Int. Journal for Housing Science, Vol. 36, No. 1, pp. 17-24, 2012
Published in the United States

Urban Energy Planning for Small Municipalities

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Key words: The urban planning and the city, Energetic analysis and verification of existing residential building.

Abstract

The acquisition of a method of approach to energy planning for housing in a small town appears to be the tool that awards to the variable energy a 'strategic' peculiarity for the programming of the city. This testing instrument propose a new work organization energy planning at three levels: the first phase of analysis, including urban analysis, technical and energetic analysis of construction and size and power analysis. Urban analysis is a sharp classification of the building for the construction typology and volumetric order. The building's energy performance are estimated through research of the materials used for the external covering's achievement of the buildings and the last type of analysis executes an energy balance about dwelling houses in the town through the comparison of the warmth dispersed from the buildings every year and the energy used. A second phase of planning, testing the limits imposed considering legislation and establishing an energy balance of building and the objectives and steps to achieve them. The results of these tests allow to get a clear picture about shortages of the area object of study, like the energetic efficiency of buildings and the lack of local energy production areas. The phase of design is constituted by "objective scenarios" of the plan that are the consumption's reduction reached through the implementation of performs direct towards improvement of systems and sub-systems building. The tool of planning proposes a series of restructuring measures construction, along with strategies for their realization, based on a logic of rewarding suggested by the Italian legislation which have taken in the European Community Directive. It is also proposed the revision of urban and building communal regulations in force on the town object of planning to agree dispensation to urban prescriptions already existing to a reduction of heat loss and emission of carbon dioxide.

Why an Urban Energy Planning

At present both the climatic and energy change at international and local level, than a situation of deep economic stagnation have left their mark on political, economic and environmental phase and this

0146-6518/01/17-24, 2012

represents the occasion to reflect on limits about current system of development and the deep links between economic recession, energy crisis, climate change and saving of resources.

The literature of this sector and statistical examination told us that 45% of energy global consumers are due to the construction sector. Because of lack of discipline about use of energy sources to the achievement of "thermic comfort" this percentage tend to increase and for this reason this matter is more linked up private residential building.

The necessity of containment of energy consumers requires in this sector the tendency of an instrument of design into which could been precisely stated the methodology of approach to individualize the actual user scenery and them future increase and the possible solutions to reduce this increase.

The acquisition of a methodological approach to the Energy Planning of private residential building of a small municipality has the purpose to achieve not a general analysis but a precise work in order to cause real improvements to the energy urban establishment and to reduce the consumers getting trained to discipline inhabitants' actions.

Urban Energy Planning in fact, is configured as the tool that assigns to the energy variable a strategic character for the programming of the city, in one's capacity as transversal element to the processes of urban transformation and requalification [1]. It has the objective to individuate the actions and the instruments necessary to guarantee the development of a local energetic system that is been efficient and sustainable that gives his priority to the energy saving and to the renewable sources as tools to reduce the consumers of fossil sources and the emission of carbon dioxide and, to a better environmental protection; similarly it purposes to guarantee the development of a local energetic system that is been efficient and sustainable that results consistent with the major social and economic variable present on every local lands. These objectives are placed contemporary on a double direction: on a side the necessity to answer at the energy request by consumers and, on another side, the responsibility to reduce gradually the same request. In the contest of these actions, the Energy Plan shows a joined value that results to be fundamental inside of a serious energy planning and it is intended to overcome the fragmented and sporadic actions for energy saving in housing, based on a survey of local needs related to climatic parameters, construction materials and urban development in the area.

It must in fact be aware that the evolution of the energy system towards ever higher levels of consumptions and the emission of climate-altering substances can't be stopped unless the introduction of very wide levels of intervention involving as many stakeholders as possible and the most numbers of technologies. The Energy Plan answers this need in its ability to analyze and evaluate processes in act and outline, therefore, rationalize, to define and translate the theoretic objectives into specific commitments; broken down by energy source and economic sector, combining the statements of principle theoretical and objectives by careful mediation with the historical context and socio-economic problems; of associating climate and energy opportunities derived from the Kyoto Protocol and encourage, in this way, the construction of an energy system with low carbon emissions, promoting, at the same time, its ecological modernization.

Legislative co-ordinate

The issue concerning the reduction of energy consumption in the construction sector has made its way into our country from Law 10 of 1991 (Rules for the Implementation of the National Energy Plan on rational use of energy saving and development of renewable energy) and Legislative Decree 192/2005 (Implementation of Directive 2002/91/EC on the energy performance of buildings) subsequently updated and amended by Decree 311/2006 (Corrective and supplementary provisions of Decree 192/2005 implementing Directive 2002/91/EC) requiring compliance with specific standards in the design of building envelopes and covers actions for energy retrofit for existing buildings. From 2005 to 2008, pending the adoption of decrees of carrying out on, some Provincial and Regional Public Administrations have acted voluntarily with the publication of protocols, test methodologies, regional laws and guidelines for action in the energy sector which included possible solutions to reducing energy consumption and a virtuous production of energy (for example Casaclima of Bolzano Self-Governing Province, Itaca or LEED protocols and so on).

Were subsequently issued on President of Republic Decree number 59, April 2, 2009 (Rules of Legislative Decree 19 August 2005 on implementation of the Energy Performance of Buildings Directive 2002/91/EC) on more detailed methods of calculating the energy performance of buildings and the Ministerial Decree , June 26, 2009 (National guidelines for energy certification of buildings) which in connection with UNI TS 11300 number 1 and 2 provided a more precise method of calculating consumption linked not only to winter heating and summer cooling but also have related to the energy performance of manufactured housing not only to the dispersion transmission in winter and summer, but also to dispersions for ventilation, the contributions to the internal gains and solar heat. From the large number of parameters varies according to which the index of energy performance of buildings shows the tremendous difficulty in making a plausible classification of these at a national and regional levels; for this reason there's the need for local planning based on the one hand on uniform climatic parameters related to the climate zone in which the municipality is located and on the other hand relating to certain data about existing building fabrics and next buildings in program.

The stages of planning

The work of energy planning is based on three levels: the first phase of analysis, divided in turn into urban analysis, analysis of construction and dimensional techniques and analysis of energy characters of the material, the second phase of verification made by the limits imposed legislation and the setting of an energy balance of buildings and the third phase of project that will set the objectives and the necessary steps needed to attain them.

Town-planning analysis (Fig.1)
In the phase of town-planning analysis, after a territorial framework, demographic and climate of the municipality object of study, the energy manager proceeds to the analysis of the plans and planning instruments in force throughout the municipality as the Basin Plans, Territorial Plans of Regional and Provincial Coordinating, Urban Programs between group of Municipalities and all instruments that establish a first level of disciplinary action processing in a more general scale. Then we study the Urban Planning of the city to understand the zoning consistent with the rules and regulation which

contain specific provisions on the construction of buildings in particular, is that they are residential or public and on the restructuring of existing ones.

In relation to installations and energetic fittings are subdivided the number of dwellings present on town land about type of installation and type of supply over the year by controlling the percentage change of total occupied dwellings than comparing the data provided by General Registry Office and by National Statistic Institute with data provided by major companies providing raw materials for energy in the area of the municipality.

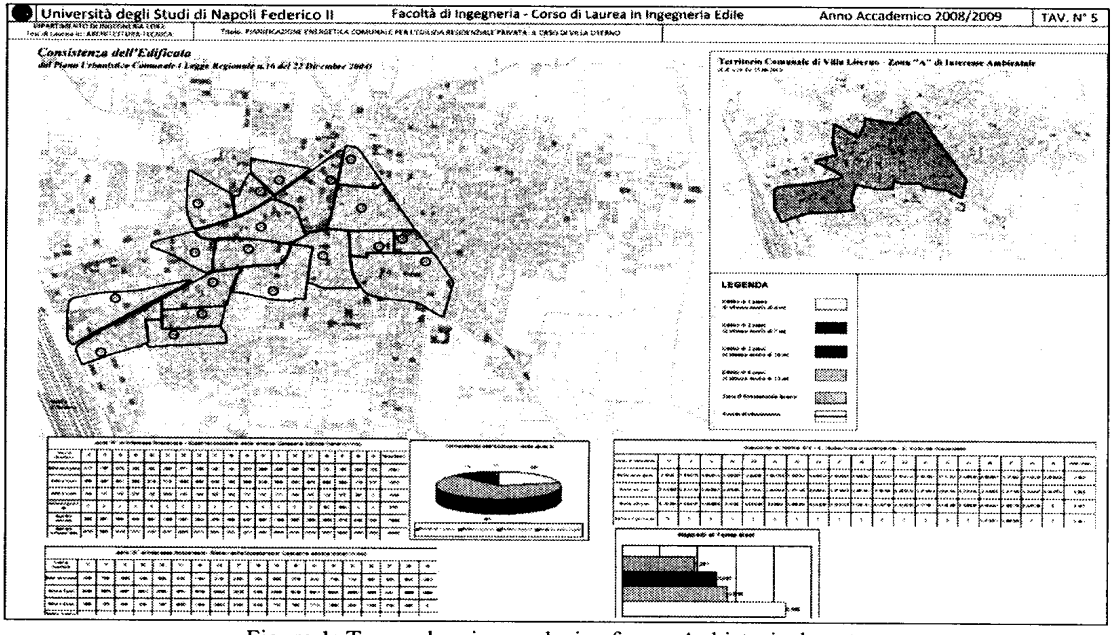

Figure 1: Town-planning analysis of zone A: historical centre

Dimensional and constructive techniques analysis

From the intersection of information gathered by the Urban Planning and by official permits submitted to the municipality for the title licensed to building renovations with data published by the National Statistics Institute are broken down buildings for census areas, they are classified by age of construction according to the different type of construction used for the realization of their dispersing surface as the curtain, the floor covering, the first floor and the fixtures and flooring [2] (Fig. 2-3-4) are further divided by classes of building consistency in the number of floors and number of interior of each floor, depending on their "shape ratio": S / V, where S = Surface dispersant and V = volume heating. As for the fixtures classification suffers a further breakdown on the percentage of surface area compared to the opaque surface of the envelope.

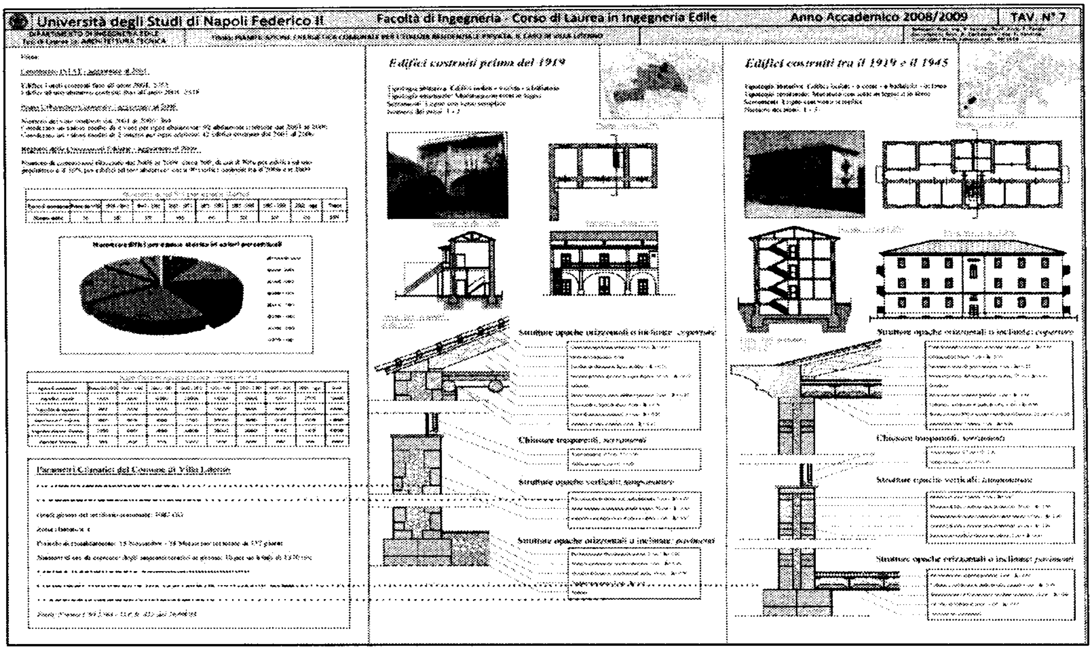

Figure 2: Analysis of constructive techniques of building since the end of nineteenth-century to 1945

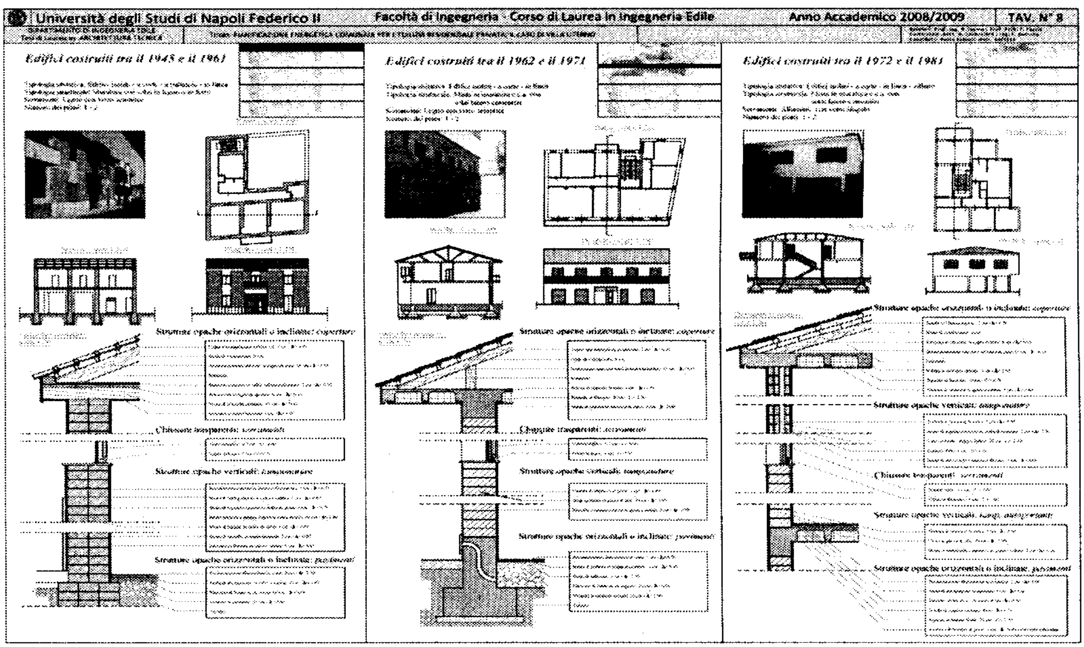

Figure 3: Analysis of constructive techniques of building since 1945 to 1981

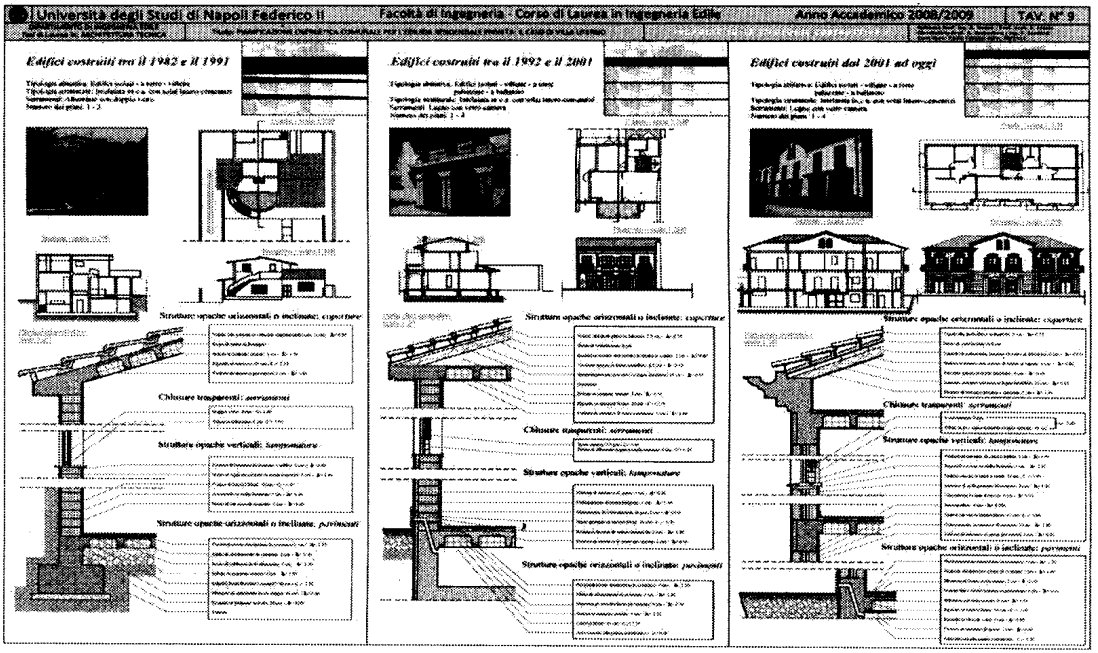

Figure 4: Analysis of constructive techniques of building since 1981 to 2010

Material-'energy analysis

Considering the conditions of stationary regime in unidirectional thermic flux hypotheses, through study of the Coefficient of Conductivity of homogeneous materials which physically expresses the thermic flow that is established between the internal and the external face facing the wall for every square meter of wall and for every degree of temperature rise and each meter of wall thickness and the Conductance Cj of not homogenous materials that physically expresses the heat flow that is established between the internal and the external face facing the wall for every square meter of wall and for every degree of temperature rise and for every meter of the wall thickness uniform [3] used in the realization of envelope in several years, we shall calculate two parameters indicator of energy efficiency of the existing building in winter: the Thermic Transmittance Surface U and the Energy Performance Index EP, taking into account the percentage of the Efficiency of the installations inside the apartments. As for the summer cooling is evaluated on the Thermic Periodic Transmittance YIE related to the time into which the building are exposed to sun light, the Phase-Displacement S_f that is the interval of time between reaching the maximum temperature on the outer surface of a component and the achievement of maximum temperature on the inside and the Attenuation Factor F_a or the wideness of changes in surface temperature inside than outside [4].

Finally, we shall calculate the amount of heat lost from buildings in kWh per year [5], adding to this rate on the dispersion due to the famous Thermic Bridges and comparing it with the thermic energy consumed annually for heating of buildings divided by the major sources of energy in the examination area.

Verification

The verification phase we compute the energy characteristics of the classes that comprise the municipal housing stock and are compared with those prescribed by the law described above. If these parameters are lower than the verification must be met otherwise enhance the efficiency of the casing and the performance of systems where they exist. In almost all cases the result of the audit revealed several problems: at first, both the Thermic Transmittance that Energy Performance Index of buildings do not comply with the limits prescribed by law, except for certain small buildings for which, however, the effect of surface coverage is given precedence over that of the lateral surface. Secondly, the percentage of housing units on municipal territory without centralized systems for heating buildings is a major source of increased consumption and therefore spending but is primarily responsible for the foul emissions released into the atmosphere. In addition to verifying the operation of the laws in force that has more critical is the Energy Balance of buildings between kWh per year or equivalent gallons of gas oil fuel they consume, less any contributions from internal heat, and the amount of energy they produce during the year. Even in this case the budget is presented for passive cases provided innovative devices that use renewable sources of energy such as Solar Thermic Installation and Systems of Photovoltaic Energy.

Design

The target suggested by the Urban Energy Planning depends on the state of the art is located in the municipality under the plan, by the presence of urban energy basins such as geothermal power plants, gas turbines, solar or biomass and should be achieved into the time indicated in the plan. The primary input of local energy planning is to reduce the level of energy consumption, despite the gradual increase in volumes over time inhabited and therefore heating and cooling. For this reason, the "scenario objective" of the plan expected to be implemented containment measures on existing buildings and energy than on new construction. In this way, although for some types of buildings the parameters prescribed by the regulations will not be verified, will still be achieved two results: the reduction of foul emissions in the atmosphere, quantized in long tones of CO_2 equivalent, and the rationalization of the relationship between costs and benefits in terms of a significant reduction in percentage of annual expenditure due to heating.

The way to achieve the objectives relate to actions to be carried to greater resistance to heat transmission through the surfaces of the building products and improving the efficiency of the plant. In particular, the restructuring proposed by the Urban Energy Plan Building for Private Housing are:

- external insulation for the walls opaque,
- external warm roof and ventilated for sloping roofs,
- garden roofs for flat roofs,
- reconstruction of pavement for terraced roofs,
- replacement of glazed elements with double glass with wooden frames coated aluminum with low emission glass containing gas,
- the Integrated Solution total wrap insulation for buildings particularly critical in terms of energy.

Near these technical solutions, the strategy for implementing these improvements is the establishment of special "Bonus Cubature". This intervention is to create a pitched roof with attic space, thus

achieving a further residential unit existing on the building, after static and seismic verification or ordering of appropriate incentives for any restructuring or struts of structure. This proposal is an incentive to improve energy efficiency and is consistent with the rewarding indicated by those rules. It also proposes, within the Energy Plan for the possibility of updating and amending Urban Building Communal Regulation in force within the city so it should be derogated from, under the procedures for issuing licenses approved, the existing planning requirements, in order to greater reduction of heat loss and CO_2 emissions.

Conclusion

At the end of this work, it is clear that any technical intervention is likely to remain isolated and without adequate cultural change on how to design buildings, a cultural change can only occur through specific planning and shared. In this sense, the involucres should be designed more with aesthetics, but function merely as a sort of "reagibile skin" of the building at the same time protects it from heat, cold and inclement weather and can generate active forces can improve the living comfort and features the same fabrics [6]. The constructions that will be built in the coming years, in fact, they will represent the result of this new concept. They are changing the structure, skin and performance. Improving the quality of buildings and ensure better living comfort by supporting the implementation of innovative interventions are not easy for commitments which are not enough legislative guidelines and strategic guidelines and awareness campaigns about the subject. Specific Planning is needed instead of a local area in which all the actors in the construction industry, from business designers to individual employees in public institutions are called to interpret these challenges and opportunities together with practical and effective proposal.

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