

# DOVE INIZIA L'INTELLIGENZA

*Saggio sull'evoluzione delle infrastrutture energetiche e degli assetti insediativi*

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## INTRODUCTION



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## ENERGY INFRASTRUCTURES FOR THE RESTORATION OF LOCAL GEOGRAPHICAL CONDITION

This study focuses on the transition from a centralized energy system, based on fossil fuels and passive management, to a distributed, renewable and interactive system at urban scale through the configuration of Local Micro Grids.

This topical theme revolves around the definition of “evolution” and aims to implement actions of strategic priority in the Environmental and Technological Management of Settlement Processes. Here, the innovation of energy infrastructure is regarded as a complex instrument able to restore Local Geographical Conditions through the maximum technological diversity. The theme of the infrastructure development can be considered from a specific and topical point of view: the relationship between material infrastructures and the dematerialization processes introduced by the IT revolution.

This work intends to provide a conceptual framework in order to disseminate a greater comprehension of Distributed Renewable Interactive energy system as technological solution able to synchronize the social and technical low carbon city transformation in an ecological perspective.

The book is divided in three parts. The first part entitled “Infrastructures. New models against taxonomies at sunset” introduces the state of the art of energy infrastructure and the research hypotheses assertion. The second part “Energy Infrastructure in Applied Research” represents the process of the hypotheses falsification. Such a process is based on information gathered from several experiments concerning the energy infrastructure technological innovations and the sustainable urban transformations. The third part describes the path “towards a new operating theoretical framework”, defining the organizational principles and the main tools of the Distributed, Renewable and Interactive energy system.

In conclusion, in order to develop a preliminary technological literacy on the implementation of Micro Local Grids urban vision, eight adaptable and implementable actions are illustrated, thus pointing where urban intelligence begins.

## PART ONE

# INFRASTRUCTURES. NEW MODELS AGAINST TAXONOMIES AT SUNSET



This first part introduces the state of the art of energy infrastructure and the research hypothesis assertion about energy infrastructure and settlement evolution. This topic is investigated starting from the current energy policy about the Low carbon City transition. Currently, the European energy policies focus on a diversified set of energy technologies listed in the Strategic Energy Technology Plan (SETplan). From the SETplan point of view, all the listed technologies are able to build the Low Carbon City; however, if we take into account the real technologies able to restore Local Geographical Conditions, the above-mentioned list is clearly reduced. Hence, the need for an innovative approach to the Low Carbon City emerges. The novel approach is characterized by the evolutionary mechanisms the Low carbon City transition has to be founded on.

The research questions are: what type of energy infrastructure is able to interact with such evolutionary mechanisms? What are the conditions the new energy infrastructure is called to operate in? To what extent is it possible to organize these conditions?

The Distributed and Renewable energy system together with its Interactive emergent property represents a possible solution. Therefore, a novel conceptual framework on energy infrastructure is needed to understand, communicate and develop the new system properties. The novel conceptual framework is based on a combined reading of Hughes's Large Technological System definition, considered more coherent to introduce the description of the energy system components as ecosystem services, and Zeleny's description of High Technology components, useful to explain the whole system functionality and its interactions with the local community.

By doing so, the conceptual framework establishes the inalienable features in which the evolution of the Distributed and Renewable energy system is called to operate. The new model is called Local Micro Grid and its implementation and interaction with the settlement opens a new research path towards the Environmental and Technological Management of Settlement Processes.



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In the second part, the investigation proceeds with the hypotheses falsification by examining some selected case studies.

The experiments analysed have been taken from different sections of the 6th European Framework Programme for energy infrastructure: Sustainable Energy Systems; Energy Efficiency; and specifically for the urban transformation, the Concert Initiative.

Within Sustainable Energy Systems, the focus issue is technological innovation. The examination indeed concentrates on a number of instruments to configure the "Smart Grids", in particular the operation of the Virtual Power Plant and its related processes.

Within Energy Efficiency, the major theme is the increasing energy efficiency in a highly diversified technological system, where the following aspects are under consideration: high-efficiency mechanisms, tariff management, study of incentives and decisional processes according to specific energy supply systems.

Within Concert Initiative, we can see how these innovations impact on the material and immaterial elements of urban transformations.

The choice of focusing on case studies from the 6th European Framework Programme arises from the need to deal with experiences already finished and entirely assessed in their processes, as well as, from the necessity to understand the evolution of the guidelines included in this European research programme, these being currently leading the new frontiers of applied research, such as the concept of Smart Cities.

The falsification has determined a conceptual framework and operational results directed to the promotion of settlements respectful of the local geographical conditions and based on the maximum technological diversity.

The results are presented in tables, which identify a set of general objectives and general strategic interventions according to the local needs, technical and technological instruments and processes implemented by each operation.

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In the third part, the information collected from the applied research is organized in order to enhance the emergent property of Local Micro Grids. Such organization is founded on three organizational principles: economic competitiveness and green economy; technological innovation and environmental qualities; quality of life and environmental values. These organizational principles are the key driver factors towards an infrastructural evolution, which seeks to synchronize the social and technical low carbon city transformation in an ecological perspective. Hence, to better understand how such synchronization can be implemented, the main Virtual Power Plant properties are associated with the conceptual framework proposed, underling how the Virtual Power Plant leads to an adaptive behaviour of the energy system, capable of self-adjusting according to external conditions, whether due to different supply systems or to the users' needs.

In this way, an operational perspective emerges, this being based on the Virtual Power Plant technical-organizational wealth and the possibilities offered by the new human-machine interactions. These interactions have to be understood at local level. Therefore, a technological literacy process becomes the starting point as the main problem for the short term in the Local Micro Grids dissemination.

For this purpose, the research results have been collected in a complex series of actions distinguished by different objectives, strategies, technical recommendations to be carried out, in order to develop the material and immaterial components of the Micro Local Grids model. This is an 'open' guideline principle that is structured in its entirety as a self-poietic system. In fact, any potential user can look at the guidelines according to the most convenient point of view to the local situation.

The Micro Local Grid is an important support system for Smart Cities and its implementation should be seen as an excellent opportunity for defining new rules of urban transformations, so that we can envisage totally new spatial-functional-environmental forms and organizations, by applying the maximum technological diversity through an appropriate Environmental and Technological Management of the settlement dynamics.