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Pumped-storage hydroelectricity systems in buildings

Pumped-storage hydroelectricity systems are to be found throughout the world, but always on a large scale. Guilherme Silva and Patrick Hendrick, researchers from the ULB Brussels School of Engineering, investigated whether energy storage via pumped hydro systems is possible on a very small scale, in particular in buildings. They used the Goudemand apartment building in Arras in France as their case study.

The Goudemand apartment building in Arras in France has one surprising feature: an open-air water tank on the roof, connected to cisterns in the building's basement. Using the principle of pumped hydroelectricity, these water tanks constitute a form of energy storage, unprecedented in buildings but not necessarily advantageous vis-à-vis other storage technologies. This finding sums up the conclusion of the study conducted by **Guilherme Silva and Patrick Hendrick from the ULB Brussels School of Engineering** and recently published in the journal *Applied Energy*.

Pumping water up to a reservoir located on higher ground with a view to subsequently releasing it to drive a turbine and produce electricity is the principle behind pumped-storage hydroelectricity production. This form of energy storage is to be found throughout the world. In Belgium, for example, the Coo-Trois-Ponts power plant run on the principle of pumped-storage hydroelectricity, plays an important role in ensuring the nation's energy balance and is able to reactivate the power grid in the case of a black-out. The principle of pumped-storage hydroelectricity is however little used on a small scale, for instance in buildings.

With this in mind, the two researchers set out to examine the feasibility and cost effectiveness of such systems. The smallest pumped-storage hydroelectricity system they found was in Greece, but it turned out to be too large to apply to a building. The two then got wind of the Goudemand apartment building in Arras in France. Managed by the regional social company “Pas-de-Calais Habitat”, the building had been recently refurbished, with solar panels and wind turbines installed on the roof. But it is its pumped-storage hydroelectricity system which makes the building unique.

After having found this rare jewel, the researchers set about studying this enormous battery: they conducted a full analysis of the building and then built a model allowing them to extrapolate the results for other similar buildings. Thanks to these simulations, the researchers realised that the economies of scale which make large pumped-storage hydroelectricity systems economically viable are not present in such small systems. Moreover, large amounts of water are necessary, requiring large and heavy facilities which are difficult to install in an urban context. Integrating such a system in a building's water supply system is also a challenge for water quality.

As other storage options (for instance lithium-ion batteries) seem to be more cost-effective, pumped-storage hydroelectricity does not seem to be an interesting option for use in buildings. However, the researchers point to the case of buildings located for instance close to a canal, a factor which could reduce the cost of such a system. Furthermore, the full impact of such pumped-storage hydroelectricity systems (for instance on CO2 emissions) has not yet been calculated and compared to other technologies. Until then, installations such as the Goudemand residence help to pump up knowledge on the subject.

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Article:

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