

Latvijas Zinātņu padome

Noslēguma posma konsolidētais vērtējums

Projekta nosaukums: Izp-/1-0363 Smart building EnVElope with solaR Energy STorage (EVEREST)

Zinātniskā izcilība

The project obtained the three main planned outputs in terms of realisation of the dynamic façade with solar energy storage ("SOLARAGE"), experimental testing (in both laboratory and real conditions), and numerical modelling. The project topics have been developed through a rigorous analytical study, including an in-depth literature review, a robust experimental campaign and an excellent valorisation of the results. Analytical and experimental tests confirmed that the project idea was good, robust, innovative, and envisaged further development. Detailed design and prototype implementation have been accurately executed. Results confirmed the research's excellence in terms of advancement beyond the state of the art and opportunities to go ahead in investigating further aspects and applications of the idea. Relevant scientific innovations can be observed in the fields of both PCM (Phase Change Materials) integration in building envelopes and adaptive dynamic building envelopes (in the specific case, based on dynamic shading systems and solar concentrators). The research team, also supported by the steering committee, demonstrated high project conduction capabilities. The perspectives of the research are promising and aim to achieve higher TRL levels. For these reasons, the team has to further investigate issues related to performance stability due to control system adaptation in different operating contexts, the reliability of the hardware-software system, and the durability of material working upon deformation cycles. Preventive and ordinary maintenance guidelines can be beneficial. Another aspect to stress is the scalability of SOLARAGE in facades of different dimensions. This aspect requires more studies on constructive details. There is also the need to provide a broad suitability to interconnect SOLARAGE facade with BEMS or HVAC control systems to achieve the smartest exploitation of its potential in the energy management of a building. To this end, more industrial research and experimental research in pilot or demo installations must be planned. The availability of several subjects to host these installations in their buildings and the perspective of new research project funding applications is a plus for planning and achieving future activities.

Ietekme

The project has a sound potential impact in the field of buildings' energy efficiency from several points of view: scientific research, policy development, society and economy. To spread and disseminate the results, the team has accomplished an intense activity higher than those originally included in the C&D plan reported in the project proposal. In particular: - five scientific papers have been published in important scientific journals, and one paper is currently under review; - two datasets have been published, in line with the EU goal of Open Science; - three oral presentations and four posters at Conferences; - six international partnerships have been firmly established (Aalborg University, Danish Technical University, University of Venice, project SWEDA, VTT Finland, Project B+NESDG). The dissemination activity report presents a detailed list of 39 public events/meetings/advertising where the project's concepts have been delivered to different stakeholders. These activities have led to three possible solar façade demonstration sites in other technical institutions. In addition, public authorities might create a platform to demonstrate active building envelopes in the public sector. A patent on the SOLARAGE concept has been submitted to the Latvian patents board, demonstrating the potential exploitation of the project's technological results. As the team discussed new project proposals for Horizon Europe calls with three foreign universities, the reviewers suggest pursuing this task to develop further and diffuse the SOLARAGE concept.

Īstenošana

The project implementation has been efficient and fruitful. All scheduled activities and work packages were conducted as planned, and all milestones and deliverables were met, despite the problem of the global Covid-19 pandemic that occurred during the project time. WP1 (Project management) and WP5 (Information dissemination) were active throughout the project implementation. Project supervision has been efficiently leading to complete project fulfilment. In WP2, the smart building envelope SOLARAGE optimised by adding the dynamic component to improve its thermal performance has been tested in an artificial environment. The research team has edited the deliverables: WP2.1 "Project outline and literature review", WP 2.2 "Design and experimental tests of the smart building envelope in artificial environment" and WP2.3 "Passive control strategy" which are complete and exhaustive in describing activities and results. In WP3, experimental data obtained in laboratory testing were used to validate the mathematical model developed to describe the behaviour of the solar façade module. The related deliverable "WP3. Numerical simulation of solar façade" is excellent. In WP4, an up-scaled version of the solar facade module was designed and built (see the deliverable WP4. 1. "Large scale module development"), and an experimental setup was elaborated. A validated mathematical model was used to simulate the developed facade under typical meteorological conditions in Latvia. The report WP4.2. "Large-scale testing under real climatic loads" describes the tests as well as the deliverable WP4. "Large scale testing. Automation system operation algorithm" the control logic. The project obtained the involvement of several master's and PhD students and the integration of projects' activities and results in the course "Energy Efficiency in Buildings" at RTU University. In particular: four Master theses have been defended, and one more is planned in 2023, together with a bachelor thesis. In addition, a PhD thesis is ongoing. This appropriate student involvement has guaranteed the excellent advancement of knowledge in the field of active building envelopes, laboratory testing, and system dynamic modelling. As a matter of fact, the students' and PhD candidates' engagement was excellent.

Projekta mērķis sasniegts