University of Colorado
TECHNOLOGY TRANSFER OFFICE

Low-cost, Modular, Building-integrated Photovoltaic-Thermal Collector

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Status:

Patent pending; available for sponsored research or partnering

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Ref. # CU2225B

Background

Buildings consume approximately 40% of the energy, and nearly 70% of the electricity used in the United States. Building surfaces are well suited to renewable energy production. The surface area of a typical residence is large enough to produce the electricity required to operate the building. However, in order to achieve net-zero energy use, solar thermal collectors are often required to produce hot water for domestic and space heating needs or pre-heated ventilation air.

Current problems with the approach to building based renewable energy production:

- Collectors are not integrated into the building surfaces and are not aesthetically pleasing.
- Both systems remain separate, each with different mounting systems, resulting in added expense.
- Because both systems are installed separately, total roof area required to meet electrical and hot water loads can exceed the roof area available.
- When mounted flush to the roof, photovoltaics tend to overheat, reducing efficiency and annual output.
- Collectors are durable enough to act as the building surface, but are typically installed over an existing building surface, resulting in unnecessary material use and added expense.

Technology

Chad Corbin is a graduate student in the CU Building Systems program in the CU-Boulder Department of Civil & Environmental Engineering. Chad proposes a research project to design a low-cost hybrid solar electric/solar thermal collector module that mounts directly to a building surface, forming the weathering skin of the façade. The collector replaces traditional building materials such as asphalt shingles or wood siding. The proposed project will combine electricity, hot water and pre-heated ventilation air production in a single collector that integrates mechanical connections and mounting system into the collector frame, resulting in a collector that installs quickly, and saves on traditional building costs.

Preliminary results based on Chad's thesis work indicate that electrical output can be increased 5% to 15%, with a total efficiency of 30% to 70%, by combining electrical and thermal collection in one unit. A properly sized BiPV/T collector can produce enough electricity and heat to satisfy all electrical, domestic hot water and space heating loads. If only 10% of an estimated 1.156 million new homes built in the US each year were to include a BiPV/T collector to reach net-zero energy use, total energy savings could total 1,232 GWh and 8.4 trillion BTUs, or 1.17 million metric tons of CO_2 per year.

Benefits

- The collector will reduce the amount of area required for solar electric, solar hot water, and solar air pre-heat by combing the functions into one collector.
- The framing system will eliminate the need for a third-party mounting system, reducing installed cost.
- Heat collection will improve solar electric output by actively cooling the photovoltaic cells.
- The collector will act as the weather-proof building surface, eliminating the need for traditional building materials and reducing the effective collector cost.
- The collector will be low profile and will integrate into the building skin, creating an aesthetically pleasing, uniform surface.
- The collector components will be designed to be easily manufactured and assembled by incorporating panel connections into the framing system, further reducing installation cost.

Key Document

"Low-cost, Modular Mounting System for Building-integrated Photovoltaic-Thermal Collector." Patent application filed May 5, 2011; available under CDA.