Luminescent solar concentrator

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Abstract

Luminescent solar concentrator (LSC) is a device that has luminescent molecules embedding or topping polymeric or glass waveguide to generate electricity from sunlight with a photovoltaic cell attachment. LSCs can be employed both in small and large scale projects, independent on the direction or angle of the surface with respect to the sun, promising more freedom for integration in urban environments compared to the traditional PV systems. The aim of the SEB&C PDEng project is to investigate the applicability of this innovative technology in the built environment and to bridge the gap of knowledge linking societal, design and technological aspects. The final goal is to exhibit potential application concepts of LSC developed by co-creative methods at SPARK campus which is a hub for open innovation in built environment.

Necessity of a paradigm shift towards sustainable and smart cities came into being due to the significant increase in energy demand of the buildings. The challenge is to increase renewable sources in the energy mix while designing aesthetic environments. Thus, building integrated renewable energy technologies represent a great opportunity to help overcome this current challenge. Smart energy, energy efficiency and use of renewable sources are key aspects to be considered nowadays and many innovative technologies need further exploitation to be commercially viable, such as luminescent solar concentrator.

Keywords

luminescent solar concentrator; LSC; photovoltaics; urban environment; built environment; renewable sources; renewable energy technologies

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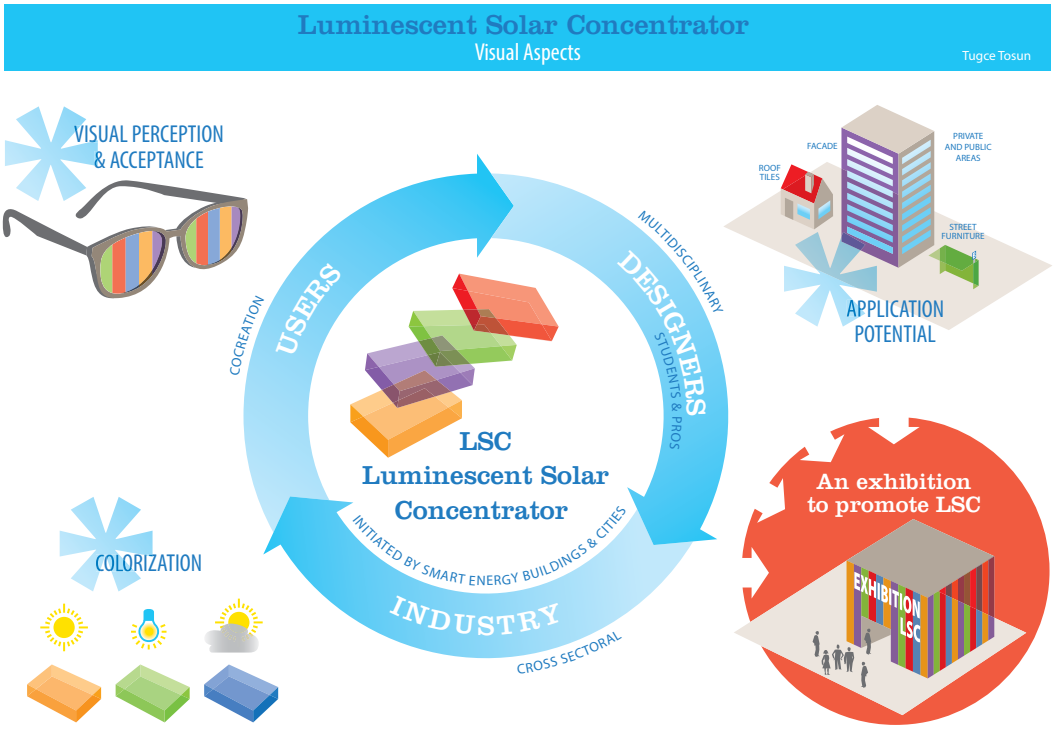

FIGURE 1 Graphical abstract

A luminescent solar concentrator (LSC) is a device that has luminescent molecules embedding polymeric or glass waveguide to generate electricity from sunlight with a photovoltaic cell attachment [1] [2]. LSC device can function in diffused light as well as direct light. It may come in a variety of colours, shapes and transparencies. This innovative technology can be employed both in small and large scale projects, independent on the direction or angle of the surface with respect to the sun. Therefore, it promises more freedom for integration in dense urban spaces and design choices compared to the traditional PV systems.

The main components of the device are a semi-transparent coloured plastic/glass panel and solar cells that can be attached to the edges and/or occasionally on the surface of the panel using glue. [1] The panel is usually composed of a transparent polymer plate containing luminophores that gives the original florescent color of the device. Type of the luminophore is one of the factors that influence the performance of the system and thus the power output. Current research about the organic dyes [2] [3] [4] asserts that some of the dye types shows better pho¬to-stability compared to others and can be considered for practical applications.

Even though LSC may offer many advantages over existing solar technologies, the design and presentation aspects of the device have not been properly explored. This study aims at exploring the applicability potential of LSC and showing that different products can be developed with it for integrating solar energy generation the built environment.

A participatory approach is being followed throughout the project. People from different fields of expertise are encouraged to involve at the initial product development phase of the project. In particular, co-creative workshops, interviews with experts and an open innovation survey are being executed to gather ideas with different perspectives about the applicability of LSC. The result of these co-creative idea generation methods will be later analysed and it will give us guidance to develop products using the LSC device.

Looking at the results gathered so far, it can be stated that, people perceive LSC as a technology that will help integrate renewable energy generation in urban areas. Exterior façade cladding, window glazing, public transportation waiting area, shading device and street lighting are some examples of possible applications proposed by the participants. Once, the question of 'what can be produced using LSC?' is exploited, 'how to produce these products' will be studied.

The results of this study will be exhibited at SPARK campus which is a hub for open innovation in the built environment. The exhibition is intended to increase the visibility of LSC while demonstrating different design concepts.

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