

## The VacPCM project abstract for general public

### Research project objective

The recommendations of the so-called European Union *Green Deal* introduced a number of challenges related to the energy efficiency and energy demand of various energy systems. In particular, these recommendations affect the temperature-controller supply chains (also known as Cold Chain). Inefficient cold-chain and food-chain systems are directly related to the increase of the energy consumption required for food storage and transportation, food waste caused by improper food storage and the quality of the food products for the final consumer. Therefore, the main objective of the VacPCM project is the design and fundamental research of the food storage container equipped with the cold thermal energy storage system (CTES) integrated with the vacuum freezing unit. Such a system can be used for a simultaneous freezing of the food products and the phase change material used in CTES. As a result, the novel freezing, storage and transportation method for food products will be developed. Consequently, the outcome of the project will be used for the minimisation of the food waste related to the outdated storage techniques used in the Cold Chain and significantly improve the energy performance of these supply systems.

### Motivation

The aforementioned *Green Deal* recommendations and the *Farm-to-fork* strategy require the development of new storage and freezing methods for the food products. The vacuum freezing method can be considered a novel and promising freezing technique. That freezing method guarantees the rapid freezing process which is beneficial from the product quality point of view. In addition, the literature review showed that the energy efficiency of vacuum freezing is exceptionally high. Moreover, vacuum freezing may be used to freeze the phase change materials (PCM) for the CTES. The results available in the literature did not consider the simultaneous vacuum freezing of the food product and PCM inside the container designed for food storage and transport. The fundamental research that takes into account all of the partial processes related to the vacuum freezing of food products and PCM performance during the food products storage phase will significantly improve the development of effective and safe food freezing and storage systems for novel and state-of-the-art Cold Chains.

### Project work plan

The VacPCM project will include numerical and experimental activities. Moreover, these activities will be performed in a parallel manner. Within such an approach developed numerical models for the vacuum freezing and CTES system performance simulations will be validated with the detailed experimental data gathered on the dedicated experimental test rig. The work plan of the project will be composed of the six research tasks such as:

- Activities 1 & 2: Numerical and experimental analysis of the vacuum freezing of food samples
- Activities 3 & 4: Numerical and experimental analysis of the vacuum freezing of various PCM solutions
- Activities 5 & 6: Numerical and experimental analysis of the PCM melting and heat transfer inside the CTES-aided storage system