RENEWABLE ENERGY

Solar electricity in architecture

FACT SHEET

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LARRY KROM

Winter Garden, Mary Ann Coffrin Hall at University of Wisconsin–Green Bay. The glazing in this atrium roof generates electricity while allowing the sun to shine through.

A photovoltaic system installed on a building is a silent and environmentally friendly power plant generating both green electricity and public relations benefits. There is no other renewable source of electricity that can be widely used in cities. And there are few green building technologies that are as accessible and visible to the community.

One way to optimize the curb appeal of a photovoltaic system is to use a building-integrated design. Building-integrated photovoltaic systems replace metal roofing, atrium glass, windows, curtain walls and shade screens with materials that serve these functions but produce solar electricity as well.

A NEW LOOK FOR BUILDINGS

Architects have traditionally used expensive stone and other decorative materials to create a prestigious building facade. Building owners are now recognizing that making a public statement about sustainable energy use carries its own prestige, and the new photovoltaic building materials are an attractive way to express this commitment.

Several types of building-integrated photovoltaic materials are currently available:

- Standing-seam metal roofing, shingles and roofing tiles
- Awnings, sunshades and carports

Installation costs for solar power generated by integrated-building materials

	cost per watt[1]
Roofing	
standing-seam metal roofing	$8–14[2]
shingles	$10–14
slate roofing	$12–14
Shading	$9[3]
Glazing	$14[3]

WISCONSUN SOLAR USE NETWORK

The Oneida Nation incorporated a solar generating system into the metal roofing on its community center in Oneida, Wisconsin.

- Curtain wall and window glazing, atrium and skylight glazing, insulated glazing

BUILDING OWNERS CAN CAPITALIZE ON INTEGRATED SYSTEMS

- Photovoltaic output matches the typical daytime patterns of energy use in institutional and commercial buildings, promoting cost savings during peak periods.
- Selling power to the utility is not an issue—commercial and institutional buildings will generally use all the solar power generated.
- Business-owned photovoltaic systems are eligible for tax advantages, such as accelerated depreciation and federal income tax credits.

CONDITIONS THAT MAKE INTEGRATED SYSTEMS COST EFFECTIVE

- In addition to meeting solar requirements, building location should consider curb appeal, employee pride and public image created by a photovoltaic installation.

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[1] Prices do not include incentives offered by the Focus on Energy program.
[2] Lower price does not include cost of roofing materials.
[3] Highly variable.

Photovoltaic, or solar, electricity

The word *photovoltaic* comes from the Greek *phos* meaning "light" and from the word *volt,* for Alessandro Volta, the man who first devised apparatus for developing electric currents. Photovoltaic materials have the ability to generate a current of electricity when exposed to light. Photons, which make up light, knock electrons from the front to the back of the photovoltaic material, creating an electrical current. That DC (or direct current) electrical power can be transformed by an inverter to AC (or alternating current) power, which is the standard household current. Electrical generation within a solar cell is non-mechanical. There are no moving parts, only moving electrons, and therefore it is silent and clean, and it continues indefinitely as long as the light source is present.

Photovoltaic cells, the basic components required to produce solar electricity, are made of specially formulated silicon crystals. Two basic types are currently in use: crystalline or polycrystalline cells, and thin-film cells. Crystalline cells are fragile and require sturdy mounting and framing, but they are the most efficient for producing solar electricity (converting 10 to 15 percent of the energy in light into electricity). Much progress has been made in improving the efficiency of the thin-film cells (which convert 5 to 10 percent of the energy from light into electricity).

Both crystalline and thin-film photovoltaic cells can be used in solar electric building products for walls, windows and roofing systems.

- The photovoltaic system should be integrated during the initial concept and design stage of the building.
- The support of the local utility should be secured.

WISCONSUN SOLAR USE NETWORK

The Society of Friends in Madison, Wisconsin, replaced the roof of its meetinghouse with standing-seam integrated photovoltaic roofing panels.

- All state and federal incentives (including grants, tax incentives and deductions) should be utilized.

APPLICATIONS AND PAYBACK

Like any other photovoltaic system, a building-integrated system can be applied in a number of ways as a power generator. An integrated system can be installed with or without battery storage, and it could be connected to the utility grid or stand alone. Building-integrated systems can also be used for homes and other small building applications.

Calculating the payback for a building-integrated system is complicated by the many factors involved. For example, if a photovoltaic curtain wall is substituted for the conventional version, the difference in cost should be the figure used in the payback calculation, not the total cost. Photovoltaic building materials are as functional as their nongenerating counterparts.

FOR MORE INFORMATION

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Case studies on building-integrated photovoltaic system installations in Wisconsin

Building-Integrated Photovoltaics: Solar Roofing in Northern California, by Stephen Heckeroth

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