E^3 Solar Awnings:

UNIVERSITY OF OREGON

HiPE High Performance Environments Lab

The Energy, Ecological, and Environmental Benefits of an Innovative Building Integrated Photovoltaic System

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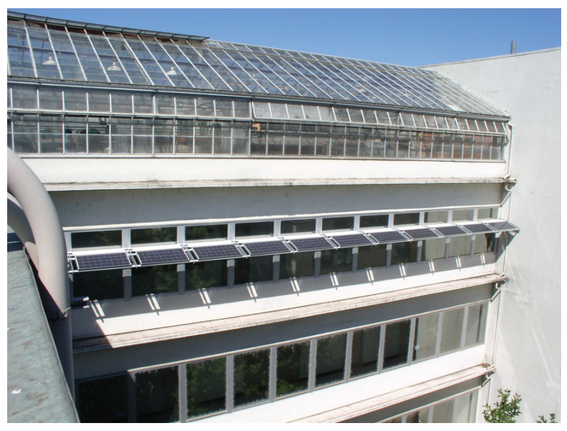
Overview



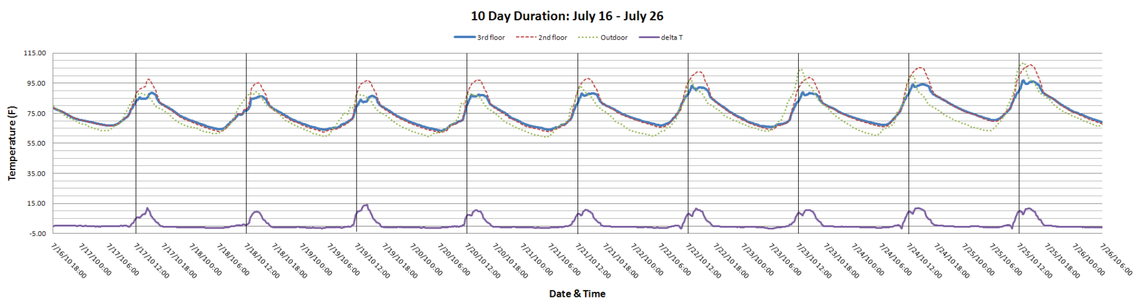
Building Integrated Photovoltaics (BIPVs) have major impact in reducing the need for fossil-fuel energy use in buildings and providing carbon-neutral environments. Despite the grid market penetration of PVs in many countries, such technologies face a number of market barriers that limits their widespread integration in buildings. Such barriers include, but not limited to, cost, balance of system components, and difficulty of their integration within the building envelope, design, orientation, and financing.

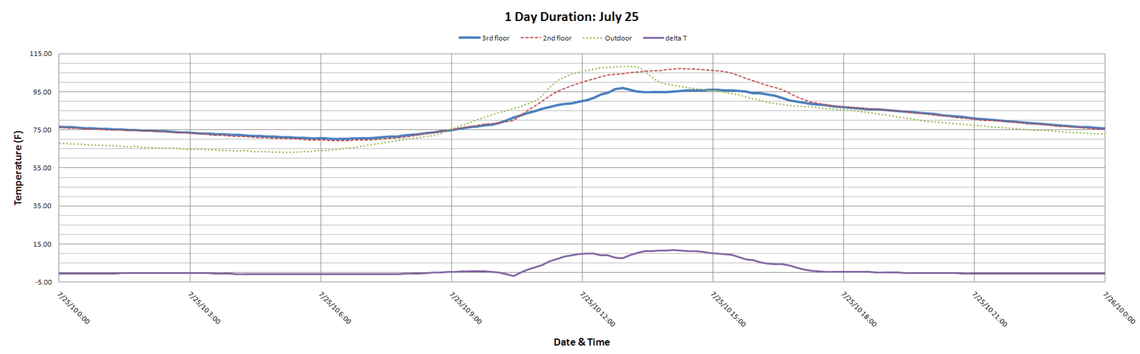
In response to the above-mentioned problems, we have researched and developed a BIPV awning prototype that will overcome most of these barriers. We have designed a number of BIPV façade-shading devices (awning systems) in our lab that showed superior performance with respect to shading and a 60% reduction in cooling energy loads for commercial buildings. In addition, we have incorporated photovoltaic systems within these awning devices that will generate clean energy power supply. The prototype product we designed also includes a daylighting shelf and an LED electric lighting system. This four-in-one, plug and play green building product could revolutionize the commercial building market leading to a transformation in the construction and operation of green buildings.

This poster reports on the results of a year-long verification and experimentation of the performance of this innovative prototype. For this study we have constructed a full-scale experiment by retrofitting the third floor of a southern facing glazed façade of a commercial building with the product under testing and comparing it to a control second floor of the same façade for experimental purposes. At this stage we have substantial quantitative and qualitative evidence from our experiments that the product we have developed would lead to a 60% in energy savings for direct connected spaces to this system, and a payback period of less than five years. In addition to environmental, ecological, energy, and lighting/daylighting analysis of the designed system the paper will report on the applicability of the designed system for retrofitting existing building as well as for new construction projects.

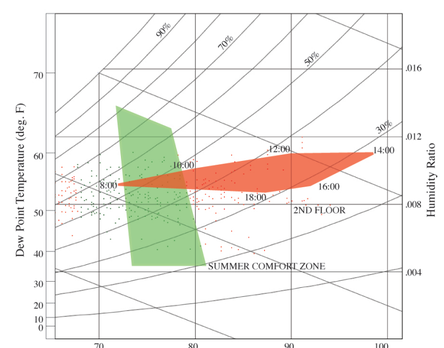
Thermal Performance and Comfort

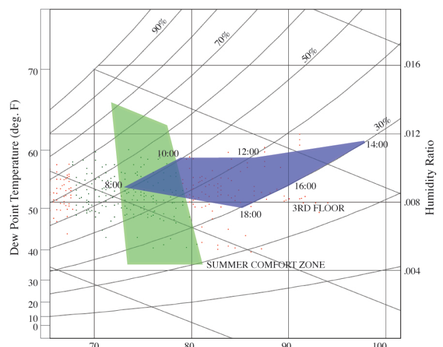
The thermal effects of the retrofit prototype were monitored during a 2 week period in July. No active cooling or ventilation systems were in use during this period. Our results show a decrease in cooling load when the awning system was in place, marked at times by 15 degree temperature differences between the control and retrofit corridor.





Psychrometric charts : July 25, 8:00 - 18:00





System Description and Performance

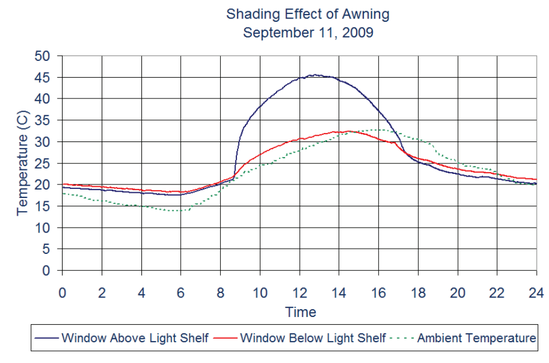
The designer created an integrated façade shading/lighting device (awning system) for commercial buildings that:

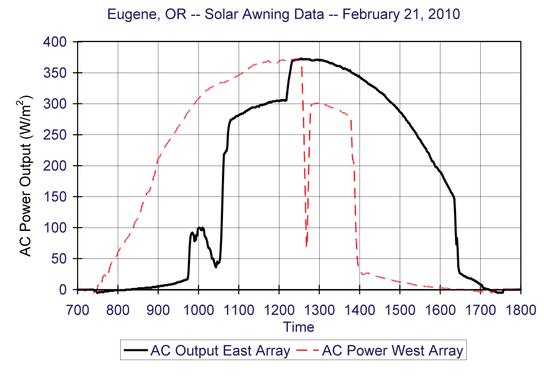
(1) saves energy by reducing solar loads on the building façades (approx. 60% reduction in cooling loads),

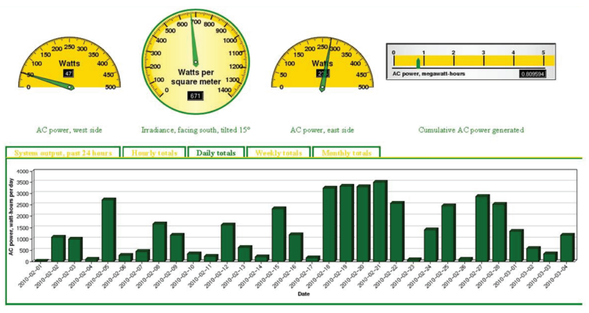
(2) generate energy from integrated Photo Voltaic cells (PV), and

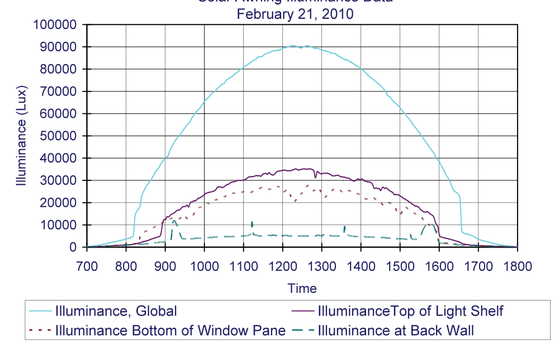
(3) emit energy from harvesting and reflecting daylighting energy deeper into space in the daytime and powering a low-energy LED electric lighting system for use at nighttime.

This three-in-one, Energy3 (E3) plug and play green building product could revolutionize the commercial building market leading to a market transformation in the construction of commercial buildings as well as an ease of retrofits for energy upgrades of existing buildings.



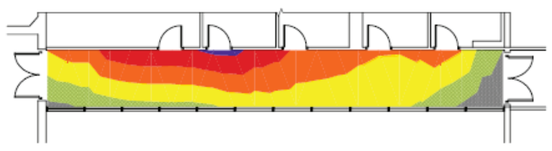




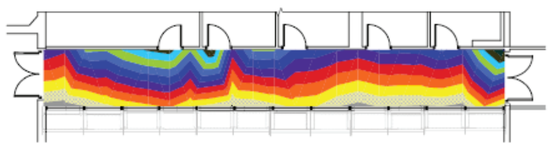


Luminance/Illuminance Performance and Visual Comfort

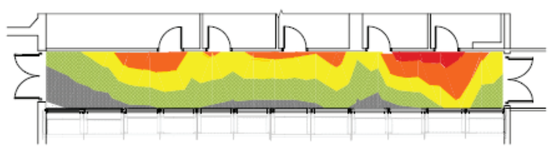
Daylight mockup 2nd floor existing w/o PV awning or light shelf



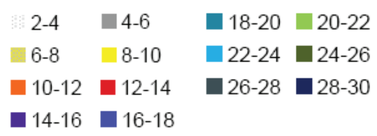
Daylight mockup 3rd floor w/ PV awning and light shelf



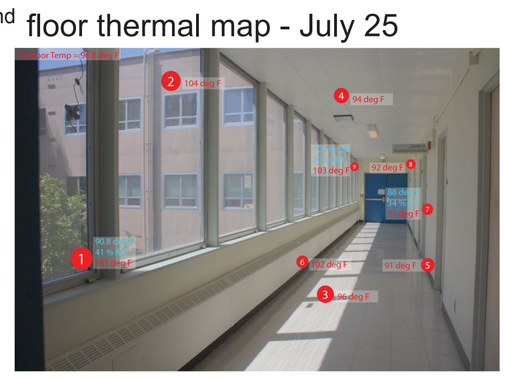
Daylight mockup 3rd floor w/ PV awning, no light shelf



Daylight Factor %



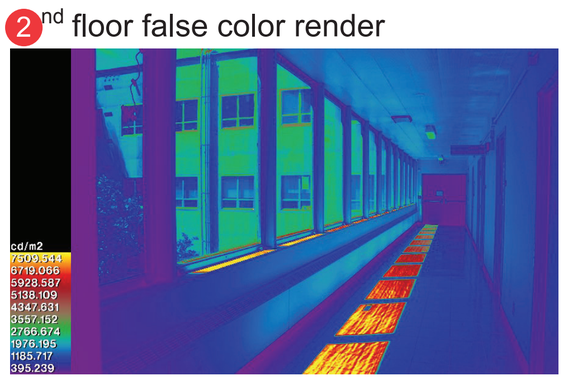
2nd floor thermal map - July 25



3rd floor thermal map - July 25

5 89.4 deg F = Kestrel meas. 4' - 0" above floor
31 %RH
84 deg F = Raytek meas. at floor, 4' - 0" above, 8' - 0" above, and ceiling

2nd floor false color render



3rd floor false color render

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This technology has the potential to:

- ***become an important tool for retrofitting and greening existing buildings***
- ***achieve the current green economy goals passed by Congress***
- ***achieve American Recovery and Reinvestment Act funding***
- ***enhance the Oregon economy by creating both short and long term job opportunities in emerging renewable energy industries.***

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