



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

PARTENARIATO PNRR Research Field: AN ENVIRONMENTAL DECISION-SUPPORT SYSTEM: A DATA-DRIVEN LIFE CYCLE ASSESSMENT TOOL FOR IMPROVING THE SUSTAINABILITY PROFILE OF POSITIVE ENERGY DISTRICTS

Monthly net income of PhDscholarship (max 36 months)

€ 1600.0

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

**PE2-NEST Spoke 8 - CUP D43C22003090001
Decreto di concessione D.D. 1561 del 11/10/2022**

The building sector is recognized as a major contributor to the overall environmental impact of humankind's activities. The sector accounts for about 30-40% of the total energy consumption in the European Union. In this context, European guidelines aimed at reducing the environmental burden of the construction sector have moved from the scale of buildings to groups of buildings, hence districts, and from a "nearly-zero energy" approach to the more challenging and stringent concepts of "positive energy" and "climate neutral". Energy and Environmental Decision Support System (EEDSS) tools have been developed for urban district planning. Although these kinds of tools are already on the market, offering solutions for planning new districts and renovating existing ones by applying the Life Cycle Assessment methodology, standardized in Europe by EN 15978 and EN 15804, for supporting the decisions, there is still a gap in the approach to dynamic district modeling. The dynamic issue concerns not only the energy loads of buildings (already implemented in energy modeling software) but particularly the emission factors used in LCA for the assessment. Especially Positive Energy Districts (PED),



	namely, districts that produce more energy than they consume, should be planned and designed by maximizing the energy consumption produced on-site concerning the hourly environmental profile of energy required off-site, particularly electricity from the national grid. The research proposes to develop a tool for evaluating PEDs in terms of environmental, cost, and social profile, equipped with dynamic emission factors (with hourly environmental profiles), thus capable of optimizing district planning more consistently (i.e., energy systems and photovoltaic modules).
Methods and techniques that will be developed and used to carry out the research	After an initial study on the positive energy districts, energy systems for supply energy (district energy networks, decentralized and centralized), and the process-based life cycle sustainability analysis, a model to analyze the energy loads of the buildings will be selected, among available Urban Energy Building Modellings open tools (e.g., City Energy Analyst, etc.) and/or in-house developed tools. Data from the following districts will be used to estimate energy loads and define the configuration of the district heating and cooling microgrids: (i) L'Innesto – Scalo Ferroviario Greco Breda; (ii) GreenBetween – Crescenzago; (iii) ARIA – Ex Macello; (iv) MIND – Ex Area EXPO Milano; and (v) Green Soul – Ravone Prati. The outcomes will be used to develop the tool, composed by: (i) a background Life Cycle Inventory database; (ii) dynamic emission factors (at least the electricity grid hourly); (iii) power-mass correlations to scale up the appliances. A programming language or numeric computing environment (e.g., python, Matlab, etc.) will be utilized in this regard. The validation of the tool will be supported by a literature review of the previous scientific articles, a common practice in LCA.
Educational objectives	To deepen knowledge Life Cycle Sustainability Assessment method (environmental, cost, and social aspects), including dynamic modeling. Modeling skills and LCA tools and databases.
Job opportunities	R&D within the district heating industry. Research in academia or public and private institutions. Energy



	Services Energy Management and Energy Auditing Companies. Software providers.
Composition of the research group	2 Full Professors 2 Associated Professors 2 Assistant Professors 7 PhD Students
Name of the research directors	Prof. Mario Motta, Prof. Livio Mazzarella

Contacts	
Research group: <i>Buildings Environment and Energy Systems (BEES)</i> https://www.energia.polimi.it/dipartimento-di-energia/ricerca/gruppi-di-ricerca/sistemi-energetici-e-ambientali-negli-edifici-bees/ <i>marcello.aprile@polimi.it</i> <i>jacopo.famiglietti@polimi.it</i>	

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	800.0 €
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.: 6 522.50 Euro 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. <i>Computer availability:</i> individual use. <i>Desk availability:</i> individual use.