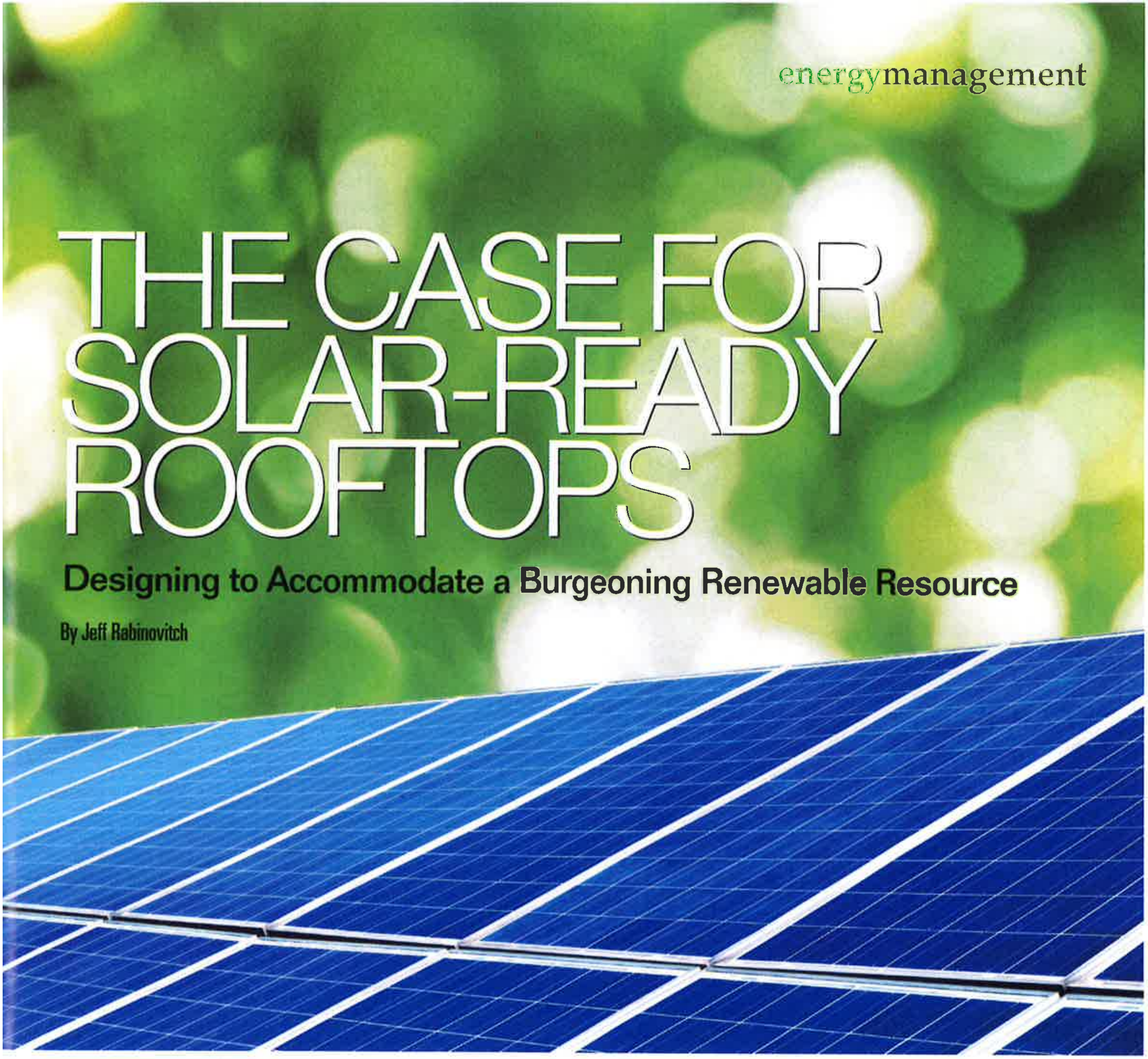

THE CASE FOR SOLAR-READY ROOFTOPS

Designing to Accommodate a Burgeoning Renewable Resource

By Jeff Rabinovitch

SOLAR POWER is gaining profile among renewable energy sources as technological advances and improved efficiencies steadily bring costs down. Significant opportunities exist in rooftop solar installations. In existing buildings, owners/managers will still have to carefully weigh the inherent benefits against the cost of possible upgrades to accommodate solar panels, but developers and designers could see significant advantages in making new buildings solar-ready from the outset.

Solar power supply to buildings predominantly falls into the category of distributed generation, meaning that it is closely connected to the end-use of the electricity rather than flowing into the high-voltage power grid. Photovoltaic systems (PVs) are the most common vehicle for this, creating power via solar panels and distributing it to the building using electrical wiring.

PVs create voltage through certain materials (i.e. silicon, arsenide, etc.) when exposed to light, thus converting sunlight into electricity. Essentially, photons of light excite the surface of a semiconductor, knocking electrons loose to become part of a charged electrical field. This field generates an electromotive force that can be tapped by wires into a useable form of electricity.

ENVIRONMENTAL CONSIDERATIONS

Once installed, solar power installations have very low operation and maintenance costs. They do not produce air pollutants or carbon dioxide and have a minimal impact on the environment when located on buildings.

Ongoing advances in manufacturing and materials have resulted in current efficiencies of up to 18% for silicon-based panels and 32% for panels using arsenide in production models. Cells in the R&D phase have been known to reach up to a 40% efficiency.

Looking more closely at the elements of the system, the production of solar PVs involves many materials that can be hazards to the environment and to producers through accidental or fugitive emissions, especially in regions where low environmental regulations exist. For example, gallium arsenide, an important material used in high-efficiency solar cells, is a carcinogen on the California Environmental Protection Agency's list of chemicals known to cause cancer.

Silicon tetrachloride, a by-product of the production process, is also an extremely toxic substance and can be an extreme environmental hazard. Furthermore, the purification of silicon depends on high temperatures achieved by highly energy intensive and expensive processes, during which up to 80% of the initial metallurgical grade silicon is lost in the production process.

It is imperative that technological innovation lead to safer and more efficient means of producing solar panels. Excessive waste, environmental hazards and potential health hazards resulting from the production process can significantly undermine the environmental gains realized from solar power. These advancements in solar technology and improvements in efficiencies are lowering costs for the use of solar power.

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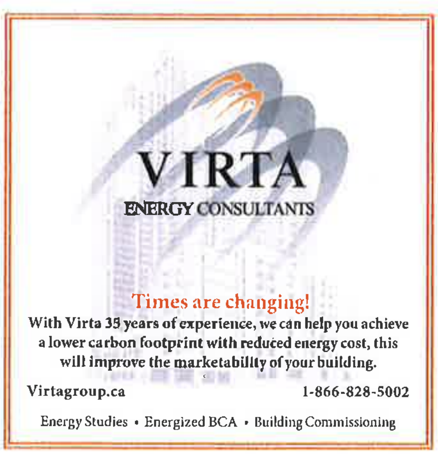
MOUNTING

As solar power and solar panels become more common, designers will need to carefully consider the structural impact of existing, new and future solar panel installations. Roofing systems installed in new buildings are typically designed to outlast or at least match the average life of the new solar PV system, which is about 25 years. Depending on the type of panel installation used this will allow for synergies to be realized in replacement cost.



Roof mounted PV solar panels are typically supported by racking systems that come in two basic forms. The first is a mechanically fastened system and the second, the more common of the two, is a ballast restrained system.

The mechanically fastened system penetrates through the roofing membrane and can be used in pitched roofs and flat roofs. A complete mechanically fastened PV system, including the panels and the racking, weighs 0.1 kilopascals (kPa) to 0.24 kPa.

The more common systems are restrained on the roof by ballast weights and have no roof penetrations. These systems are typically low-profile and are installed on flat roofs. They can be easily installed on the roof surface and are usually more economical.

The average weight of the ballast systems is typically in the range of 0.17 kPa to 0.34 kPa, which includes the racking, the panels and the average weight of the ballasts over the surface area of the PV system. The distribution of the ballasts on a roof is typically not uniform and usually has more weight concentrated along the edges and corners of a building, where wind loads are higher. In high seismic zones and post-disaster buildings, special consideration may also be required to prevent sliding of the PV system.

LOADS

Part of the limitations of solar panels is that the sun is not available at all times of the day and a large surface area is required to capture a usable amount of the sun's energy. The larger the surface area required to support the PV system, the greater the potential impact on the building structure.

The use of rooftop solar panels increases the superimposed dead load (SDL) of the roofing system, and can have varying impact on a building depending on what material is being used for the structural system. For concrete buildings, which intrinsically have a higher structural self-weight, the relative additional weight of the solar panels will generally prove to be an insignificant portion of the building's total structural costs.

For a steel or wood low-rise building, the relative additional weight from rooftop solar panels can add approximately 10% to the total factored design load of the roof structure. However, when considered in light of the total building costs, this additional costs may prove to be minimal.

Unlike new construction, upgrading for solar panels on an existing steel or wood roof can lead to significant renovation costs. In new construction projects, the designer should always consider alerting the owner and design team to the long-term savings that potentially result from designing new roofs for future a PV installation, considering the anticipated rise in the use of solar energy in the future.

The installation of solar panels supported by low-profile racking systems will typically not increase the snow loading on a structure. The apex of the solar panels is usually designed to be just below that of basic snow depth on a flat roof. The designer should confirm this with the solar panel supplier.

Higher profile stand-mounted PV arrays can have a greater impact on roof snow loads and wind loads and should be individually investigated. As well, solar panel installations on sloped roofs can act to trap snow that otherwise may have been considered to slide off the roof structure.

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