



# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

PNRR\_352 Research Field: DEVELOPMENT, MODELLING AND OPTIMIZATION OF THE ALLAM CYCLE

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1400.0**

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**

The progressive increase of the share of renewable energy sources in the national and global energy scenario, is one of the most relevant key goals of the very next future. The decarbonization process, the so called *“green revolution”* and the *“Ecological transition”* are also one of the Mission of the PNRR Programme, specifically with mission M2C2.1 Among the possible technologies to reduce fossil CO<sub>2</sub> emissions, CO<sub>2</sub> capture and storage is one of the most cost effective, especially for the medium-term. The research program of the PhD project focuses on the Allam cycle, a novel high efficiency oxycombustion cycle. The PhD project focuses on the optimization of the cycle by means of modelling activities, thermodynamic analysis, and numerical optimization algorithms. The final goals are to identify cost-effective cycle designs (techno-economic optimization) and to optimize the cycle configuration for the most promising applications (e.g., process industry). The PhD candidate will be involved in the research activities related to the agreement between Politecnico di Milano and Nuovo Pignone (<https://atlante.energy>). The candidate will have to spend a period of 6 months at Nuovo Pignone and a minimum of 6 months abroad in a university or research institute.

**Methods and techniques that will be developed and used to carry out the research**

The models and algorithms will leverage on and, eventually, extend those already developed by Politecnico



	<p>di Milano. Additionally, thermodynamic models (e.g. equation of state) to be validated with data from existing pilot plant. The modelling approach will be based on process/cycle simulation software and ad hoc codes for the preliminary design of the cycle components (heat exchangers, turbine, compressors, etc). State-of-the-art optimization algorithms (e.g., surrogate-based derivative-free algorithms) will be used to perform the techno-economic optimization of the cycle and/or the design optimization of the components. The PhD candidate is thus expected to interact with a multidisciplinary team of researchers.</p>
<p><b>Educational objectives</b></p>	<p>The PhD candidate will grow professionally, acquiring transversal skills in thermodynamics, turbomachines, supercritical CO<sub>2</sub> cycles, cycle modelling and advanced optimization algorithms. Furthermore, the PhD candidate will learn about the challenges arising in the development of a novel cycle. At the same time, the candidate will also be able to strengthen some soft skills, such as:</p> <ul style="list-style-type: none"> <li>• The ability to acquire new knowledge autonomously</li> <li>• Critical assessment</li> <li>• Communication and scientific communication, both oral and written</li> <li>• Time management</li> <li>• Project management</li> <li>• Teamwork, in a multidisciplinary and international group.</li> <li>• Moreover, the PhD program foresees advanced programming/coding courses and scientific writing classes.</li> </ul>
<p><b>Job opportunities</b></p>	<p>This research activity will qualify the candidate for future academic and research positions, as well as for a highly qualified professional career in industries or organizations operating in the energy sector. Collaborating institutes: Nuovo Pignone, Baker Hughes.</p>
<p><b>Composition of the research group</b></p>	<p>1 Full Professors                  1 Associated Professors                  0 Assistant Professors                  6 PhD Students</p>



<b>Name of the research directors</b>	Prof. Emanuele Martelli
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<b>Contacts</b>	
Prof. Emanuele Martelli (research director): Emanuele.martelli@polimi.it	
PhD secretariat: phd-STEN@polimi.it	

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

<b>Scholarship Increase for a period abroad</b>	
Amount monthly	700.0 €
By number of months	6

<b>National Operational Program for Research and Innovation</b>	
Company where the candidate will attend the stage (name and brief description)	Nuovo Pignone
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Da definire (to be defined)
By number of months abroad	6

**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information**

**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. The amount is about Euro 5700.

**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.

**Computer availability:** individual use.

**Desk availability:** individual use.

Accommodation in Politecnico's Residences (<http://www.residenze.polimi.it>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application).