

Efficiency assessment of water-energy nexus in residential buildings

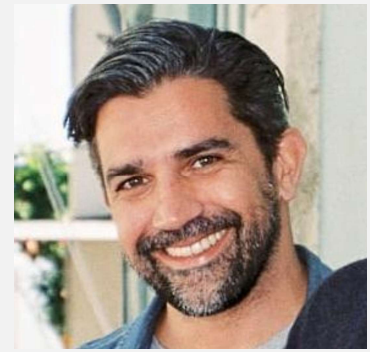
Summary

Not only does energy production need water, but water supply is also energy dependent. The provision of freshwater to households, from surface and groundwater sources or via desalination, the transport and distribution as well as the collection and treatment of wastewater require energy. The amount of energy required depends on a range of factors, such as topography, distance, water losses, equipment and system inefficiencies and the level of required treatment. Despite the energy consumption in the urban water cycle in Portugal representing a small fraction of the total Portuguese energy needs (only 2% according to the International Energy Agency 2016), this consumption can be significant at the local level. Water supply and wastewater collection and treatment account for about 50% each of the total energy demand of the urban water sector. The utility bill of households, related to water uses represents 30% of the total, considering hot water uses. All the above considerations denote that the use and management of energy and water resources, in residential buildings, need to be addressed in an integrated approach, this is not what actually happens in practice. There are currently no recommendations or standards from the actual and the future Energy Efficiency Directive, for water use. Some associations and governments have undertaken initiatives to include water-related efficiency targets, asking water utilities to meet these targets, but none for residential buildings. The implementation of voluntary or mandatory water-energy nexus efficient solutions would decrease water demands which, consequently, would lead to lower energy consumptions, together with the application of energy efficiency measures, operational optimisation of treatment plants, and addressing leakage in water networks.

The aim of the current research is the establishment of an integrated methodology for the assessment of water use and water-energy consumption at the household level. The methodology is objective-oriented (objectives>criteria>metrics) and incorporates a performance assessment system with key-performance indicators, a weighting system and improvement measures. The methodology will be tested, calibrated and validated in a set of Portuguese residential buildings with different typologies. The proposed research approach is the following: (i) Development of a state-of-the-art review on water efficiency performance assessment applied to households; (ii) Data collection, processing and analysis on the Portuguese residential sector, related to its installed water equipment and infrastructure and detect incoherent data and modify it into accurate and validated data; (iii) Methodology development integrating a KPI assessment system based on /following recommendations established in the Energy Performance Building Directive, for the residential buildings; and (iv) Methodology testing, calibration and validation with different case studies.

Keywords

Performance assessment, water-energy nexus, residential buildings.



PhD student

Pedro Manuel Saraiva Cardoso

PhD program

Sustainable Energy Systems (IST, University of Lisbon)

Supervisor

Dídia Covas (CERIS, IST, University of Lisbon)

Co-supervisor

Marta Cabral (CERIS, IST, University of Lisbon)

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