Resource Links on Solar Carports and Canopies

The following list was largely compiled in 2016, and updated in September 2017. The update includes one article (Schwartz, 2017) that lists current market leaders and their contact information. It also includes information from ParkSmart, which was formerly managed by the Green Parking Council, a resource called out during the CSVP webinar on solar carports and shade structures (August 2016).

An updated market review indicates that prices for solar shade structures have been declining. However, these declines are limited, because solar carport pricing is largely driven by the cost of steel and local building code requirements. Also, pricing differs based on site conditions and the aesthetic preferences of the customer. CSVP found fairly consistent low-end all-in pricing for solar-equipped carports, which puts this premium product in the same price range as commercial rooftop solar alone in 2013. CSVP also has explored ways to capture more benefits of solar shade structures, including utility avoided-cost benefits from strategic siting and orientation, values associated with strategic electric vehicle market development, direct shade and shelter benefits to site hosts and numerous community benefits.

Clamp, A. (2012, April). Charge it: Smoothing the road for electric vehicles. ***Public Power Magazine.*** http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=34005

This article follows the EV Project, Charge Point America, and their supporters in their goal to install electric vehicle charging stations at convenient locations across the U.S. It then looks at several examples of charging stations in Public Power cities, such as Seattle and Nashville.

Energy Trend. (2016, January). ***Sun Edison saves 25 California schools $30 million by solar carports.***
http://pv.energytrend.com/news/SunEdison_Saves_25_California_Schools_30Million_by_Solar_Carports

This brief case study looks at the developer's proposition for savings to schools and taxpayers over 20 years by installing solar carports. This is an example of a growing trend in California, where the carport market is relatively strong.

Jackson, C. (2016). ***Solar Car Parks: A Guide for Owners and Developers.*** **BRE National Solar Centre.** http://www.bre.co.uk/filelibrary/nsc/Documents%20Library/BRE/89087-BRE_solar-carpark-guide-v2_bre114153_lowres.pdf

This article briefly touches on all aspects of developing a solar parking canopy. This includes funding, power purchase agreements, regulations, procurement of the materials, site selection, various designs, and much more. Then it provides case studies, each of which has different sizes, installation types, and locations.

Massachusetts Department of Energy Resources. (2015). ***Solar Canopies at State and Municipal Facilities in Massachusetts.*** **[Video].** http://www.mass.gov/eea/energy-utilities-clean-tech/webinar-future-and-archive.html

This webinar, with downloadable slides, goes over the advantages and disadvantages of solar carports, and it reviews different designs. Also, it goes over the different financing options for building a carport: entity built and owned, self-financed, or outside-financed power purchase agreements. Note that the company cited, Solaire, was since acquired by a solar development company, SunPower.

Moskowitz, S. (2014). The next big thing: Solar freakin' carports.
https://www.greentechmedia.com/articles/read/the-next-big-thing-solar-freakin-carports

This article references a 2014 market assessment from GTM Research. Note that it is somewhat outdated, due to falling solar prices, churn among carport providers and a drive in some markets (primarily East and West

Coast) to achieve greater economies of scale. Estimated future costs of solar must be checked against current conditions, yet the report remains instructive. Executive summary is publicly available.

Puttre, M. (2015, June). Solar canopies turn parking lots into power plants with benefits. *Solar Industry Magazine*. http://www.solarindustrymag.com/online/issues/SI1506/FEAT_01_Solar-Canopies-Turn-Parking-Lots-Into-Power-Plants-With-Benefits.html

In this article, the benefits and drawbacks to installing a solar canopy are briefly discussed in relation to typical rooftop or ground mounted arrays. It shows that even though carports are costly, they can still be a great addition to homes or businesses. Projects from Solaire, Advanced Green Technologies, and Vista Solar are discussed in minor detail.

San Diego Gas & Electric. (2013). *New solar carport at SDG&E features more EV chargers.* [Press release]. http://www.sdge.com/newsroom/press-releases/2013-04-23/new-solar-carport-sdge-features-more-ev-chargers

This case study describes a solar canopy with electric vehicle charging stations at Century Park, in Kearny Mesa, CA. It also explains the rationale behind the installation of this project and how its success can be used to give rise to more projects like it.

Siegel, A. (2015, April 5). To solar carport or not to solar carport, that is the (or at least a) question. *The Huffington Post*. http://www.huffingtonpost.com/a-siegel/to-solar-carport-or-not-t_b_6607476.html

This blog entry is about the positives and negatives of installing a solar carport or parking structure. It also offers a critique, based on the cost of the carport structure compared to other solar configurations. That critique is less compelling in the intervening years since publication.

Thrill, L. (2015). *Large-Scale Renewable Energy at Indiana University*. Indiana University Office of Sustainability. http://sustain.indiana.edu/Working%20Groups/buildings-and-energy/docs/SU15_RenewableEnergy_Final%20Report_LeahThill.pdf

This report envisions a renewable energy plan for Indiana University, in light of its 2020 carbon emissions goal. Relevant to solar canopies, it offers case studies from Arizona State and Michigan State Universities, which have installed carport structures.

Thurston, C.W. (2015). Solar carports will spread across the country as costs decline. *Solar Builder Magazine*. http://solarbuildermag.com/news/costs-decline-solar-carports-will-spread-across-country/

Despite outdated economics, this article provides useful information, summarizing the reasons behind pricing differences for solar carports and typical ground-mounted or roof mounted systems. It also covers innovations by various companies to combat the excess cost of building a solar carport structure.

Tulpule, P.J., Marano, V., Yurkovich S., & Rizzoni G. (2013). Economic and environmental impacts of a PV powered workplace parking garage charging station. *Applied Energy*, 108(1), 323-332. http://www.sciencedirect.com/science/article/pii/S0306261913001876

This journal article focuses on the financial implications for building a solar parking structure, as well as the impacts on the grid from its use for electric-vehicle (EV) charging. It also provides insights on implications of the decreased demand on the grid at peak times, from charging EVs at the workplace using a solar parking structure. The references to solar carport economics are outdated, but the methodology is instructive.

Links for Useful Websites and Technology Providers

Park Smart, a Program of Green Business Certification, Inc. http://parksmart.gbci.org/

This website offers valuable information for anybody interested in the technology behind green parking, which includes solar carport options, in addition to many other strategies that can help parking lots and parking structures qualify for ParkSmart certification.

Power Parasol. Website. (http://powerparasol.com/

Power Parasol takes pride in the aesthetic, premium value of their solar canopies, and this can be seen in detail on their website. This company also provides case studies of projects done for Arizona State University and other customers, primarily in Arizona, where the company is located

Solaire Generation by SunPower. http://solairegeneration.com/

This website is no longer updated, since Solaire was acquired by SunPower. However, this one-time market leader offers still-useful case studies. This website also provides links to several news and journal articles on solar canopies and parking structures.

Solar City. http://www.solarcity.com/

Solar City's website goes in depth into the benefits of the three different types of solar installations they install frequently, residential, commercial, and utility. It offers information about carport installations, among many other configurations and projects.

SunPower. https://us.sunpower.com/

This website offers case studies of projects, as well as many useful links to articles for people interested in investing in solar power.

Schwartz, J. (2017, March/April). Solar carports and canopies. *Solar Professional*. http://solarprofessional.com/print-issue/march-april-2017

This article offers a listing of 17 companies that currently design and build solar carports. In effect, this increases the number of web links already provided above. Each summary includes web links for more information.