



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

PNRR 630 Research Field: A DYNAMIC ENERGY MODELLING-BASED METHODOLOGY FOR SETTING OPTIMAL BUILDING ENERGY RENOVATION CONTRACTS

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>In 2012, the Energy Efficiency Directive (EED) complemented the Energy Performance Building Directive (EPBD) by encouraging ambitious renovations through the requirement for Member States (MS) to establish strategies for the renovation of their national building stocks (to be submitted and updated every three years), as well as to annually renovate 3 % of the central governments building stock to a high energy performance level. However, the share of the annual building stock that underwent a major renovation has been, so far, very low: below 1% in Spain, Poland, Italy or Sweden; around 1% in the Netherlands or Lithuania; above 1.5% in other countries like Germany, France or Austria. In Italy, the so called "Superbonus" incentive, determined a rapid increase of the building renovation rate for years 2021, 2022 and 2023. However, this incentive showed to be economically not sustainable for the State, and its cancellation already resulted in a rapid slowdown of building retrofits for the year 2024 with a likely stall scenario for the coming years. The revised version of EPBD (v.4) recently (12 April 2024) adopted by the EU Council, on the other hand, will require to delivering tangible results for Europe's citizens and businesses in the coming years. Thus, business working in building energy renovation urgently requires new business models to make the application of the new EPBD possible and</p>



	<p>economically feasible without the adoption of State incentives that may affect National debit. These business models must be based on solid technical bases able to evaluate at the same time whole-building technical requirements and economical constrains. The objective of the thesis is to develop a methodological approach and a tool, based on dynamic energy simulations, real estate clustering (archetype or reference building) and multi-objective optimisation able to support business to develop new and effective business models, such as energy service contracts, to promote EPBD deployment in due time.</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 A2A Energy Solutions, a company working in the field of building deep energy retrofit. The research work will be developed both at the Department of Energy of Politecnico di Milano (Bovisa Campus) and at the company headquarters (via Francesco Caracciolo 52, Milano). The thesis will be based on advanced clustering techniques for the analysis of the building stock and the definition of archetypes (or reference buildings) to be used in the following steps. For this purpose, the output of the URBEM project (PRIN2020) will be adopted. A series of retrofit scenario based on regulation (EBPD, EED, REDII) and climate constrains will be defined and simulated via dynamic energy simulation tools, with the aim of both informing the technical design of the interventions and the economic esteems. Eventually a multi-objective optimisation algorithm will be set up to define the "optimum solutions" to be applied to the archetypes, weighting capital costs, maintenance costs, and energy/operational costs. This will lead to develop new and effective business models, such as energy service contracts, on the basis of sound energy analysis.</p>
<p>Educational objectives</p>	<p>The candidate will deepen his/her knowledge of building physics and dynamic 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 retrofit interventions. Eventually he/she will get competence on</p>



	multi-objective optimisation algorithms, adopted to evaluate technical and economic solution. On the basis of the technical analysis, the candidate will contribute to the generation of business models applied to the building retrofit industry, gaining competences extremely useful for future jobs in private and public businesses.
Job opportunities	The candidate will gain experience to apply for vacancies in engineering societies working in the design and execution of building energy retrofit, in consultancy firms, in building construction industries, DSO and energy services company (ESCo).
Composition of the research group	2 Full Professors 4 Associated Professors 2 Assistant Professors 10 PhD Students
Name of the research directors	Francesco Causone

Contacts	
francesco.causone@polimi.it	

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)	A2A Energy Solutions
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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