Task 56

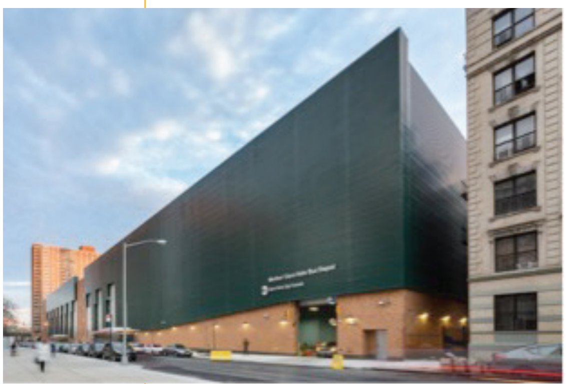
Building Integrated Solar Envelope Systems

Hurdles and opportunities offered by the exploitation of the solar source through multifunctional envelope technologies

Making use of the solar source is key in highly energy efficient buildings both to limit thermal and lighting needs and to cover the residual demands by means of technologies exploiting a high share of renewable energy. However, this requires the careful design of the individual technologies and the planning of their integration into buildings as they may eventually result in complex systems to operate and maintain, and the thermal and visual comfort of the users may not be guaranteed. Moreover, different strategies can be competing against one another (e.g., glare control against minimization of space heating demand) and finding an optimal solution is not straightforward.

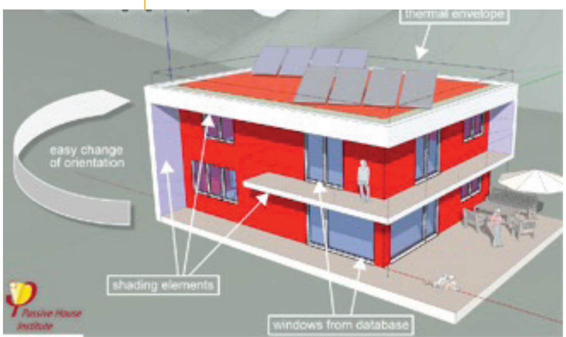
In the residential sector, solar thermal and PV systems are typically set up on building roofs with a limited attempt to incorporate them into the building envelope, creating aesthetic drawbacks and space availability problems. On the contrary, the use of facades is highly unexplored. Daylight control is delegated to the individuals' management of blinds and curtains, leading to high thermal loads both during mid-seasons and summer.

In non-residential sectors (i.e., offices, schools, hospitals), the roof is again, most of the time, the only surface devoted to the installation of solar thermal and PV technologies. While daylight control nowadays is state of the art in terms of shading effect, the utilization of shading devices to also redirect natural light into the room, improving visual comfort at the same time, has still to be expanded. Moreover, when energy efficient technologies are installed together with traditional ones, frequently the first are just "added on top" of the main systems, thereby investment costs burst and performance is hardly optimized.



Dark Green SolarWall on the three walls of Bus garage in New York City
(Source: SolarWall)

While taking advantage of the large areas of building façades with high solar irradiation is useful for electric and thermal conversion through PV and ST systems, the incoming irradiation could otherwise be exploited through extensive glazed surfaces, allowing for improved daylighting and passive solar heating. An interesting option to overcome these competing aspects is to combine multiple functions in integrated building envelope components, thus enabling these hybrid systems to use different aspects of solar energy simultaneously while guaranteeing envelope energy efficiency, users' comfort and architectural integration.



PHPP simulation environment
(Source: Passive House Institute)

IEA SHC Task 56 on Building Integrated Solar Envelope Systems for HVAC and Lighting focuses on the analysis of multifunctional envelopes that use or control incident solar energy in order to:

- deliver renewable thermal or/and electric energy to the systems providing heating, cooling and mechanical ventilation in buildings.
- reduce heating and cooling demands of buildings, while controlling daylighting.

The Task's scope is to prepare an overview of multifunctional solar envelope products and systems that are available or near to market, analyzing the conditions for their effective market penetration and discussing these factors with relevant stakeholders, such as technology

continued on page 5

Integrated Solar Envelope Systems *from page 4*

providers, consulting offices and architects. This is being accomplished through a number of different activities. On the one hand, by gathering relevant information on solar envelope systems in terms of energy performance, reliability and duration, architectural integration and costs. And on the other hand, assessing and categorizing tools available and opportunities offered by numerical simulation models and laboratory test methods for performance characterisation of solar envelope systems. Moreover, the barriers encountered by manufacturing companies, for example due to the large variability and inhomogeneity of construction standards among different countries, are evaluated and suggestions for improvement are being outlined.

The Task partners are also working to develop planning tools to use during the initial building design phase to easily predict technologies' performance when integrated in different building fabrics. To do this, partners simulate and monitor the interaction of the multifunctional solar envelopes with buildings heating, cooling and ventilation systems, and their impact on thermal and visual comfort. The lessons learned from this analysis will be used to elaborate simplified algorithms to be included in the planning tools.

Two partners are among others developers of DALEC (Day and Artificial Light with Energy Calculation) and PHPP (Passive House Planning Package). DALEC is a free online tool (www.dalec.net) supporting planners and architects to decide among different daylight and artificial lighting solutions in the early design phase. Based on the choices and climate data, daylighting and electric lighting are simulated in detail for a building while heating and cooling demands are calculated with a simplified approach based on standards. This allows an integrated evaluation of energy demands and visual and thermal comfort.

PHPP on the contrary, estimates the electricity demand for light and includes more thorough calculations in terms of space heating and cooling consumption by also taking into consideration the operation of heat pumps, solar thermal and PV panels.

Through the collaboration within SHC Task 56, it will be possible to add new simulation algorithms accounting for multifunctional components' performance.

Overall, SHC Task 56 work is devoted to supporting industry and consultancy with the market uptake and utilisation of multifunctional solar envelope systems. For this reason, the interaction with companies is of utmost importance. In addition to the cooperation within the Task activities, industry workshops are organised in conjunction with the Task's technical meetings. Here, invited companies present their technologies and projects in order to discuss in an open and collaborative environment the barriers and opportunities experienced when developing innovative building integrated solar envelope systems.

This article was contributed by Roberto Fedrizzi of EUREC and the SHC Task 56 Operating Agent, Ellika Cachat of Norwegian University of Science and Technology, Bärbel Epp of Solrico, Fabian Ochs of University Innsbruck, David Geisler-Moroder of Bartenbach, and Tomas Mikeska of Passiv Haus Institut. To learn more about SHC Task 56 visit http://task56.iea-shc.org/

1 **Webinar**
Advanced Lighting Solutions for Retrofitting Buildings
held on March 21, 2017

2 **Webinar**
Solar Heat for Industrial Processes
held on July 6, 2017

3 **Webinar**
Solar Energy in Urban Planning
held on September 13, 2017

4 **Webinar**
Energy Economy and Solar Heat –Perspectives and best practice
Held on December 14th, 2017. View here.

What role solar thermal will play in the energy sector in 2050 is one of the principal questions that the experts in IEA SHC Task 52 on Solar Heat and Energy Economics in Urban Environments intend to answer. This webinar will give information in two areas, one on energy scenarios about future development of energy systems and two on best practices, actual economy and planning tools for solar heat based urban energy concepts. Presenters: Sebastian Herkel of Fraunhofer Institute for Solar Energy Systems in Freiburg, Germany and IEA SHC Task 52 Operating Agent and Martin Joly of Sorane SA, a top Swiss company specializing in advanced building energy engineering.