



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 40th cycle

PNRR 629 PA Research Field: DEVELOPMENT OF OPTIMISATION AND ENERGY MANAGEMENT MODELS FOR THE LECCO ENERGY COMMUNITY

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	<p>Renewable energy communities (RECs) have been identified as key tools in supporting the European Union's transition to climate neutrality by 2050. In 2019, the Clean Energy for All Europeans Legislative Package (CEP) acknowledged the pivotal role of energy community (EC) ownership in advancing the European Union's climate and energy objectives. The CEP introduced a facilitative legislative framework designed to empower citizen and renewable energy communities. Notably, two directives within this package marked a historic milestone at the European level by explicitly recognizing the EC concept. The Directive 2008/2001 (RED II), a revision of the European Renewable Energy Directive, provided a comprehensive definition of the Renewable Energy Community (REC). Simultaneously, the Directive 944/2019, known as the Internal Electricity Market Directive (IEMD) and focused on electricity market design, delineated the model for Citizen Energy Communities (CEC). In this context, the Italian interpretation of European regulatory packages on RECs provides opportunities for consumers, businesses, and institutions, with available funding potentially strengthening the Italian energy market. In particular, on the 23rd of January 2024, the Ministry of the Environment and Energy Security published the ultimate decree defining the regulatory framework for the incentives and the rules for the</p>



	<p>participation to a REC project, and GSE, shortly after, published the related technical guidelines, ending the legislative process. Three different REC models have been so far developed in Italy: bottom-up, top-down, and energy operator-driven. However, the majority of the initiatives fall under the top-down approach, led by local authorities or non-profit organizations. In particular, small municipalities such as the Municipality of Lecco, face challenges due to the lack of technical and administrative expertise. The design and management of a REC presents, in fact, multifaceted challenges, particularly in urban areas characterised by high population density and limited space for renewable energy technologies implementation. In this context, the effectiveness of decision-making is paramount, yet hindered by the absence of a reference design framework and evaluation criteria. The objective of the thesis is, thus, to develop a methodological approach and a tool, based on urban energy simulations, energy data analysis and multi-objective optimization (MOO) models to support the optimisation and management of the recently founded Renewable Energy Community of Lecco.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The thesis is developed in collaboration with the Municipality of Lecco, that recently launched an urban REC, including Politecnico di Milano among its members and prosumers. The research work will be developed both at the Department of Energy of Politecnico di Milano (Bovisa Campus) and at the Municipality of Lecco. The aim of this research is to develop a methodology supporting decision-makers in the implementation of REC models in urban environments. The methodology will provide optimal scenarios of REC configuration, under multiple criteria: technical, economic, and environmental. For this purpose, it will exploit urban building energy modelling (UBEM) tools, to carry out dynamic energy analyses at the urban scale, and multi-objective optimization (MOO) models, to include decision-makers multiple perspectives. Furthermore, the methodology will be translated into an automatized process, to model REC scenarios in urban contexts, releasing technical, economic, and environmental results. The main research</p>



	<p>question is: how to assess optimal scenarios of potential REC users' aggregation within an urban context?</p> <p>Intermediate objectives are moreover defined: (i) to define an integrated model of a REC pointing out consistent technical, economic and environmental parameters; (ii) to define a mathematical optimization model based on those parameters; (iii) to develop an algorithm enabling the integration of each procedure stage into a single automatized process.</p>
Educational objectives	<p>The candidate will deepen his/her knowledge of building physics and dynamic urban energy modelling and simulation. He/she will train on data analysis, especially applying advanced clustering techniques, such as machine learning, to develop archetypes and to define RECs interventions. Eventually he/she will get competence on multi-objective optimisation algorithms, adopted to evaluate technical and economic solution.</p>
Job opportunities	<p>The candidate will gain experience to apply for vacancies in engineering societies, in consultancy firms, in building construction industries, DSO and energy services company (ESCo). Moreover, he/she will be trained to work as energy manager in public and private bodies, including RECs.</p>
Composition of the research group	<p>2 Full Professors 4 Associated Professors 2 Assistant Professors 10 PhD Students</p>
Name of the research directors	<p>Francesco Causone</p>

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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Comune di Lecco
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
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