Boosting the energy efficiency of working buildings with passive and active technologies

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There is nothing like the real world to reveal a project's true worth. This is why a project called BRICKER will test its mettle out by retrofitting public buildings situated in three different countries in three different climatic zones. The goal: to significantly boost the energy efficiency of these working buildings by combining passive and active technologies in a system that could be rolled out across Europe.

The project is to tackle retrofitting of administrative offices in Extremadura, Spain; an engineering college building in Liège, Belgium; and part of a university hospital in Aydin, Turkey. A return on the

retrofit is expected in around seven years. "After retrofitting, we expect to have the same comfort levels in the building, using 50% less energy," says Yunus Çengel, dean of the faculty of engineering at the Adnan Menderes University in Aydin.

In the Turkish showcase, the plan is to install solar films on east- and west-facing windows and solar shades on south-facing windows in summer to reduce the energy thirsty air-conditioning load. Heat exchangers that allow incoming cold air to be preheated by outgoing stale heated air, without mixing, will also be installed.

The first stage is to monitor the existing building. But new technologies, like the solar powered heating, cooling and electrical generation system, will then be installed and their impact assessed.

In their more northerly clime, Belgian high-school building blocks will be upgraded to better hold onto energy; this will be done by insulating with a polyisocyanurate rigid foam (PIR) that contains "phase-changing materials" – these can adsorb and store thermal energy which its structure changes.

"Simulations suggest that a five centimeter-thick PIR-insulation could reduce the thermal transmission factor ten-fold, and thus limit heat loss. After the reconditioning of the building, the walls and the roofs are expected to achieve a thermal transmission factor further cut by a third," says Raymond Charlier, industrial engineering expert attached to the Liège Provincial Building Service, who spoke to youris about the challenges which retrofitting faces.

In the Belgian showcase, double-glazing with built-in solar protective layer will replace monolayer glass windows in the school – representing a four-fold energy efficiency gain. The school building is expected to move from an E class energy level to a B class, with savings in electricity

and natural gas and reductions in greenhouse gas emissions.

The third project will be in Spain, with the focus on an administrative building of the Regional Government of Extremadura. Here, the emphasis is on solar and biomass technologies. Therefore, only active energy saving measures will be applied to what is a relatively new building with good passive behaviour.

"The project consists of integrating Parabolic Trough Solar Collectors (PTC), a biomass boiler, a heat and electricity cogeneration unit based on Organic Rankine Cycle (ORC), an adsorption chiller and a cooling tower," explains Noemí Jiménez, industrial engineer at CEMOSA, a company that specialises in the study of materials and building control. "The PTC and the biomass boiler will produce hot oil that will feed the ORC unit. The ORC unit will produce electricity as well as hot water."

Solar parabolic collectors track the sun and focus sunlight on a tube, heating fluid inside up to 300 degrees Celsius. The Rankine cycle is based on a mathematical model that is used to predict the performance of steam engines. The advantage of such ORC thermally activated cooling is that it harnesses waste heat that is then used for cooling. These innovative technologies are introduced here on the project website.

The Spanish wing of the project faces two major challenges. First, it combines technologies that have never before been used together. Second, it integrates these technologies into an existing public building. And like the other projects, the retrofit must work around an occupied public building.

"One of the initiatives included within the framework of the project is the drafting of a replication plan. It includes an evaluation of the potential for replication of other government buildings in Extremadura," explains Carolina Grau, general director of industry and energy at the

Agriculture, Rural Development, Environment and Energy Council of the Government of Extremadura.

Energy consumption in the non-residential sector is typically around 40% higher than in the residential sector in Europe, so there is plenty of scope for improvement. A major goal of the project is to refine its approaches so that they can be applied to other public buildings around Europe. The potential replication is 1 in 314 buildings in Belgium and Spain alone.

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