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ENERGY PLANNING AND INACTION OF THE CITY: PROBLEMS AND METHODS OF ASSESSMENT, THE ROME'S CASE STUDY.

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ABSTRACT

The last few years show a great change in social behavior, economic and cultural rights on the issue of energy.

The energy system is adopting new energy technologies that go beyond the pioneering stage, and fill the market.

The energy efficiency of buildings has supported about 30% of national. Consumers look to energy more economic concern but also more ecological interest.

After several years of investment firms and citizens, many in quantity and with high quality on innovation, we are then able to analyze the events of energy, from the data of the works actually completed and problems have arisen during construction.

This study aims to develop an initial analysis of the events, which, without being exhaustive, in addition to illustrate the prevailing content, linking it to the limits and the positive concepts of spatial planning.

Spatial planning and urban planning have left the energy issues into the background, until the onset of the current global emergency, characterized by climate-altering effects and the emerging changes in the current energy paradigm.

Today, the same schedule, however, can begin to measure the changes actually occurred in the area. The study illustrates the new paradigm of energy and analyzes their impact on the urban plan.

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METHOLOGICAL NOTE

The current energy issue contains two very stringent requirements for the residential sector: 1) to enter production capacity of energy from renewable sources strictly close to the consumers in buildings, 2) to consume less energy in the use of buildings.

These Terms and conditions are imposed by international agreements and supported by funding and policy actions in each states, and in Europe by the EU.

The residential sector is characterized by two specific segments: a) the structural characteristics of buildings, b) the form of settlements, particularly urban.

While techniques have been developed for the performance of individual buildings, there aren't still rules of comparable value for urban planning, and the accuracy can now support building regulations with specific energy standards is not available for "planning systems tools", land-use urban plan in Italy (PRG).

The study has identified some specific indicators, such as demographics, volume and surface extention, urban climate trends, the area's topography, the shape of the urban fabric, and related them in a correlation method, designed to produce estimates of urban energy .

The study applied these indicators toOfficial Urban Plan (PRG), issued in 2003, examining in terms of energy costs (economic, environmental-emission of CO2, and quantities of energy consumption) the development proposals contained in it imply, and with respect to the possible energy conservation measures in the specific urban morphology.

The proposed methodology has assumed that, however you express residential indicators (number of rooms, additional volumes, etc.etc.), population growth implies a corresponding increase in energy demand, which need to be answered in the plans and development programs.

Also the EU and national programs related to residential energy consumption are cited two items separate but related: 1) the energy characteristics of buildings, 2) the savings energy use. Both must be qualified to define an urban development planning, and it seems simplistic to rely on only one of them.

From this analysis the study developed the design of policy instruments to reduce analysis costs, improve estimates of energy on the urban environment, and optimize the action to support renewable energy plants for the production and for energy savings.

1 THE ENERGY CERTIFICATION OF BUILDING

The directive 2002/91/CE implemented in Italy since 2008, establish obligations on Member States to improve energy efficiency in buildings, including through the establishment of a certification system for energy. The aim is to contribute to the reduction of energy consumption in the construction industry, which alone is responsible for about 40% of EU energy consumption. Energy certification of buildings with significant implications in terms of environmental and economic benefits, and is essential in achieving the objectives set out in international for a and boosted by a decision by the European Union (known as the 20-20-20).
Energy certification of buildings by means of the evaluation of the "consumption " (in analogy to what happens with the energy rating of appliances). It also aims to identify and promote measures to improve the most effective and convenient.
This qualification is already mandatory for new buildings, those subject to large renovation and existing buildings that are required to have energy performance certificates when enter the property market.
The certification is issued as a result of building energy audit performed by a qualified professional, who on the basis of data collected, calculate the energy consumption (using specific software recognized as "Docet-ENEA) giving the “building energy class”. More, the certification shall specify the plan of measures aimed at achieving an improvement of energy performance, resulting in reduced consumption and allocation of a higher energy class.
In order to improve the implementation of European Directive 2002/91/EC in 2006 in Italy there is an obligation to use renewable sources to produce heat and electricity, for new construction, for renovation or installation new thermal plants. In particular, for new construction makes mandatory the installation of photovoltaic, and there are National Guidelines to achieve uniform national application of energy certification. The regions and provinces have adopted measures to encourage a gradual approximation of its regional instruments to the new provisions. This approach, where it happened, was made at the local level, through the drafting of planning tools and technical and administrative regulations. In most cases, is an integration of environmental concerns in building regulations. To date, there has therefore implementation of regulations regarding certification of buildings, substantially deficient on national level, and certainly not homogeneous throughout the territory.
Energy certification, regardless of the regulatory system of reference, provides multiple parameters to define the theoretical consumption of the building under standard conditions.
The main parameters that most influence the energy consumption of a building are:

- geographic location to determine the conditions under which "work".
- values of thermal transmittance of all areas adjacent to an ambient temperature other than standard internal reference (external walls with different thickness and

composition, glasses, frames, doors, any thermal bridge data from balconies, pillars, etc. ..)

- inputs of heat due to activities in the building,
- the solar energy contribution through transparent surfaces,
- heat losses due to air changes

To these must be added the energy requirements on the production of hot water, depending on the number of occupants, dimension area and activities.

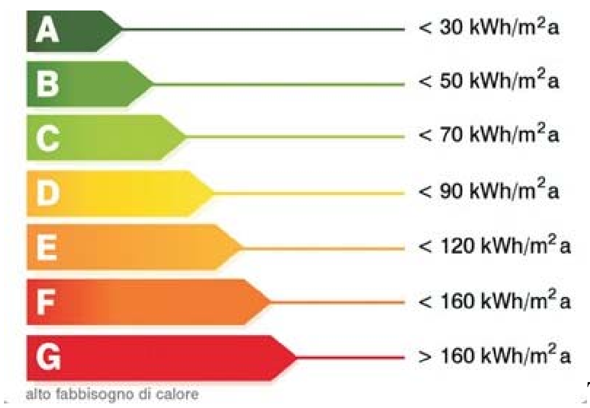
The evaluation of the parameters shown the values of energy saving to keep the building under standard conditions.

Is also important to evalute consumption and efficiency of the plants in the building (heat generators, heat pumps, distribution systems, control systems, ventilation systems, solar photovoltaic, solar thermal, etc.) to maintain the standard conditions imposed by energy class reference. The processing of the data set determines the class of the building energy consumption and its emissions of CO_2.

This process, very complex, in addition to mapping the current energy consumption of a building, you can identify exactly where to act to improve energy performance of the building and ultimately a reduction in consumption and CO_2 emissions.

In medium and big-sized cities, human activities and relationships between the stakeholders users / producers of energy that can affect the energy performance of a building are presented in different forms. This line of study, which intends to continue and complete the analysis on other case studies, aims to identify and classify the different “urban network” that make a city and how these various "forms of the city" can influence the energy performance buildings.

Energy bulding class Italy (kWh/m2/year) scale



The study also aims to integrate the methods for calculating energy needs (individual buildings) currently in force, with the evaluation of the energy derived from human activities and the "form of the city, which in turn are object of study and quantify the potential for energy production in various forms (heat, electricity) from renewables, even in urban areas.

2. GENERAL ANALYSIS OF INDICATORS USED FOR THE PRG ROME AND THEIR IMPACT ENERGY

2.1 : the story, the size, indicators

Rome is a city that has at least two decades no population growth.

This does not mean that the stable population corresponds to a "residential offer zero": the decrease of the population is in fact a social innovation that has a substantial increase in the number of families, there is also an internal dynamic to the population claiming new space to improve their housing conditions, or to adapt to the needs and size of new homes. The terms of housing needs and size need not necessarily coincide: the first is the question, the second is the manner in which the administration intends to meet that demand. These concepts, which represent how well the shape of the city is evolving, however, would also be extended to energy issues.

In particular paying attention to at least two elements:

1. the shift from large families to one-dimensional family, induces a change in lifestyle and therefore needs the same energy.
2. land use and the ways in which we consume and produce energy are technologically changed, and have influence on the materials, shapes, colors and layout of residential and non-urban in the plant.

Consult the official documents state that "The Plan's objective is to stimulate the introduction of features for specific activities in parts of the city more and more external and promote a residential conversion of the more central areas including facilitating the process of fractionation for the reuse of building units only for the residence. "

From which you would need to capture at least some highlighting energy issues (energy performance of buildings, energy certification procedures for installing renewable energy systems, etc ...) both in infrastructure and in terms of specific indicators, such as those cited in on space requirements, services, etc.. etc.. Which does not happen.

The new plan will narrow its planning standards, confirming the typical residential standard set by the PRG, and establishes an objective standard of locally reaches 22 m2 / ab.

Overall, the total size of Nprg, amounted to 549,051 rooms equivalent, corresponding to 20,589,394 square meters of Sul, and a volume of 65,886,062 cubic meters of residence with a market share of approximately 56.54% and a market share forecast scheduled approximately 77.14%.; the increase, compared to 710 million cubic meters of estimated volumes built in the city, is thus equal to about 9%. With regard to the scope of the new demographic Prg theoretical reference to the population outcome of the plan, namely at the end of the full situation and forecasts of changes of plan listed, amounts, however, to 3,067,608 inhabitants and the registered population of 2003 PRG amounts to 2,810,931 inhabitants.

2.2: estimation of energy performance in Rome

Table 1 shows the energy derived from the residential choices of the downsizing plan and planning standards listed above.

In calculating the energy performance of Rome, three indicators are used to:

1. consumption of energy (gas) for space heating (corresponding to 87.3 kWh/m2/year)
2. electricity consumption for lighting and appliances, including those already installed for summer cooling (equivalent to 93.03 kWh/m2/year)
3. **reference framework for energy certification class C (70kWh/m2/anno)**

For the estimation of areas of reference data are cross-PRG Rome 2008, and PTPG Province of Rome 2006.

The comparison between the current measured rooms and extra rooms derived from the plane, shown in the table below, drive to estimate the amount of energy consumption in terms of MWh required that environmental impact and, more generally on the sustainability of urban form, expressed as a function of energy infrastructure and technology choice to meet the new demand for energy.

Table 1: SPECIFIC REQUIREMENTS FOR CONSTRUCTION PERIOD

CONSTRUCTION PERIOD	SPECIFIC REQUIREMENTS
	kWh/mq/year
before 1919	107,5
1919-1945	97,8
1946-1961	98,6
1962-1971	96
1972-1981	76,6
1982-1991	68,4
after 1991	44,1
Average total	87,3

Source: Aicar_ L. De Santoli and others 2010

Table 2 – Calculation energy additional consumption by PRG Rome

	ROME PRG, CALCULATIONS OF RESIDENTIAL ENERGY CONSUMPTION (extrapolated from data on consumption with certification limits)	I° example	**source**
a	**ROOMS PER CAPITA**	1,088	**DiPART. VI PRG*(art.105 comma 3ter delle NTA) tab.1**
b	**STANDARD ROOM SIZE m3**	120	**DIPART. VI PRG***
c	**POPULATION 2003**	2.810.931	**DIPART. VI PRG* tab.1**
d	**THEORETICAL POPULATION 2006**	3.067.608	**DIPART. VI PRG* tab.1**
e	**Rooms currently number (a x c)**	3058292,928	
f	**ROOMS PRG number (a x d)**	3337557,504	
g	**DIFFERENT ROOMS PRG number**	279264,576	

h	**Estimated volume m3 current rooms built by PRG 2003 (axbxc)**	366995151,4	
i	**volume m3 prg equivalent additional rooms (axbxg)**	33511749,12	
l	**current built area m2 rooms estimated PRG 2003 (axbxc) / 3**	122331717,1	
g	**m2 surface for extra rooms estimated PRG 2003 (axbxg) / 3**	11170583,04	
	COEFFICIENT ENERGY kWh / sqm / year	70	**dlgs_ 192-2005*** **
A	**PRG current energy consumption MWh / year**	8563220,198	
B	**Additional energy consumption MWh / year**	781940,8	
F	**Annual electricity production from fossil fuels by gas central 3000mW Operating MWh x 8000h**	24.000.000	**ENEA COEFF.**
	% A / F	35,7	
	% B / F	3,26	
R	**Annual electricity production from solar photovoltaic 3000MWp x 1400 (conversion factor), which occupies an area of 240.000m2, in MWh / year**	4.200.000	**ENEA COEFF.**
	% A / R	203,9	
	% B / R	18,6	

Source: elab. ENEA, by PRG

Table 2 shows the estimation of residential energy consumption, with a first quantification of the maximum estimated value, with current energy date. Therefore, the modification of existing buildings results in an increase in energy consumption, which in turn requires to create systems of energy production, not provided. In the case of renewable sources we need to understand were put them and which technologies to use.
In the case of fossil fuels, we must understand where to put them and how to reduce emissions. Currently there are no official data on the volumes of the building, but we can estimate in an informal way, starting with photos of urban areas, and using direct measurements of the size of buildings; value of the additional volumes derived from the plan amounts to 65,886,062 m3 (with a share of residence at around 56.54%, and a planned share forecasts of around 77.14% of total), hence an increase of about 9% compared to 710 million m3 in the urban built-up volumes, estimated from morphological surveys with aerial photograph.
From this initial estimate, were obtained, using the parameters of the plan, details of current availability of rooms and the final energy consumption by deducting related

2.3: Environmental Impact of Rome PRG additional energy consumption

To estimate emissions of CO2 shown in fig.3 deriving from the plan, we used studies already carried out by ENEA on the emission factors by sector (residential), for intervention (in this case the energy certification of buildings) by region (Lazio).
These factors have been identified for each area of action for energy efficiency, taking into account any differences arising from regional and local climatic factors, with the purpose of obtaining an indicator of the relationship between investment and savings.
The emission factors used in the study to convert the energy savings expressed in toe for each final-use in tons of CO2 are:

- for the electricity sector, the issue avoided by the reduction in operating power plants in 2005 amounted to 4.19 tCO_2/toe final use (see Table 3);
- for the thermal sector, avoided the issue referred to the mix of fuels consumed in Italy in 2005, equal to 2.56 tCO_2/toe final use (see Table 3).

Table 3: Estimates of the CO_2 emitted by PRG Rome-2008

ROME PRG, CALCULATIONS of energy consumption and CO_2 EMISSIONS	I° SAMPLE CACLULATION RESIDENTIAL	SOURCE
COEFFICIENT ENERGY kWh / MQ	70,0	dlgs_ 192-2005***
CURRENT energy consumption by PRG MWh	8.563.220,2	
ADDITIONAL energy consumption by PRG MWh	781.940,8	
total ADDITIONAL emission CO_2 by eletrical consumption (ton/year)	195.485,2	
total CURRENT emission CO2 by thermal consumption (ton/year)	819.083,0	
ADDITIONAL toe consumption by PRG	195.485,20	
ADDITIONAL emission CO_2 by PRG electric final use (ton/year)	819.083,00	
ADDITIONAL emission CO_2 by PRG thermal final use (ton/year)	500.442,10	
conversion ratio MWh in toe (additional consumption)	0,25	PRG-Fasano/Caminiti
electric emission factors: end-use tons CO_2/toe	4,19	Fasano/Caminiti
thermal emission factors: end-use tons CO_2/toe	2,56	Fasano/Caminiti

Source: elab. ENEA, by PRG

3: SPECIFIC ANALYSIS OF THE URBAN FABRIC (historic city, consolidated city, etc..) MAPS INDICATING THE POTENTIAL AND EVALUATION OF BUILDING FOR ETA '.

3.1. Description territorial modification processes.

With its 129,000 ha, is the largest town in Europe. A specific territorial situation, positive and negative in the same time. Positive because this size allows to develop a unique policy of free space since, large parts of the Agro Romano are still intact and are a very important historical, environmental and landscape resource. Negative because within these areas were still planned, in the former PRG in 1993, the possibility of urban transformation in size - about 120 million cubic meters of the structure built mainly for residential compound - but whose location appears today practicaly inconsistent with respect to a serious policy of energy saving, environmental protection and enhancement, both with respect to the real economic and social dynamics.

Building interventions in the capital since 1800, have followed one another relentlessly, including forms of illegal housing development, which have replaced the timing agreed under the laws and upon which is grafted "Abusiveness of necessity", which replaced the construction of buildings and infrastructure sometimes only based on “simple static and persistence "of the artifacts.

The road map planning that led to the new Master Plan of Rome, which began in 1994, was particularly long and complex, with intermediate steps for its contents condisione(that do not contain energy issues) very complicated, as indicated below.

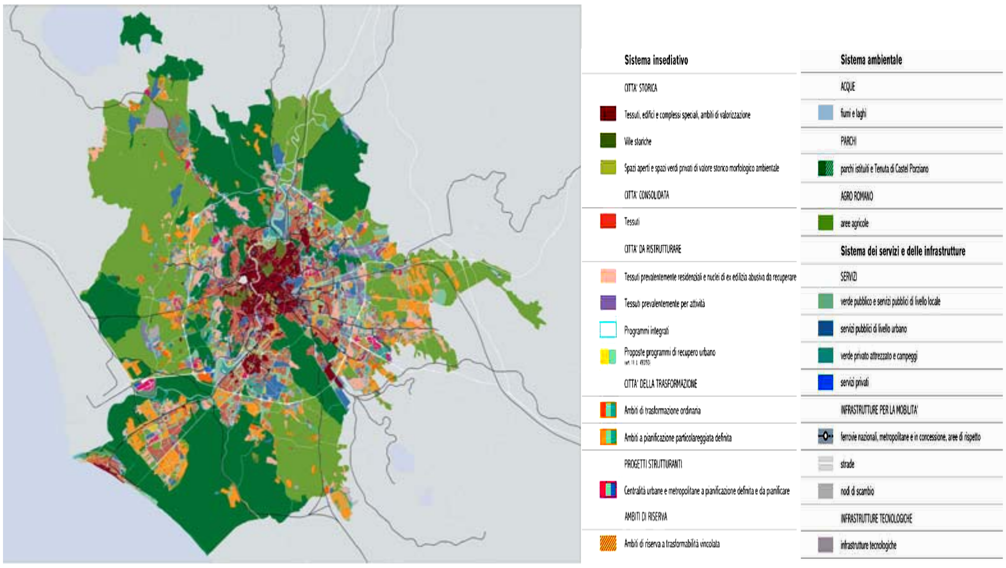
1. The scope of the consolidated city of the "terms of the certainty" has been greatly expanded and replaced, from the historic town (5,000 ha of tissue) and the consolidated city (10.800,0 ha).
2. The scope of the city will extend and transform the city to be restored (9.200,0 ha) and the transformation of the city (8.700,0 ha), which must be added to the urban centers and metropolitan areas (2.300,0 ha).
3. The areas of the reserve increased transformability bound (200 ha).
4. The system of general public services increased (5.000,0 ha).
5. The scope of the suburban area further increased, passing from the original 82.800,0 hectares to the current environmental system specified in 87.800,5.

The settlement system of the province, characterized by complex urban construction in the city of Rome after the great growth of the '60s and '80s is covered in the 90's and 2000's intense dynamic metropolitan and local transformation processes, that profoundly alter the structure and form and highlighted the conurbation centers adjacent to Rome.

As already mentioned above, seen in Fig.1, the Rome PRG settlement system is composed of:

▪Historic City; ▪City consolidated ▪City to be restored; ▪City of transformation

Figure 1: SUMMARY PRG Table. D8,doc. Official City of Rome



Morphological settlement system

3.2. Types of intervention in the territory valence energy

The city of Rome understood as territorial entities, the analysis undertaken has submitted three characteristics (indicators) that affect the energy performance:

1. form of the city in various municipalities and districts
2. structure of buildings, building types briefs due to their years of construction
3. use of buildings and socio-economic parameters of the residents

From the intersection of these three indicators show the cause of different responses that the residents have given the new demands of energy, derived from the new energy paradigm.

Briefly, this systemic response, but is made on an individual basis, is inferred from the analysis of the interventions that have supported various forms of incentives, relating to air consumption, building structures and installations for the production of energy.

To be able to show they used the data of the ENEA and the building stock of the city of Rome (ISTAT Census 2001), and official boards in the PRG Rome 2008.

Emerges from the data (see Figure 2) a different answer depending on local urban indicators such as:

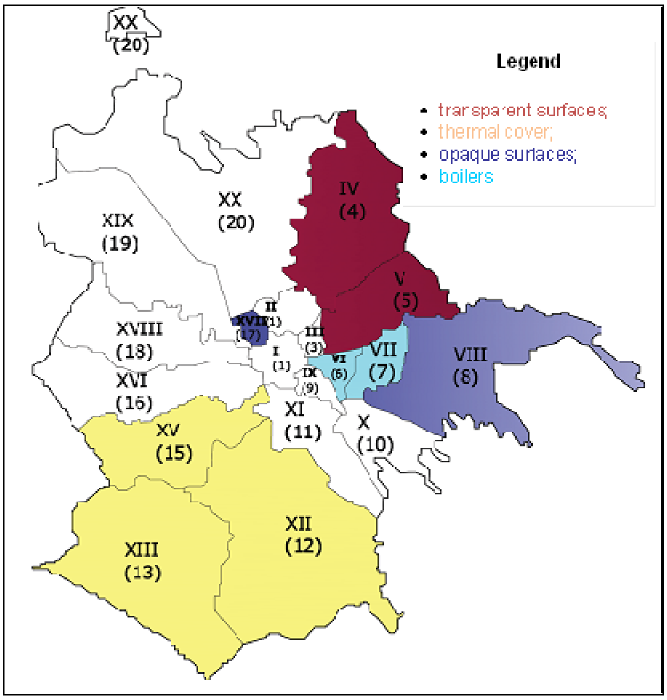
- Age in year of the building,
- use of the same, reconstructed on the basis of socio-economic classification of the residential area where the same is placed,
- location of the building in the city,
- shape of the city around the building site in the context of the intervention.

Is so possible to make therefore a classification of economic convenience/efficiency of possible interventions that will maximize the performance of any investment in the energy saving sector.

Note that in next fig. 2, in urban district VIII and XVII, where the presence of social-housing building with characterization (typical of the years 1970-1980) is consistent, has been carried out in greater numbers, interventions on the basis of structural features of these buildings, built according to the then current reference standard, which determines the shape of the city in these areas. While in the urb. distr. IV and V, characterized by a predominance of buildings of twentieth-century building, (by the period 1960 – 1970) and consist of blocks of flats with facilities of centralized services. In this constructive configuration is possible to assume only simple actions by individual owners, related to the fixtures, as is apparent from the data at our disposal.

For the urb. distr. VI and VII, where it is the same way as a twentieth-century construction but prior to 1960, can trust to work on the boilers for heating because of their technology is not suited to the requirements regarding energy conservation and respect of environment. Note, however, as in the area XII, XIII and XV, which are often characterized by differing characteristics of the villas or isolated buildings, which are the best location for the installation of panels for the production of ACS, can be seen in their many of these interventions

Figure 2: Distribution of main types of intervention on the territory



This analysis shown in fig 3, by database ENEA, shows that the structure of housing influences the choice of technologies for energy saving. If stakehoderls must define the policy, they must start from the specific characteristics of the components of the urban plan. But there is still a fact: the contribution of the urban plan, the city's shape to the city's energy performance. But this can be defined only by crossing the urban and architectural morphology classification climate.

4 THE APPLICATION OF THR CITY 'HISTORICAL

4.1 The urban forms from downtown to the city ‘history.

Figure 3: P.R.G. Systems and rules adopted 2

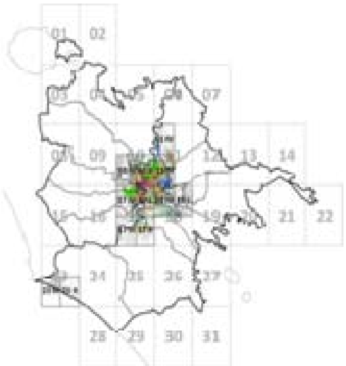
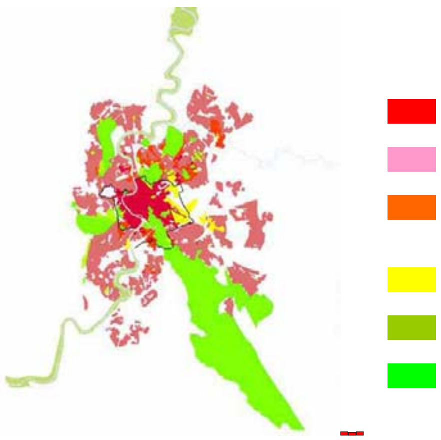


Figure 4: from P.R.G. From downtown to the historic city



Zone A: restoration and conservation;

Zone B1: conservation of volumes, shapes and existing surfaces;
Zone B2: preservation of existing volumes and surfaces;
Zone B3: conservation of volume and surface existing obligation of PP;
Zone G1: private park bound;
Zone: archelologico and landscape subject to constraint (1089/39, 149/39).

The concept of Old City modifie and extends the traditional center of town as today unidentified.
Inside the Old City, you can recognize the characters - historical training, and their different values and levels of quality planning, distinguishing:

- The **Old City within the Walls**, attributable to that part of the city of ancient plant that has been confirmed on the urban structure of Rome, its use changes with additions after medieval period with modern and pre-unitary plan, and mainly based on the estimated plan of 1883 , showed a gradual saturation of the free areas along the hstorical walls edges with the consequent disappearance of villas and gardens.
- The **Historic City of expansion "extra moenia"**, following the plan of 1909 and some subsequent expansions by plan of 1931, maked on forecasts but also planned on

the basis of spontaneous and unplanned processes, urban variations or changes in zoning regulations.

- A **wide network of signs**, made by small groups, isolated testimony, archaeological sites and trails, but also by contemporary urban buildings and installations of quality, which is the armor most qualifying the entire existing city, outside the historic town, more compact.

Today, it is therefore possible to recognize and identify the concept of historical city

Figure 5: from P.R.G. From downtown to the historic city

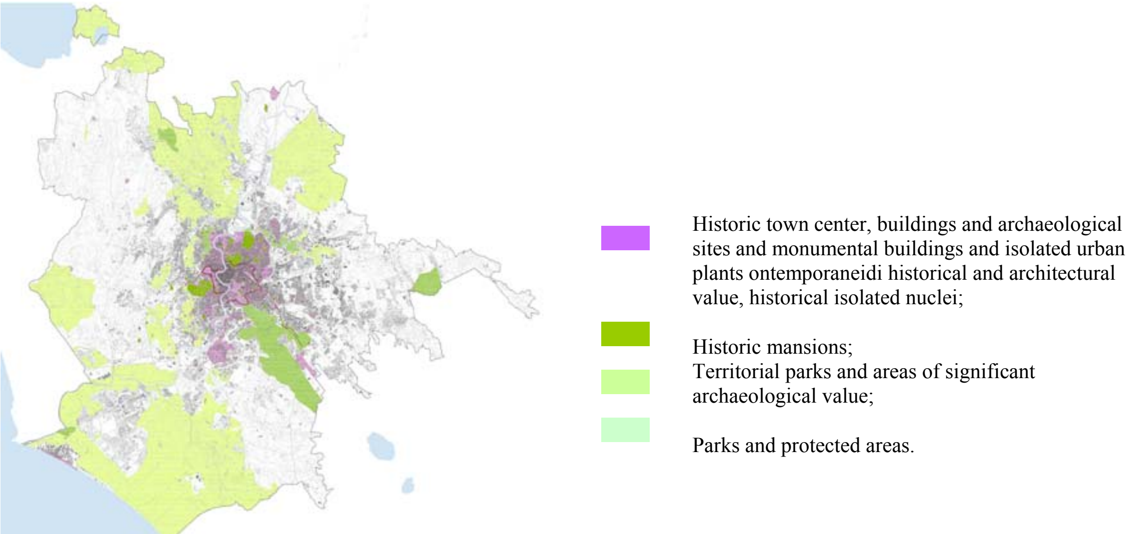


Table 4 - Calculations of energy consumption

	ROME PRG, CALCULATIONS OF RESIDENTIAL ENERGY CONSUMPTION (extrapolated from data on consumption with certification limits)	I° EXAMPLE	coefficent source
a	ROOMS PER CAPITA	1,07	DIPART. VI PRG*(art.105 c. 3ter- NTA) tab.1
b	STANDARD ROOM SIZE m3	120	DIPART. VI PRG*
c	POPULATION 2003	636.240	DIPART. VI PRG* tab.1
d	THEORETICAL POPULATION 2006	677.544	DIPART. VI PRG* tab.1
e	Rooms currently number (a x c)	679525,5	
f	ROOMS PRG number (a x d)	723639,6	
g	ADDITIONAL ROOMS PRG number	44114,0	
h	Estimated volume m3 current rooms built by PRG 2003 (axbxc)	81543063,4	
i	volume m3 prg equivalent additional rooms (axbxg)	5653833,0	
l	current built area m2 rooms estimated PRG 2003 (axbxc) / 3	27181021,1	
g	m2 surface for extra rooms estimated PRG 2003 (axbxg) / 3	1884611,0	

	COEFFICIENT ENERGY kWh / sqm / year	70	dlgs_ 192-2005***
A	PRG current energy consumption MWh / year	1.902.671,50	
B	Additional energy consumption MWh / year	131.922.768,80	
F	SIZE CENTRAL NATURAL GAS TO MEET DEMAND FOR ADDITIONAL PRG	16,5 MW	ENEA
R	SOLAR CENTRAL DIMENSION TO MEET DEMAND FOR ADDITIONAL PRG	94 MW	ENEA

The analysis presented in table 4, shows that also remaining in the only historic urban area, there is an increase in energy requirements, which must be satisfied, and that in itself contradicts the obligations undertaken by Italy to meet the Kyoto Protocol and options Post Kyoto.

This increase in energy demand can be met by fossil fuel plants, or with source renowable plants, in which the study produce the estimated size in previous table.

It has, however, that while the New PRG Rome not providing new construction or substitution in the historical city, we can foresee a development in this area, which reduces energy requirements by implementing measures highly effective "energy saving" ..

To this goal, it was developed a GIS tool, shown in fig. 6 and its legend.

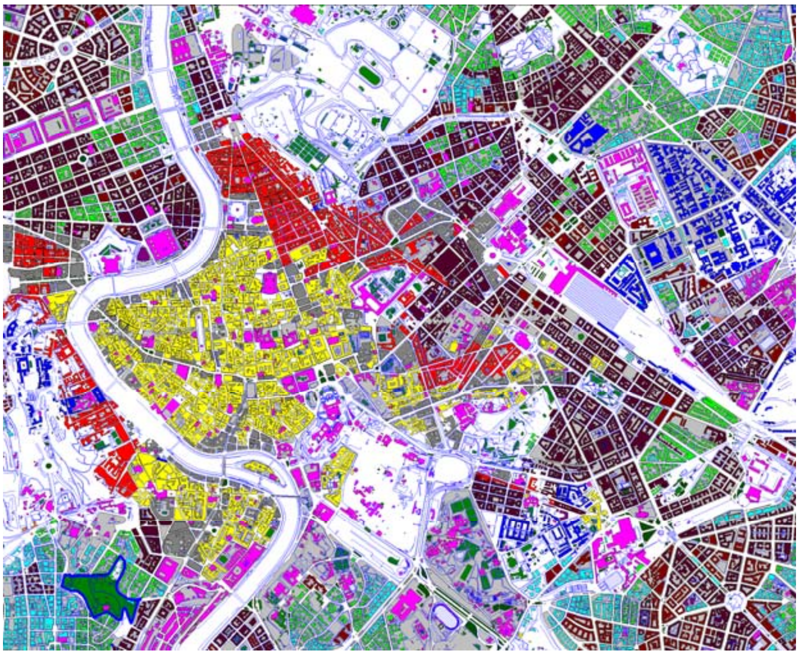
We have reclassified the architectural definitions, identifying each building in the central city, and georeferencing. This new classification has been connected to a data base with the energy performance of buildings, energy classification, as defined through the use of energy coefficients adottatti by national and international scientific literature.

So we have a GIS that includes: location, description building, architectural classification, energy characteristics.

This GIS is not enough, because there is still a fact: that measures the performance of the building into the real energtcai its place in different areas of the city morphological.

For this reason we supported the GIS by instrumentation for thermal analysis (thermo-camera), shown in fig. 7, fig.8 fig. 9, fig. 10, and table 5, that has helped to identify the energy parameters of the urban fabric, not only of buildings and define in detail the specific energy conservation measures for the historic area of town. he map below shows how the fabric is classified according to the structural characteristics of buildings, it is superimposed by the morphology of the urban area, resulting in an interpretative scheme of the energy performance of urban form.

Fig. 6 GENERAL PLAN Systems and rules: CITY 'HISTORY on GIS



Legend fig. 6: GENERAL PLAN put on STUDY GIS produced

Settlement system	
	Fabrics
	Tissues medieval
	Tissue expansion pre-Renaissance and modern unit
	Tissue restructuring city planning eight-twentieth-century
	Tissue expansion in twentieth-century eight-block
	Tissue expansion in twentieth-century eight-point subdivision
	Tissue expansion in twentieth-century front continues
	Tissue expansion in twentieth-century subdivision point
	Tissue expansion in twentieth-century modern plant and unitary
	Isolated buildings
	Construction and complex special
	Centre monumental archaeological / architectural landmarks and urban / historic villas / building blocks of special historical and architectural monuments.
	Department equipment and post-plant unit
	Open Space
	Structuring project
	Centrality of local
Environmental system	
	Water and parks
System of services and infrastructure	
	Services
	Public parks and public services of local / urban level of public services / cemeteries / green area / private
	Mobility infrastructure

The following fig. 7, fig. 8, fig. 9, fig. 10, and table 5, show how, through careful selection of measurement points, and the relationships, as measured over a georeferenced database, you get a sizing of energy issues is derived from the structural form of the city and its network.

Fig. 7 City map with ANALYSIS POINTS: (Gianicolo, Castel Sant'Angelo, Aventino)

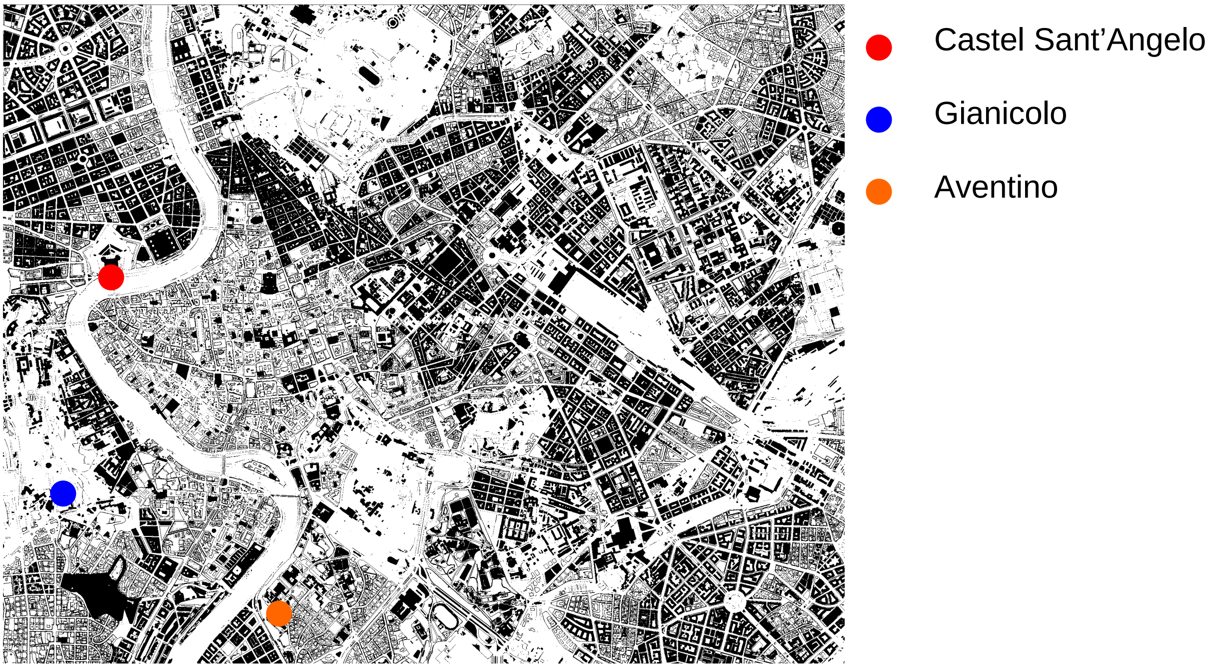


Table 5: City map general plan measurement point result.

	Settlement system	Max Temperature measured		
	Fabrics	**Castel S. Angelo**	**Gianicolo**	**Aventino**
	Tissues medieval	8.5° C / 11.5° C		10.4° C
	Tissue expansion pre-Renaissance and modern unit	8.3° C / 11.6° C	10.7° C	
	Tissue restructuring city planning eight-twentieth-century	8.2°/10.4°/11.5°		6.3° C
	Tissue expansion in twentieth-century eight-block	17.8° C	25° C	
	Tissue expansion in twentieth-century eight-point subdivision			
	Tissue expansion in twentieth-century front continues	10.8° C	25° C	
	Tissue expansion in twentieth-century subdivision point		21° C	
	Tissue expansion in twentieth-century modern plant and unitary			
	Isolated buildings	11.7° C		
	Construction and complex special			
	Centre monumental archaeological / architectural landmarks and urban / historic villas / building blocks of special historical and architectural monuments.	11.5° C/	0.6° C	8.3C
	Department equipment and post-plant unit	8.5° C / 11.5° C	9.7° C	

The fig. 7 shows the measurement points with a thermal camera, and the thermical data in table 5 and in fig 8, 9, 10, shows the difference between the various buildings, located in the same area, measured in a single moment change, due to different forms of the city in which buildings are included. These differences are significant, and explain part of the energy performance of different buildings of the same characteristics.

The followings 3 images represents some of the measurements, which were then insert into the database source georeferenced system.

Fig. 8

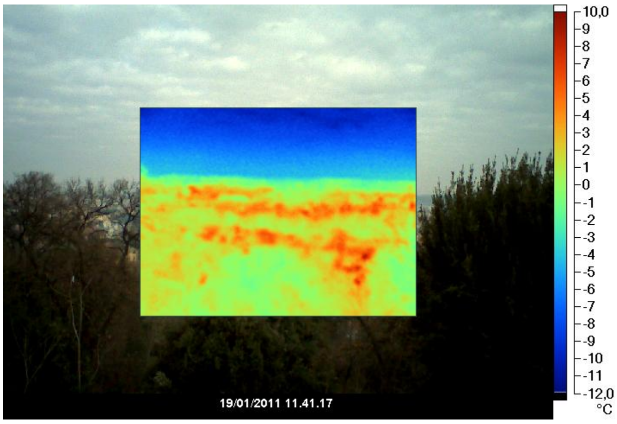


Fig. 9

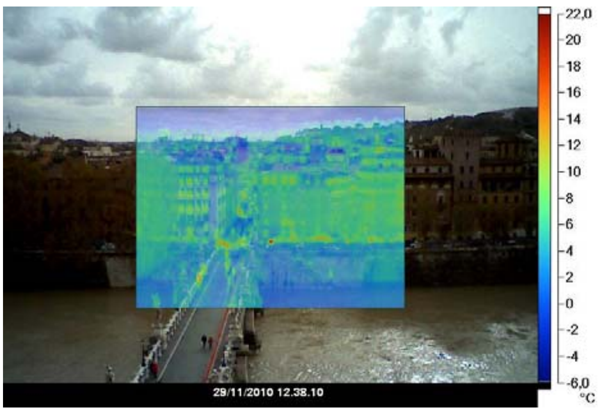
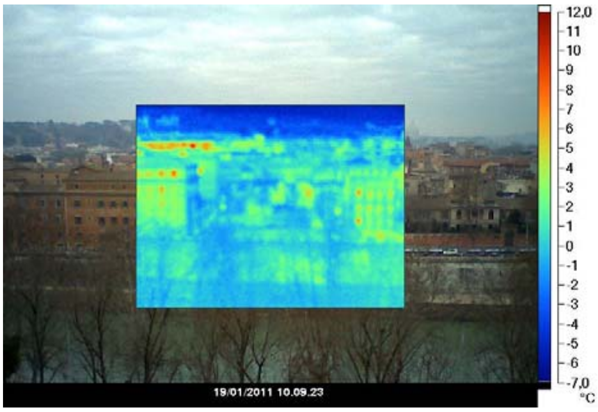


Fig. 10



5 CONCLUSION

In conclusion, the study showed that land use decisions affecting the energy problem. While the response to the objectives of reducing consumption, reducing CO_2 emissions, increase energy production from renewable sources in urban areas can and must be implemented not only with incentives but also through the optimization of the lines of urban development by including benchmarks and indicators within the rules of town planning.
The choice of the New PRG do not change the plan and structures in historic areas of cities, can be shared, but those choices represent an increase in energy costs for the community, and therefore must be accompanied by measures quantified and qualified for energy savings.
These interventions can be designed not only from individual buildings, but also starting from urban areas and the urban plan. The planning systems, however, must accompany the work with the specifications, analysis, can now be done using GIS tools and measuring equipment, building energy-urban database based on geo-referenced measures, performance indicators and energy efficiency.
he study found that, in implementing the field surveys and analysis there are several problems, such as the overcoming of natural obstacles, climate and landscape, and the definition of the measuring point, and finally, the calibration and the metric system used, which must be validated by the scientific community and universal.

The basic final assumptions by the study are:

- Unavailability of unlimited energy.
- Today, in order to have greater energy efficiency in buildings particularly, and very precise and specific fuel consumption and performance of buildings and facilities, very advanced computing capabilities are required and they have to be designed to meet the needs of institutions also in terms of availability.
- The city changes its use in the range of "before and after intervention energy" and requires new standards and operational criteria which take account of its shape, it inertia energy, both for the temperature range for the time of acquisition of energy-loss (thermal inertia and power).
- The energy changes require innovations in methods of analysis and monitoring of the city, based on indicators, which support the introduction of newly developed power plants.

In particular, the study shows that, to measure and monitor energy efficiency of an urban system is necessary to assess all three aspects:

1. building structures,
2. municipal power plants,
3. the context and social climate and morphology of the city.

Some case studies, analyzed with the use of computer tools based on indicators, shows upon completion of the research.
The cases illustrate, such as urban areas in terms of energy manifests a more complex design, derived from the difficulties of the inclusion of new plants and technologies in the urban structure, and how, in the margins, the district concept remains valid, in this case energy, such as geographical boundary of the urban element which forms an integral part, can be made "sustainable" planning and design efficiency.
The conclusions are highlighted refining lines of analysis tools available today for planning, not only with regard to the tools to visualize and query GIS software provided by the municipalities, to simulate actual calculation processes of heat transfer, leakage or accumulation of heat in the city in relation to the elements, natural or anthropogenic-listed above.

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