How to make solar energy systems more widespread

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Retrofitting existing buildings with adequate cutting-edge technologies is thought to guarantees spectacular energy savings, by about 50%. The objective of the EU funded project BRICKER is precisely to demonstrate such possibility. Luigi Crema, a physicist who is the head of the Applied Research on Energy System (ARES) group at the Bruno Kessler Foundation, a private foundation dedicated to research and controlled by the Province of Trento, in Italy, talks to youris.com about the challenges of applying solar technologies to smart buildings, smart communities and smart cities.

Choose three keywords to describe your approach

Without a doubt the three guiding principles are: efficiency, effectiveness, and modularity. Efficiency is taken for granted. Systems based on renewable sources clearly have to compensate the costs needed to produce the energy. Effectiveness means that you need to make sure that the client's needs and expectations are fulfilled. End-users want to be able to use the energy when they need it, not when technology or nature – in the case of renewable energy – can provide it. Finally, modularity: each site is geographically distributed, has different characteristics, and different needs and has to be furnished with a system that is adequate for a given location. If these three characteristics are fulfilled, this technology is certainly a winning one.

What are the strategies adopted to reduce energy

consumption?

The strategy involves implementing different active energy production mechanisms for large public buildings. It relies on two renewable energy sources: concentrated solar power and biomass. The idea is to join them in a hybrid co-generation system, using a technology called Organic Rankine Cycle (ORC). This consists of a turbine activated by an organic fluid, working at much lower temperatures than those of the standard vapour or gas turbines. The system makes it possible to lower dependence on fossil fuels. In parallel, other partners in the project focus on passive technologies—that is, the integration of more efficient materials or elements that allow energy savings.

How does a concentrated solar power system work?

Nowadays, we use two main technologies to generate electrical or thermal energy from solar energy. One is the common photovoltaic system and the other is called concentrated solar power, or CSP. As the name suggests, this is when solar radiation is concentrated onto a receiver, a cavity or absorbing material to convert it into heat. The heat generated can reach very high temperatures, even 800ºC or 1,000ºC at the point where the radiation is concentrated. The ratio can be of a thousand to one or even more, which means that the radiation from the reflecting surfaces can be concentrated onto a focal point; one thousandth of the surface of the mirrors.

What kind of concentrated solar power technology are you using for the project?

We are using parabolic trough collectors that track the position of the sun and concentrate solar radiation onto a tube of limited dimensions, the receiver. This technology is designed to be easily adaptable to the roofs of large buildings. The tube acts like a so-called black body which absorbs radiation with only a minor fraction re-emitted. An organic fluid flows inside the tube and it can reach a temperature of about 250 ºC. The key point is that this temperature is maintained constant in the loop thanks to a biomass boiler directly connected to the solar system.

The issue is that the sun is an intermittent source. Therefore, a constant supply of radiation to the receiver is not guaranteed. On a rainy day or at night, then, the fluid temperature would drop and the solar system would not be efficient. So the hybrid system is conceived to allow a small energy accumulation that covers the time required for the biomass boiler to be activated to compensate for the missing energy from the sun.

What was your role in the project?

The energy savings can be achieved through different designs. We have to identify the best configuration of the modules of energy systems to guarantee efficiency—minimal energy loss—in each site. Our role is to determine the optimal configuration of the system by introducing experimentally measured data. We have to guarantee a stable generation of energy with variable energy demand profiles. We call this method 'dynamic modelling' and it provides a virtual model of the functioning of the system. This is how we identified the different needs of the three showcase projects. One of the objectives of the project is to propose a modular technology that can match the needs of different locations.

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