The Brightest Light on the Sustainable Horizon

By Brian Lambert

Solar energy is radiant energy produced by the sun. Each second the sun radiates more energy than has been used by man since the beginning of time. Each day, enough of this energy reaches the earth to supply our annual energy needs. What's needed is a way to harness this energy.

An Historical Perspective on Solar Energy

The power of the sun's energy has been known to man for centuries. The Greek philosopher Socrates wrote, "In houses that look toward the south, the sun penetrates the portico in winter." Today we call this passive solar design. Like many ancient ideas, using the sun and architecture together, makes tremendous sense. More recently, in 1931, Thomas Edison stated in a conversation with Henry Ford and Harvey Firestone, "I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." Finally, today we are ready to listen to these wise men of our past.

Polycrystalline panels attached to Garland's R-Mer® Span structural standing seam metal roofing system using non-penetrating S-5![1] Clamps

Defining Photovoltaic Systems

Although there has been a great deal of venture capital, research, and development focused on all kinds of renewable energy technologies, photovoltaic technologies (PV) — also known as solar electric systems — are recognized as a desirable solution by fully 94 percent of the population[2].

[1] S-5!™ is a trademark of S-5!.
[2] Kelton Research, as reported by SCHOTT North America Inc., June, 2008.

According to *PV News*, in 2007 the solar market grew by over 45 percent in the United States, and by over 50 percent worldwide. It is anticipated that many PV manufacturing facilities will come on line in the next several years to supply this growing demand.

Benefits of PV

There are many applications for solar technology, but one is in particular is gaining in popularity — commercial rooftop applications. Rooftop PV makes sense for several reasons.

- First, most roofs are unused real estate. Building owners are looking for every way to maximize profits and reduce costs. Installing a PV system on their roofs allows them to get the benefits of solar without giving up costly land.
- Second, roofs often provide great exposure to the sun. Care should be taken to consider shading from parapet walls, penthouses, equipment, trees, and surrounding buildings, because shade is the enemy of solar.
- Third, for applications where vandalism is a hazard or where aesthetics are of primary concern, installing solar arrays on a rooftop where they are out of sight can be a real advantage.

Typically, PV systems will last 25 or more years. For a rooftop solar array to be financially prudent, it is therefore essential that the underlying roof system maintain its waterproofing integrity for that long, or longer.

Where structural load considerations make a rooftop solar array retrofit impractical, another popular method for installing PV systems is to apply solar cells to canopies shading large parking areas.

Self-adhering thin-film laminates installed over Garland's R-Mer® Loc standing seam roof system

Estimating Return on Investment

The commercial viability of rooftop solar solutions is largely determined by the existence of certain factors pertaining to the building's size, physical orientation, and energy usage, as indicated in this chart:

Building Characteristics	**Rooftop Solar Viability Checklist**
High energy usage	√
Low number of projections	√
South/West exposure	√
High energy costs per kWh	√
Large unshaded roof area	√

There are a number of on-line tools available that allow you to identify the variables of your particular situation in order to estimate your return on a solar technology investment. Although a field audit is recommended for providing an accurate assessment of the energy-reducing potential of a rooftop solar array on any particular facility, a tool that allows you to include the most critical variables, as listed below, will give you at least a preliminary idea of the energy-cost-reducing potential of a solar system in your application:

- Usage – typically expressed in kW per month and analyzed over a 12-month period
- Site Location – critical, due to varying exposures to shade from perimeter walls, trees, surrounding facilities, etc.
- Government incentives - which vary by region
- Current utility cost – typically expressed as a per kWh rate
- Estimated annual rate increase – critical in assessing long-term return

Keep in mind that other variables, such as size of the proposed PV system, building orientation, off- versus on- peak-hour usage, and the number of existing rooftop projections, will ultimately affect the rate of return on your investment.

In today's volatile market, the availability of federal tax credits, accelerated depreciation, and local grants, loans, and rebates remain a driving factor in rate of adoption. Recently, a 30 percent federal investment tax credit was renewed for an eight-year period, along with a five-year accelerated depreciation schedule.

In addition, some states offer attractive incentives, for example:

- The California Solar Initiative offers rebates (based on the actual, energy-generation performance from solar energy systems) to a complete range of residential and non-residential buildings, including agricultural, commercial, industrial, governmental, non-profit, and educational buildings. These incentives can reduce the cost of a solar project by as much as 30 percent, depending upon the type of facility.
- New Jersey's lucrative Solar Renewable Energy Credit (SREC) program issues tradable certifications representing the clean energy benefits of solar-generated systems, which

can be sold or traded separately from the power. An SREC is issued for each 1000kWh (1MWh) of solar energy generated.
- In Pennsylvania, a variety of energy-related grants, loans, and rebates are available.

Check with your local utility company or visit the State Incentives for Renewables & Efficiency database to find out what incentives are currently available in your area.

In addition to the obvious financial benefits of adopting solar energy solutions, the proliferation of such systems is helping limit our dependence on foreign oil and is reducing green house gasses in our communities, providing long-term health-and-wellness benefits that extend far beyond immediate financial gain.

Differentiating PV Technologies

There are two main types of photovoltaic panels that are commonly used in commercial applications: polycrystalline and thin film. Polycrystalline panels are the conventional glass-encased solar panels that most people think of when they think of solar. Thin film PV cells are the next-generation solar, and are believed to be the technology most likely to bring solar to the masses.

Polycrystalline Solar Cells

There are several advantages to crystalline panels. First, they have an excellent history of performance. An early version of this technology was used in the 1950's for space exploration, and newer versions are used on the Hubble Telescope and the International Space Station. Although some building owners question the durability of this "new" technology, there are many European examples of building-mounted polycrystalline systems that have been in place for more than three decades. In fact, most major polycrystalline manufacturers will guarantee 80 percent of the panel's rated output for 25 years.

Another advantage of polycrystalline panels is that they have higher efficiency than thin film systems. Most polycrystalline panels have an energy conversion rate of 12 to 16 percent. Therefore, about 15 percent of the sun's power that reaches the solar panel is converted into useable energy. In comparison, thin film has an energy conversion rate of 6 to 8 percent.

Thin Film Solar Cells

The fastest growing solar technology is thin film. In the book *Solar Revolution*, author Travis Bradford of the Prometheus Institute for Sustainable Design states that thin film technology will eventually dominate the PV market. The main reason is that thin film technologies require significantly lower manufacturing and raw material costs.

Often, in building-integrated photovoltaic (BIPV) applications, thin film products are flexible panels with a peel-and-stick backing for easy installation. Flexible thin film PV is significantly lighter in weight than traditional crystalline panels. Also, flexible thin film systems allow design professionals to incorporate solar into more diverse building applications. A typical commercial

roofing application for flexible thin film PV is metal roofing. Metal roofs provide a great substrate for thin film panels.

Thin-film laminates installed at a CA school over Garland's R-Mer® Span structural standing seam metal roofing system

Which Type is Right for Your Application?

Where power output per square foot is the primary driver, polycrystalline arrays remain the best choice for many public, commercial, and industrial applications. For applications that have vast amounts of rooftop real estate, structural load limitations, or where initial capital investment is limited, thin film technology may be the wiser choice.

But the good news is, regardless of the type of solar array used, solar panels are expected to follow the pattern of other emerging technologies, continually getting smaller, cheaper, and more efficient. Compare your first computer or first cell phone to the one you currently own. Solar panels are no different — evolving advances in technology will continue to make these systems more efficient and more affordable.

Conclusion

Energy independence is the buzz word of the day. Commercial rooftop solar applications are not the sole answer, but they are a big part of the answer. Despite all the advances of modern man, we sometimes need to look to our past for answers to today's problems. How much better off would we be if we had taken the advice of Socrates and Edison before today?

Brian Lambert has been active in industry initiatives promoting green roofing and other sustainable design solutions since 1996. Lambert was a founding member of the Toronto-based Green Roofs for Healthy Cities Coalition and frequently promotes sustainable design as a guest lecturer to professional organizations in the U.S. and Canada. Brian is general manager of *Garland Energy Systems, Inc.*, a fully owned subsidiary of Garland Industries, dedicated to making alternative energy solutions as easy to purchase, install, and maintain as utility electricity.