



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

THEMATIC Research Field: MODELLING AND OPTIMIZATION OF HIGH EFFICIENCY POWER GENERATION CYCLES

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

Decreasing CO₂ emissions is one of the most relevant key goals of the very next future. Using green hydrogen and capturing CO₂ are two possible ways of mitigating CO₂ emissions from energy systems. To limit the increase in the cost of electricity, it is fundamental to increase the efficiency of the energy conversion cycle (so as to consume less fuel and/or to generate less CO₂). The best available technologies (fuel cells and combined cycles) reach efficiency values in the range 60-64% (LHV basis). However, according to different literature studies, hybrid gas turbine- fuel cells cycles could achieve efficiency values as high as 80% (LHV basis). These cycles could be suitable not only for utility scale power plants but also for propulsive applications. The research program of the PhD project focuses on the development, modelling and optimization of hybrid gas turbine-fuel cells cycles 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.

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

The models and algorithms will rely on or extend those already developed by Politecnico di Milano. 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.
Educational objectives	<p>he PhD candidate will grow professionally, acquiring transversal skills in energy systems, thermodynamics, fuel cells, turbomachines, 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"> •The ability to acquire new knowledge autonomously •Critical assessment •Communication and scientific communication, both oral and written •Time management <p>Teamwork, in a multidisciplinary and international group Moreover, the PhD program foresees advanced programming/coding courses and scientific writing classes.</p>
Job opportunities	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: original equipment manufacturers (OEMs), energy companies, utility companies, EPC (engineering procurement and contractor companies), consulting companies.
Composition of the research group	1 Full Professors 1 Associated Professors 0 Assistant Professors 9 PhD Students
Name of the research directors	prof. Emanuele Martelli and Paolo Chiesa

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>Increase in the scholarship for stays abroad: euro 750 per month, for up to 6 months.</p> <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> <p>Computer availability: individual use.</p> <p>Desk availability: individual use.</p> <p>Awards: Awards will be recognized to the PhD candidate up to Euro 2500 (gross amount) per year, in case of exceptional achievements in the research project, subject to the evaluation of the research director.</p>