



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

PNRR 630 Research Field: STRATEGIES FOR DECARBONIZATION OF THE INDUSTRIAL, CIVIL, AND TERTIARY SECTORS IN PRE-ALPINE TERRITORIES

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 objective is to identify the best renewable energy production technologies tailored to the specific characteristics of the regions involved, taking into account the energy needs of key sectors such as manufacturing, tertiary, and public and private construction. These needs will be influenced by future electrification processes expected in manufacturing companies and the residential sector. Therefore, the project will study the best energy generation technologies based on specific requirements and territorial characteristics.</p> <p>Phases of Research Activities:</p> <ol style="list-style-type: none"> 1. Mapping of Energy Needs: Mapping the energy requirements of industrial, public, and private sectors. 2. Critical Analysis of Generation Technologies: Conducting a critical analysis of applicable energy generation technologies and examining the economic and financial aspects related to the construction of plants. Technologies will include: renewable power generation, waste heat recovery, cogeneration, heat pumps, and district heating networks. 3. Foresight for Energy Demand: Identifying and forecasting the energy needs for various types of energy carriers.



	<p>Among the generation technologies, innovative thermodynamic cycles based on supercritical CO₂ (sCO₂) will be studied in detail and modeled. This includes studying sCO₂ cycles for waste heat recovery (WHR) applications and for heat pump systems.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Calculation tools will be developed for the study of innovative thermodynamic cycles based on supercritical CO₂.</p> <p>First, a numerical model will be created for simulating waste heat recovery (WHR) power plants. These sCO₂ systems will be compared with Organic Rankine Cycles (ORC) and traditional steam Rankine cycles.</p> <p>Another calculation model will study CO₂ cycles for heat pumps operating at medium-low or medium-high temperatures. In the first case, the heat pumps will supply urban district heating networks, while in the second case, they will serve thermal loads within industrial processes.</p> <p>In all cases, the calculation models will serve two primary purposes:</p> <ol style="list-style-type: none"> 1. Preliminary Component Sizing: They will enable the preliminary sizing of the main plant components by estimating their energy performance. 2. Performance Analysis: They will study the operation and performance under off-design conditions, allowing for simulation of the real plant operation as load and environmental conditions vary throughout the year.
<p>Educational objectives</p>	<p>To provide high-level knowledge about advanced thermodynamic and thermo-fluid-dynamic concepts applied to design and optimization at both system and component levels. Additionally, to equip individuals with up-to-date skills in numerical methods for energy engineering.</p>
<p>Job opportunities</p>	<p>National and international companies in the field of energy conversion systems, with a specific focus on thermofluid-dynamic and turbomachinery design and operation. Additionally, consultancy companies, as well as private</p>



	and public research centers and universities.
Composition of the research group	5 Full Professors 7 Associated Professors 7 Assistant Professors 40 PhD Students
Name of the research directors	Paolo Silva

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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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Acinque Spa
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	To be defined
By number of months abroad	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 by the regulations.</p>



Computer availability: individual use.

Desk availability: individual use.