



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

THEMATIC Research Field: STRATEGIC ANALYSIS OF THE SMR/AMR INTEGRATION IN THE ITALIAN ENERGY SYSTEM

Monthly net income of PhDscholarship (max 36 months)
1700.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
<p>Motivation and objectives of the research in this field</p>	<p>The global energy transition requires the rapid deployment of low-carbon, reliable and secure energy sources capable of supporting industrial development while ensuring environmental sustainability. In this context, nuclear energy is increasingly being reconsidered as a strategic component of future energy systems, particularly through the deployment of Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs). These technologies promise enhanced safety features, greater flexibility, reduced construction risks, and new non-electric applications, but their successful deployment depends not only on technological maturity, but also on effective governance frameworks, financing models, regulatory readiness, and industrial organization.</p> <p>Despite growing international interest, significant gaps remain in understanding how national nuclear ecosystems—especially in countries without recent new-build experience—can be structured to enable the effective introduction of SMR/AMR technologies. Challenges related to supply chain capability, workforce development, licensing approaches, stakeholder coordination, and alignment with energy policy objectives represent critical barriers that require interdisciplinary research. In particular, the Italian and broader European context offers a relevant case study, characterized by</p>



	<p>strong industrial and research capabilities, evolving regulatory frameworks, and renewed policy discussions on the role of nuclear energy in achieving climate and energy security goals.</p> <p>The motivation of this Ph.D. research is therefore to contribute to the development of evidence-based strategies that support the creation of a sustainable and competitive nuclear ecosystem, bridging the gap between technological innovation and policy, industrial, and regulatory implementation. By integrating technical, economic, and governance perspectives, the research aims to support informed decision-making by public authorities, industry stakeholders, and investors.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research is open to a multiscale modelling approach, in which detailed physics-based models (e.g. CFD simulations at component or reactor scale) can be used to inform the parametrization of energy System Optimization Models (eSOMs), while eSOM results may in turn be integrated into higher-level Integrated Assessment Models (IAMs) to assess system-wide and policy-relevant impacts.</p> <p>The research will adopt a quantitative, model-based approach centered on the use of energy System Optimization Models (eSOMs) to assess the role of advanced nuclear technologies, including SMRs and AMRs, within future energy systems. Following a review of existing modelling frameworks, a suitable eSOM will be selected and customized to explicitly represent SMR/AMR characteristics, such as modular deployment, construction lead times, operational flexibility, fuel cycle assumptions, and potential coupling with non-electric applications.</p> <p>Sensitivity and comparative analyses will be performed to evaluate the robustness of results and to quantify the impact of SMR/AMR deployment relative to alternative technology portfolios. Model results will be validated through benchmarking against existing studies and expert feedback.</p>



	<p>Overall, the adopted methods aim to provide robust, quantitative evidence to support strategic and policy-relevant decisions on advanced nuclear energy deployment. Overall, the adopted methods and techniques are designed to ensure robustness, transparency, and applicability of the research outcomes, supporting evidence-based recommendations for the development of an effective and sustainable nuclear ecosystem.</p>
<p>Educational objectives</p>	<p>The main objectives of the research are:</p> <ul style="list-style-type: none"> •to analyze the key governance, regulatory, and financing models supporting the deployment of SMR/AMR technologies in selected international case studies; •to assess the readiness and potential evolution of the nuclear industrial supply chain, with particular attention to skills, standards, and organizational structures; •to evaluate the role of nuclear energy in national energy transition scenarios, including system integration and non-electric applications; •to develop policy and strategic recommendations aimed at enabling an effective, transparent, and socially acceptable deployment of advanced nuclear technologies. <p>Through these objectives, the research seeks to provide original contributions to the academic literature and practical insights for policymakers and industry, supporting the long-term viability of nuclear energy as part of a resilient and decarbonized energy system.</p>
<p>Job opportunities</p>	<p>Energy Analyst for energy utilities and/or for NGOs and international organization or public institutions including private players The Ph.D is carried out within the JRP Nuclear of Fondazione Politecnico di Milano including: Ansaldo Nucleare, Edison, ENI, ENEL, Newcleo, Siad SpA, Sogin, Tectubi Raccordi, Brembana & Rolle, ETS SpA, CdP Venture Capital</p>
<p>Composition of the research group</p>	<p>2 Full Professors 4 Associated Professors 2 Assistant Professors 7 PhD Students</p>
<p>Name of the research directors</p>	<p>Emanuela Colombo, Marco Pellegrini</p>



Contacts

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Additional support - Financial aid per PhD student per year (gross amount)
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	1st year	2nd year	3rd year
Housing - Foreign Students	1000.0 € per student	1000.0 € per student	1000.0 € per student
max number of financial aid available: 1, given in order of merit ..			
Housing - Out-of-town residents	--		

Scholarship Increase for a period abroad
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Amount monthly	850.0 €
By number of months	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.

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.

Awards: Awards can be recognized to the PhD candidate up to Euro 3.000,00 (gross amount, per year). More details about this program will be provided by PhD Program Steering Committee.