ENERGETICS

DENERG/CRT - AI-based energy management and information systems for enhancing energy performance in grid-interactive efficient buildings

Funded By	Dipartimento DENERG FONDAZIONE CRT CASSA DI RISPARMIO DI TORINO [P.iva/CF:06655250014]
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Context of the research activity	Energy Management and Information Systems (EMIS) exploiting Artificial Intelligence, provide great opportunities to optimise energy management in buildings. Specifically, both Fault detection and Diagnosis systems (FDD) and automated system optimization solutions (ASO) are the focus of this PhD project to unveil the real value of this new paradigm behind EMIS.
Objectives	Enhancing energy efficiency during building operation is becoming a key aspect to address the challenges posed by the energy and digital transition processes in the building sector. In this perspective, Energy Management and Information Systems (EMIS) provide great opportunities to facility owners and managers to optimise the energy management of buildings and their energy systems exploiting measured building-related data coming from pervasive monitoring infrastructures. Specifically, the development of both energy information systems (EIS) and automated system optimization solutions (ASO) can be enabled when advanced data analytics techniques are employed to extract knowledge from monitoring data. The research proposal aims to investigate the potentialities of Artificial Intelligence (AI) – based services for enhancing the performance of buildings and energy systems during their operation specifically focusing on two main aspects. On one hand, novel Fault Detection and Diagnosis (FDD) processes will be developed to automatically recognize fault occurrence and identify the causes and the location of fault in relevant building energy systems such as HVAC systems. This research is relevant because HVAC systems are frequently operated in faulty conditions due to lack of proper maintenance, failure of components or incorrect installation that leads to uncomfortable indoor environment, poor indoor air quality and significant wastes of energy and money. On the other hand, the definition of energy management strategies employing advanced control methods to reduce their operational energy demand is subject of investigation. To this purpose predictive and adaptive

	approaches need to be explored to automatically improve system operation considering multiple objectives and autonomously adapting to dynamic conditions. The research activities will be then focused at different levels of detail from system level up to building and district level. Specially for the ones pertaining advanced control, the focus on the district level will unveil new opportunities to achieve control objectives for cluster of buildings as a way to provide services to the energy grid by enhancing energy flexibility.

Skills and competencies for the development of the activity	• Data-driven building energy management; • Energy data analytics technologies; • Building physics and HVAC systems; • Physics-based and data-driven based modeling of digital twins for the built environment and building energy systems; • Programming skills (Python and R environment are considered preferential); • Knowledge of state of the art of machine learning algorithms; • Knowledge of simulation environment for the assessment of predictive building energy management strategies.