



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

PNRR 118 PA Research Field: THERMAL MANAGEMENT AND ENERGY OPTIMISATION OF HIGH ENERGY DEMAND IT SERVER ROOMS IN PUBLIC BUILDINGS

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

Server Rooms in tertiary buildings represent a significant share of the total energy consumption in finance and public offices, estimated at 4% of the EU27+2 tertiary sector. This demand is expected to grow even more due to the increasing trend for the total EU electricity consumption of data centers, from 55 TWh/y in 2010 to 160 TWh/y in 2030. Server rooms must include cooling, humidification, dehumidification, low ambient cooling controls, and rugged construction able to operate 7x24 (referred to as CRAC units). Redundancy (n+1) is key to allowing concurrent maintenance and operation during a failure of one of the primary CRAC units. LCA studies revealed that the main environmental impacts derive from the electricity use of IT equipment and the associated CRAC units. Moreover, 80% of data centres are small server rooms and closets with up to 25 racks, mostly located in public buildings. Therefore, **thermal management of server rooms and valorization of IT equipment waste heat will play a crucial role in the digital and ecological transition of public administrations.** However, procurement of environmentally sustainable IT equipment and the associated CRAC units requires strong interdisciplinary competences. A step ahead is needed to promote and improve technology solutions for efficient thermal management of IT servers in the public sector. In this



	regard, the objective of the research is twofold: i) to develop a Decision Support System (DDS) for the redesign and development of sustainable IT Server Rooms in public buildings, with a special focus on replicability through standardization of digital and technical equipment innovative solutions; ii) in parallel, a highly innovative rack-integrated adsorption based cooling system is developed and optimized to carry out efficient liquid cooling of IT servers and, simultaneously, provide cooling to the server room itself in a compact, self-contained, and cost-effective way. By contributing the redesign and simplification of the selection and adoption processes of enabling IT technologies and solutions, the research aims to foster cost-effectiveness and energy and environmental sustainability of the public action.
Methods and techniques that will be developed and used to carry out the research	After an initial multidisciplinary study on the thermal management of IT server rooms, the capabilities of the commercially available monitoring and control platforms, procurement guidelines for the public sector, and conventional and innovative, i.e. adsorption based, IT equipment cooling, a library of models to analyze the energy loads of typical IT server rooms in public buildings will be developed, based on detailed dynamic modelling of technological solutions ranging from the commonly employed (e.g., in row cooling) to the highly innovative ones (e.g., liquid cooling, adsorption cooling). This models library will constitute the base for the development of the DSS tool, along with cost data and definition of energy, economic and environmental KPI useful in the procurement selection process. The DSS capabilities will be validated in a real case study, where the DSS will assist in the selection, engineering design and procurement for the renovation of an IT server facility of a public building at CNR-ICCOM Pisa. In this regard, a study period of 6 months at CNR-ICCOM Pisa is foreseen during which the candidate will also benefit from the unique competences of the CNR institution on adsorption materials and adsorption based cooling. Experience in this field will be key in performance testing and optimization of an innovative rack-integrated IT



	equipment cooling system at ReLAB, a laboratory facility of Politecnico di Milano.
Educational objectives	To deepen knowledge in thermal management of IT equipment and innovative technologies for IT waste heat valorization. To promote procurement guidelines for ICT hardware and ancillary equipment for public administrations focusing on environmental, cost, and energy efficiency aspects.
Job opportunities	Procurement of efficient IT server rooms in the public sector. R&D within the IT and building industry. Research in academia or public and private institutions. Energy Services, Energy Management and Energy Auditing Companies.
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	
<i>Research group: 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>tommaso.toppi@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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	CNR-ICCOM Pisa
By number of months at the company	6



Institution or company where the candidate will spend the period abroad (name and brief description)	
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.: 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.

Computer availability: individual use.

Desk availability: individual use.