

POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Eco-efficient Product Design
Honors theses

**Energy and heat production through photovoltaic concentrator panels
integrable on buildings facades components**

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This thesis investigates the current technology photovoltaic devices, which exploit the renewable energy of the sun, and redesign to incorporate them in the facades of buildings.

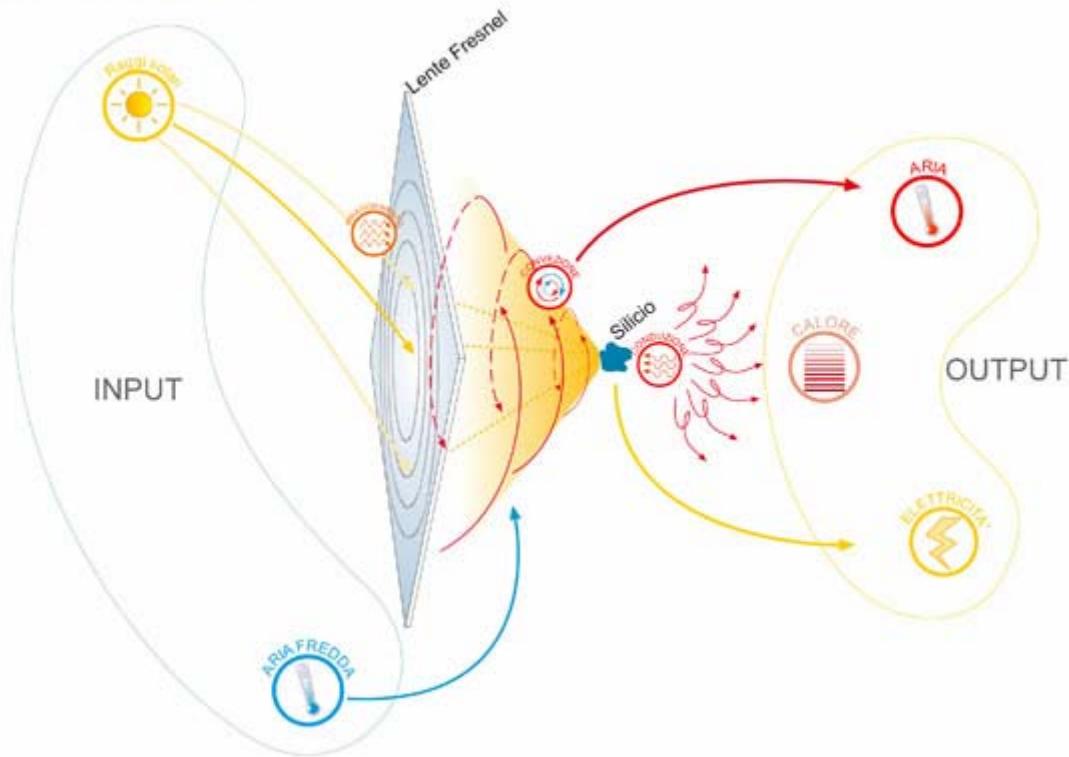
Incorporate for giving an architectural significance to the product that will be insert, in order to enable a visual recognition and increase the social rating to spread among the people the culture of sustainable development and making them partners.

The analysis started by concentrating photovoltaic panels as minimizing the amount of silicon, increase the production capacity of electricity and are made up of detectable components in industrial production in series.

A current module was composed of a Fresnel lens, which occupies a flat surface, that concentrates the rays on the cell, positioned in its focal point, which produces energy. These modules are assembled in lens-cell plastic housing. But at these high concentrations the cell produces heat in high quantities, which reduces the efficiency of the cell. That is why for each cell there is a heatsink that expels the heat unused.

An essential schema was drawn up by the components design methodology. It consists of the main components needed to maintain the functionality of the object, of the inputs and outputs and flows of energy and heat. The system is composed only from the lens and from the cell. The lens is hit by sunlight (input) and it directs rays toward the cell that produces energy and heat outputs. Heat that can be reused and not dissipate, and thus becomes input to another system, in this case the interior of the house.

fotovoltaico a concentrazione
Schema Essenziale



Simultaneously the methodological approach of components design has been applied to architecture. In this case, the facade has been considered, like the serial products, such as complex system apart and analyzed.

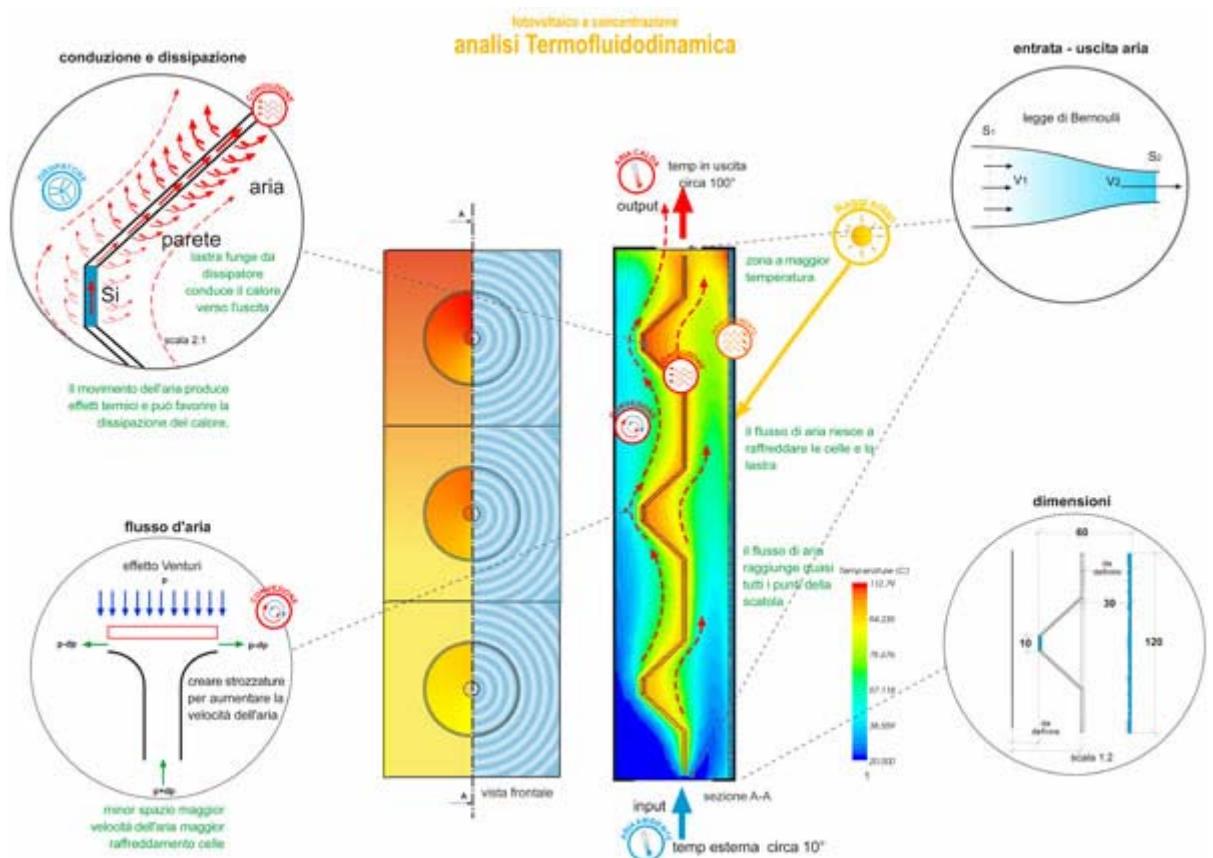
Have been identified as morphological elements of the facades the elements that are around the openings, structural elements as lintel and flat arch, and elements such as transom and container for blinds.

Analyzing the facade from the point of view of thermal insulation, through thermography, there was evidence points subject to thermal bridges.

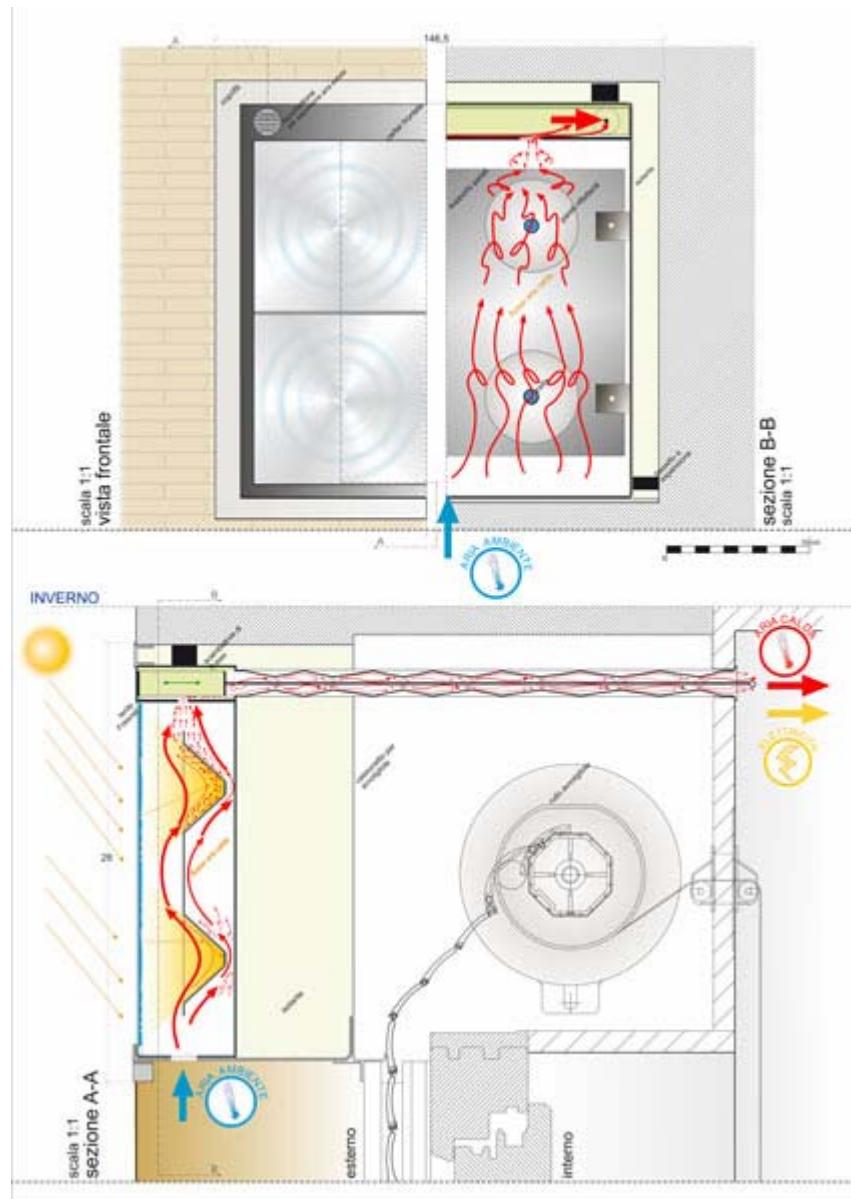
The area in front of the shutter and the box under the window are identified as areas most available and appropriate for inclusion in the panels.

Industrial products photovoltaic and the morphological elements analyses were connected.

To understand how the internal flows occur inside the panel and between the panel and building are been used virtual fluid dynamics analysis that led to the definition of characteristics of the panel as components, materials, sizes and shapes. It was concluded that exploiting the characteristics of heat transfer (conduction, convection and radiation) and thermal conductivity of materials can conduct heat from the cell to the cone walls and finally to air in a natural way, always towards high without the heatsink.



Regarding the transfer of heat is due to distinguish between winter and summer, although in both cases it was decided to intervene in a natural way, with the help of the physical transmission of the air without the use of electronic mechanisms. Through the design phase has been outlined a panel disposed in front of the dumpster roll-up window, integrated into the façade and it produces usable energy and heat inside the house.



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