

## Popular science summary of the PhD thesis

PhD student	<u>Afshin Mashayekh</u>
Title of the PhD thesis	<u>Numerical analysis of cold thermal energy storage for liquid air energy storage systems</u>
PhD school/Department	<u>DTU Construct</u>

### Science summary

\* Please give a short popular summary in English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology.

In order to limit the adverse effects of climate change, greenhouse gas emissions must be reduced rapidly. Decarbonization is primarily achieved through the use of renewable energy sources, such as solar and wind. Renewable resources, however, come with inherent variability, which makes it impossible to fully decarbonize the electricity sector without reliable energy storage solutions.

Thermo-mechanical energy storage systems are a promising solution because they can store energy for long periods and do not rely on critical materials. Among these technologies, liquid air energy storage has emerged as a promising candidate. In these systems, excess electricity is used to liquefy air during the charging cycle, and electricity is regenerated by evaporating and expanding the liquid air during the discharging cycle. Liquid air energy storage offers several advantages over other storage technologies, such as high energy density, absence of geographical limitations, and environmental safety. However, liquid air energy storage systems generally suffer from relatively low round-trip efficiency in comparison to other alternatives.

This research focuses on the enhancement of cold thermal energy storage systems within liquid air energy storage applications. Cold thermal energy storage plays a critical role in the overall liquid air energy storage cycle by storing the cold energy released during air evaporation in the discharging phase and reusing it during air liquefaction in the charging phase. Improving this subsystem is essential for achieving cost-effective and high-performance liquid air energy storage solutions.

The methodology involves numerical thermodynamic simulations, heat transfer modeling, and techno-economic analysis of both the overall liquid air energy storage system and the cold packed bed energy storage system, with the aim of developing cost-effective and practical enhancements to cold thermal energy storage in liquid air energy storage applications.

Please submit the summary to the department PhD coordinator together with your thesis