

# **Introduction of the energy parameter in the master plan of a large European town**

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## **1. SYNOPSIS**

The possibilities to strongly increase the use of energy saving and solar technologies offered by the introduction of the energy parameter in an urban master plan are described.

## **2. ABSTRACT**

In Italy a national law introduced in 1991 obliges all towns with more than 50.000 inhabitants to draw a municipal energy plan and to introduce the energy parameter in the master plan.

Till now, however, only one large town has complied with this obligation .

The only exception is given by the town of Palermo (700.000 inhabitants), in Sicily, that is working on an innovative master plan based on the recovery of the degraded existing structures of the historical centre and of the segregated peripheric areas, allowing for new constructions nearly only for the service sector.

The new territorial locations are analysed considering, inter alia, also the energy parameter. Zoning is defined taking into consideration issues like cogeneration, energy cascading, and in general integrated use of energy; also solar rights are considered and, given the role of urban solar technologies in the next decade, the solar potential of the building roofs has been evaluated.

At the level of the building regulations, specific indications are given in order to improve summer and winter thermal comfort and the energy performance in both retrofit and new buildings.

In conclusion this effort is an interesting example of actions that can be taken at local level in order to improve the rational use of energy and to support the diffusion of solar technologies.

## **3. BACKGROUND**

Traditionally in Italy a strong centralistic approach characterised decisions in energy policy. Some change have occurred since the Eighties, when the application of a policy of incentives to energy efficiency and to the use of renewable energies was transferred to the twenty Regions.

A step forward was made in 1991 with the approval of a law compelling all the Regions and the towns with more than 50,000 inhabitants to produce and adopt local energy plans (regional and municipal, respectively), with a special emphasis on renewable energy sources and cogeneration. Until now, however, only a few smaller cities (Carlino, 1994) and a large town (Aem, 1994) have fulfilled the law's requirements , since no manifest strong will and attitude have shown by the Central Government towards their application.

## **4. THE NEW MASTER PLAN OF THE CITY OF PALERMO**

One of the first exceptions to the general overlooking of the energy issue in town planning is going to be the city of Palermo, where an advanced scheme for the promotion of the rational use of energy and of renewable energy sources is being implemented.

Palermo is the capital city of the Regione Sicilia (Sicily Region), with a population of 700,000.

In December 1994, one year after its election, the new Administration of Palermo presented to the City Council the Master Plan that is going to adjourn the previous one adopted in 1962.

Among the other innovative features of the plan (rehabilitation of the historical centre, very few new residential buildings, stress on the need of services, constraints on private car use and promotion of public transport), the energy issue plays a significant role.

The choices regarding urban mobility have been made considering also the energy parameter (transportation represents a large and increasing fraction of the city energy consumption). The detailed actions in this sector will however be defined in a specific Urban Mobility Plan that is being developed in parallel with the Urban Energy Plan.

## 5. ENERGY PROFILE OF THE CITY OF PALERMO

The first energy balance of the town of Palermo is in progress, while the data for the Province of Palermo (a larger administrative area that covers 1.225.000 inhabitants) are available.

The total final energy consumption for the Province of Palermo in 1993 has been evaluated in 753 ktoe, (Tab. 1).

Gasoline	Diesel (transport)	Oil	Gas*	Electricity	Total
295	178	42	19	234	753

\* Not including the 1200 MW thermal power plant gas consumption.

Tab. 1 Final energy use in the Province of Palermo in 1993 (ktoe)

Globally the per capita energy consumption is rather low mainly due to the mild climate and to the very reduced presence of the industry sector.

It is important to note the unbalanced share of different energy uses: 65% of this amount was used for transportation; electricity consumption accounts for 31% of the total.

Compared with other cities of similar size in northern Italy or in central Europe, the energy structure appears very different: it is the energy structure of a mediterranean city, where the energy demand for heating is still limited but growing; where electricity is widely used for space heating and hot water production and where summer electric demand is growing because of air conditioning.

To better understand the specificity of the Palermo energy demand, in fig 1 the pro capita total and residential electricity demand is reproduced for four large Italian towns. It is interesting to note that the total pro capita value is much lower in Palermo due to marginal presence of the industrial sector. At the same time the residential pro capita electricity consumption is quite large and higher than in most Italian towns. The reason for these data is to be attributed to the large share of unappropriated uses of electricity (space and water heating) in Palermo.

A second element of interest analyzing the electricity data comes from the power demand.

In fig. 2 the load distribution on the electric grid in different months and hours of the day is reproduced for a winter and a summer condition in 1992. It is important to note that the peak power demand is still concentrated during the heating season, but in the last years the increase during the summer months has been larger than for the winter months.

Also gaseous fuels demand (natural and producer gas) is growing, and a sharp increase is expected in the next two years because of the in progress construction of the urban natural gas network. The availability of natural gas in domestic, services and industrial sector will certainly change the structure of the consumption in the city, especially if the announced "energy and environment conscious" policy of the Municipal Energy Utility will be actually implemented.

## 6. INTRODUCTION OF THE ENERGY PARAMETER IN TOWN PLANNING

The new master plan redefines the rules for land use and emphasizes the rehabilitation of the presently degraded historical centre; new services, infrastructures and building stock rehabilitation are the key issues, used also tools for triggering economic development.

In Palermo a sharp increase of energy consumption is undergoing for heating and cooling, due both to the improvement of the average wealth of the people and to a change in the comfort standards. In spite of this increase, only a limited share of the urban building stock is presently provided with heating systems: most people use electric or LPG stoves. Cooling is growing either in the commercial sector and in the middle-high class dwellings, also as a consequence of the state incentives for purchasing heat pumps. The rehabilitation of the historical centre and of a large part of low quality buildings constructed in the sixties and seventies for low income people, coupled with the expected significant growth of the number of commercial and service buildings, will imply a further increase of energy consumption that needs appropriate regulations.

The presence of motivated and energy conscious people in the new Administration allowed the transformation of the legal obligation to consider the energy parameter in the planning procedure, into an innovative tool for increasing the energy efficiency and the sustainability of the town for the next decades.

In the energy section of the Master Plan the attention was focused on:

- identifying the urban areas with high energy demand and where it makes sense to use strong energy conservation measures and local cogeneration systems for the production of electricity, heating and cooling (Urban Energy Basins)
- encouraging the large scale solar energy use
- encouraging the appropriate use of natural gas
- reducing the necessity of air conditioning in new buildings

In order to achieve these goals the existing laws have been interpreted in the more extensive possible way., i.e., for example, extending to all kind of buildings the guideline <197>nationally committing only for public buildings<197> to make use of solar energy or low energy mechanical systems. Moreover incentives, in form of tax rebates related to the energy savings compared to the standard consumption, are proposed for builders achieving high efficient energy standards for heating, cooling, daylighting of new or retrofitted structures and for the production of photovoltaic electricity.

### 6.1 Land use obligations

In order to maximize the solar use during the heating season and to reduce solar gains during summer months an indication has been given on the orientation of new buildings. According to the new rules, the principal building's facade should be oriented along the East-West axis, with a tolerance of plus/minus 30°. This orientation is also reasonably appropriate for infiltrations in winter and ventilation in summer, since in Palermo the prevailing yearly wind direction is from south-west, with an average speed of 3.6 m/s. At the same time "solar access" is guaranteed in all new zoning.

### 6.2 Urban Energy Basins

The analysis of the map of energy consumption has led to the identification of specific areas, among those whose use was already defined with other criteria, including the accessibility and the impact on traffic. In these areas (characterized by homogeneous and distinct energy end use or production, like large hospitals, industrial areas, commercial development areas, etc., and named UEB, Urban Energy Basins) special requirements from the energy point of view are defined, such as the obligation to leave a land surface free for a CHP plant, or to have the road network arranged in a north-south, east-west pattern; in UEBs tax rebate and special gas tariffs are also due to be issued for renewables and low energy advanced technologies. On this basis 12 urban energy basins have been defined.

### 6.3 Requirements for new buildings and for large retrofits

A recent national law (DPR 412/93) obliges the designers of all public buildings to use solar energy systems (or cogeneration plants) unless the designers demonstrates that this option is technically impossible or economically not feasible. As this law has just been introduced, it is not possible to observe the results of its application. It is however certain that it opens large opportunities to the cities that want to implement a policy of energy conservation and of diffusion of renewable energies.

This very important approach has been extended in the town of Palermo to all the new buildings. A payback time of 10 years, for large towns, has been fixed in the national law as the maximum period in order to consider the obligatory use of solar systems and components in and the same period is being considered for all new buildings in Palermo.

In order to avoid the large diffusion of air conditioning systems, attention has also been paid to the thermal behaviour of the new buildings in summer conditions. Designers must check that in the hottest room, in absence of the cooling system, in the month of July, the maximum temperature does not exceed a fixed value.

### 6.4 Opportunities for energy conscious buildings construction

In Italy there is a national building code for energy consumption since 1976, that has been, in these months, upgraded with tighter standards and with the possibility to consider the positive effect of solar gains.

As it is illegal, at local level, to impose tighter requirements, the only possibility to achieve better performances consists in the reduction of local taxes for the new constructions if specific targets are met.

This approach has been proposed in four different contexts.

- Space heating demand lower than a limit given by the national code (allowing for a good summer thermal behaviour)

- Operative temperature in the most exposed room during the month of July, calculated in absence of cooling systems, lower than a given value
- Artificial lighting use lower than given thresholds
- Production of photovoltaic electricity

In order to encourage the diffusion of energy efficient buildings other forms of promotions have been proposed. In particular:

The volume increase due to thermal insulation or thermal mass exceeding the minimum value required by law will not be considered in the legal built volume calculations.

At the same time the greenhouses (glazed balconies) oriented toward south (+/- 30°) will not be accounted in the legal "useful volume" of the building.

### 6.5 Tools for designers

The technical values (energy consumption, maximum summer internal temperature..) necessary to obtain the tax reduction and the amount of the economic advantage for the different cases are being evaluated in the context of the implementation of the Municipal Energy Plan and will be defined before the end of 1995.

At the same time a booklet containing simplified calculation methods with appropriate software and specific informations on the possibilities to achieve the tax reduction will be provided to the designers.

The idea behind this approach is to leave the designers free to find the best approach in order to achieve the energy performances necessary to obtain the building permission or the economic incentives.

All this process will be developed with a tight interaction with designers and builders, through audits and workshops. A large effort in the training sector is considered essential to the success of the new regulations; the Municipal Utility together with the Universities is preparing courses in order to create the better environment for energy conscious building designers.

## 7. CONCLUSIONS

The introduction of the energy issue in a Master Plan of a typical Mediterranean city is an important opportunity for the critical analysis and application of concepts, methods and strategies developed in different physical, economical, social and cultural climates.

New technical solutions must be proposed and implemented, especially in the area of space cooling; new tools for imposing, promoting and checking energy conscious measures at urban and building scale must be also implemented. A strong and multifaceted effort is being made for triggering the change towards a sustainable future for Palermo, including the most important part of any change: the diffusion of information and training.

In the Master Plan of Palermo the opportunities offered by the law in order to "force" the introduction of energy saving and solar technologies have been expanded as far as it was possible. At the same time specific incentives have been considered in order to encourage a larger solar use and the diffusion of high energy efficient approaches for space heating and cooling.

## 8. REFERENCES

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