One of the fundamental tasks facing scientists and engineers today is to ensure efficient methods of energy production and management. In view of the limited resources of fossil fuels and global problems related to environmental pollution, working on the continuous improvement of the energy sector is a necessity and our duty.

Examples of energy devices that are subject to constant development are ground and aviation gas turbines. Since the popularization of gas turbine engines (after the Second World War), intensive work has been carried out to increase their efficiency. In general, the increase in the efficiency of these devices is realized by (1) rising the operating temperature and/or (2) **improving the flow and pressure control of the gas streams** through successive elements of the turbine. In both cases, it is required to introduce new materials with a greater heat and heat resistance, as well as **to use new design solutions**.

Particular attention should be paid here to the issue of seals used between the rotating elements of the engine and its housing. Providing adequate clearance between the rotating turbine blades has a documented effect on reducing fuel consumption. Maintaining the right clearance has become a particular challenge in modern engines. The former engines (manufactured in the 1950s) operated at relatively low pressure ratios and the clearances above the blade tips were large enough to avoid friction between components. On the other hand, modern gas turbines have a much higher pressure ratio of ~ 25:1. To keep the performance as high as possible, the sealing clearances have been significantly reduced. Smaller clearances **lead to frictional contact at the sealing points** and necessitate the incorporation of **abradable sealing elements that are designed to wear during operation**.

Currently, the most common **abradable sealing solution** is based on so-called honeycomb structures. These types of seals are made of thin films (70 to 130 μm thick) arranged in equal hexagonal cells, 1/32 to 1/8 inch in size and soldered to the seal back plate. Today, thin films are mainly made of nickel superalloys (e.g., **Hastelloy-X**). Nevertheless, it should be emphasized that honeycomb seals structures have some significant limitations and disadvantages. Among them, the most important are: (1) high susceptibility to mechanical damage at the stage of production, assembly and operation; (2) insufficient heat resistance; (3) a low wear resistance.

The Superpore-X project focuses on the development of new materials and technologies for the application in gas turbine seals. The long-term vision of the project is to introduce **new, functionally graded, porous Hastelloy-X alloys** with improved performance and longer service life compared to current honeycomb seals.

Hence, **the main scientific goal** is to develop a process/structure/property relationship for the production of Hastelloy-X porous alloys with controlled pore size and distribution through experimental studies of the fundamental phenomena controlling pore formation.

In addition, **the main technological goal** is to design and implement a clean and easily scalable method of producing this type of materials based on powder metallurgy and the "space holder" approach. The main question we pose in the project is: "*Can we produce functionally graded Hastelloy-X alloys with predefined porous structure and properties that are competitive to that of honeycomb seals?*"

To answer to this question, the suitability of our new Hastelloy-X porous alloys as sealing materials will be assessed by **examining their performance properties** (namely oxidation resistance, abrasion and high temperature mechanical properties) **in comparative studies with honeycombs**. Finally, as proof of concept, exemplary components made of a functionally graded porous Hastelloy-X alloy with a predetermined (final application oriented) pore size and arrangement, will be provided.