Urban Sustainability: a holistic approach for energy planning and operational dimensions

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URBAN SUSTAINABILITY: A HOLISTIC APPROACH FOR ENERGY PLANNING AND OPERATIONAL DIMENSIONS

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Abstract *Strategic energy planning in cities is an emerging research field that is key to shift toward smarter and more sustainable communities. Increased awareness of environmental risks and human engagement can promote the communities toward natural and social flourishing, regarding domains namely ecology, economics, politics, and culture. Therefore, cities energy planning must bring together all the sustainable requirements toward integrated solutions and it needs new methodologies with a multi-perspective and holistic approach regarding the subjects, objects, and spatiotemporal domain of the communities.*

While macro-scale energy planning methodologies are well consolidated, the small-scale application still faces technical challenges such as the dynamic of an energy system with increasing penetration of distributed RES and the interaction of different functional layers (technology, policy, environment and communication layers) as well as multiple and diverse stakeholders. There is also the need for long-term cross-sectoral analysis and a fine disaggregation of the energy demand on a spatio-temporal domain. In this regard, it is important to develop a method to analyze the technology penetration, in order to understand the adoption mechanisms and develop policy strategies to act on accordingly. To address the above-mentioned issues, there is the necessity of combining different modeling frameworks and ICT solutions. The aim is to integrate temporal and spatial aspects, capturing the interactions between energy technologies and the physical infrastructure that distributes energy from producers to consumers while keeping into account constraints and feedback from regulators, economic drivers, and social behavior. This will require a bi-directional amalgamation of planning and operational perspectives, working toward the interoperability of models. In addition, Agent-Based Modeling (ABM) approach should be addressed because it is a suitable modeling technique in order to study real-world Complex Adaptive System (CAS), such as the urban communities. Specifically, ABM can feature concepts like heterogeneity, complexity, autonomy, explicit space and local interactions. The final goal is better understanding and prediction of: i) how consumers use energy, ii) how individuals react to information about the costs and benefits of energy choices and iii) how energy policies affect the behavior of the individual and, consequently, of the whole society.