



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 40th cycle

THEMATIC Research Field: NOVEL SCO₂ MACHINERY FOR PUMPED THERMAL ENERGY STORAGE SYSTEMS

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	<p>The research aims at designing novel machines, mainly turbomachinery, for application in 'Carnot Battery' energy storage systems operating with supercritical CO₂. In the initial phase, a conceptual design of the machines will be done using standard design tools. Subsequently, the most critical machines of the system will be optimized developing a tailored and novel multidisciplinary shape-optimization strategy. The ultimate objective is therefore to conceptualize, design and optimize a new class of machines tailored for energy storage systems.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The doctoral candidate will apply existing calculation and design methods for the design of axial and radial fluid machines, introducing the necessary updates and specific features required to deal with energy storage systems. The doctoral candidate will also have to develop a novel multi-disciplinary shape-optimization technique for turbomachinery, which will have to pursue the optimal machine design considering aerodynamic, structural, and thermal aspects. The doctoral candidate will also have to deal with designing machines operating in thermodynamic conditions close to the critical point and, therefore, exposed to the risk of condensation or cavitation, adapting the fluid dynamic model to the different phenomena encountered.</p>



Educational objectives	To provide a high-level knowledge about advanced thermo-fluid-dynamic concepts applied to thermal fluid-machine design and optimization. Up-to-date skills for fluid mechanics and thermodynamic modeling.
Job opportunities	National and international companies in the field of energy conversion and energy storage systems, with specific focus on turbomachinery design and operation. Consultancy companies. Private and public research centers.
Composition of the research group	3 Full Professors 1 Associated Professors 2 Assistant Professors 4 PhD Students
Name of the research directors	1

Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years.</p> <p>Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed</p>



by the regulations.

Computer availability: individual use.

Desk availability: individual use.