system consists of a 150W-peak solar array with 3 sealed batteries.
(iv) Assume costs and emissions are the same to get the equipment to the application site.
(v) Assume that on average, the production of 1000KWh of electricity results in the release of 1,400 pounds of CO_2. (See Reference 1)

The solar power system will have a higher initial dollar cost compared to the AC system. However, installation costs are less for the solar power system due to the lack of a utility hook up and minimal site remediation costs, initially making the solar approach equal or less expensive than the AC system.

There are more initial carbon emissions from the solar power system due to the fact it has a larger enclosure and batteries. However, in the long run, the solar system produces fewer carbon emissions. (See References 2 and 3) Assuming a 20-year life span for the solar power system we have the following values:

Approximately 900KWh/m^2 to produce a solar module with an aluminum frame, a 150W solar array charging

Solar Ped-X

batteries is pulled down by the battery load to around 120W. Assuming an average of four hours of sunlight/day year round:

900KWh/m^2 (energy/m2 to produce a solar module with an aluminum frame) X 1.33m^2 (approximate size of a 150W solar array) = 1200KWh (projected energy to produce the solar array)

120W (actual output from the solar array loaded by the batteries) X 4 hours/day = 0.476KWh/day or 173.74KWh/year

1200KWh (energy to produce the solar module) / (173.74KWh/year) = 6.9 years

Therefore, it takes approximately **6.9 years of operation for the solar array to break even for the power used to produce it**. Typically a solar module will have an additional 13-23 years of operating life to produce power.

Based on the above results and the values in assumption (v) above, the carbon saved will be as follows:

13 years X 173.74KWh/year = 2259 KWh (projected energy produced from array)

(1.4 lbs CO_2 / KWh of electrical power) X 2259KWh = **3,163 lbs of CO2 saved for 13 years**

We have a projected carbon emission savings from the solar power system. Not considered in the calculation is the replacement of the battery every 5-7 years.

Meanwhile the AC system is consuming utility power and draws a continuous load of 22W. We will have the following carbon generated from the AC system:

22W X 24-hours/day X 365 days/year = 192, 720Whrs/year or 192.72KWh/year

This CO_2 released from the AC system is then:

(192.72KWh/year) X (1.4 lbs CO_2/KWh) = **270 lbs CO_2/year or 5396 lbs of CO_2 produced for 20 years of operation**

In addition to the reduction in carbon emissions, the solar power system did not generate sulfur dioxide nor any nitrate compounds that could have been released into the atmosphere. Extend these results to a community with 20 similar solar projects and you can see the results add up fast for reducing environmental impacts. This can easily be turned around to a very positive press release for any agency.

From this brief analysis it can be seen that going "green" will save you "green" allowing public agencies to meet two objectives in a practical and affordable manner. Take the eco-opportunity and go solar.

Note that many of the values used in the calculations are extrapolations from the research in the reference materials most of which are more than one year old. For more information on this topic see the references and search the internet for "energy payback for PV systems" or "PV systems and CO_2 mitigation."

References:

1. National Renewable Energy Labs, PV FAQs "What is the Payback for PV?"
www.nrel.gov

2. Environmental Impacts of Crystalline Silicon Photovoltaic Module Production, Erik Alsema, Mariska J. de Wild-Scholten, www.mech.kuleuven.be

3. Energy Pay-Back Time (EPBT) and CO2 Mitigation Potential, Evert Nieuwlaar, Erik Alsema, www.ecopotia.com