CHAPTER TWELVE

THE MUNICIPAL ENERGY PLANS AS TOOLS FOR URBAN PLANNING IN THE VENICE PROVINCE, ITALY

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Introduction: The State of the Italian Legislation and the Role of Local Authorities

In recent years, Italy's emission of greenhouse gases (GHGs) has accounted for nearly 2% of the world's emissions, and approximately 13% of the European Union's actual. In 2003, the most important GHG in Italy was carbon dioxide (CO_2), contributing 85.5 % to the total national GHG emissions expressed in CO_2 equivalents, followed by nitrous oxide (N_2O), 7.4 % and methane (CH_4), 6.1 %. The country's policies on climate change over the years have shifted from voluntary commitments by industry and individuals to obligatory GHG emissions reduction. In fact, following the ratification of the Kyoto Protocol, Italy had a legally binding commitment to reduce GHGs emissions by 6.5% below 1990 levels (equal to 519.75 million tons –Mt- of $C0_2$eq.), over the period of 2008-2012 (Parliamentary Act Number. 120 of 1 June 2002, in the Official Journal of the Italian Republic Number 146 of 19 June 2001). The main sector to be included in domestic policies and subject to measures in order to reduce emissions is the energy sector, accounting for 83.7 % of total national GHG emissions, followed by industrial processes (6.9 %), agriculture (6.8 %) and waste (2.2 %).

The National Action Plan for 2003-2010 for the Reduction of GHG Emissions is based on European legislation and international agreements. However, its application suffers from significant delays, which are officially explained by the opposition of local authorities to approving industrial and infrastructural projects at the basis of these policies (Italian Third National Communication, Policy and Measures, 2002). However, in same cases, as this paper explores, the local commitment towards GHG emissions reduction has increased, as climate change has undergone increased research, and local officials have come to have a deeper understanding of the consequences of local actions on global climate change. The “Piano di Assetto del Territorio” (Plan of Territorial Management) of Martellago – a municipality located near Venice -- is just one of the “virtuous” example of local initiatives to seriously tackle climate change, aiming at introducing the energy factor as a fundamental aspect of the entire urban planning and management process.

In general terms, regional governments maintain the functions of establishing guidelines and coordinating all activities, while planning and management functions are transferred to the next lowest administrative level (see also Regional Law 13 April 2001, n. 11 “Conferimento di funzioni e compiti amministrativi delle autonomie locali in attuazione del decreto legislativo 31 marzo 1998, n. 112”). The Regions have to adopt, in agreement with local entities and industries, the regional energy plan on the use of renewable energy sources (Article 5 (2) of Law 10/1991). The Veneto Regional Law Number 25 of 27 December 2000 envisages norms for regional energy planning, incentives for energy savings, and the development of renewable energy sources. Law Number 10 of 1991 also prescribes an Energy Plan for municipalities with over 50,000 citizens (see Article 5 (5) of Law 10/1991). Its aim is to develop an energy system where renewable energy sources and energy savings are priority instruments adopted to achieve improvement in safeguards to the physical environment.

It is in this scenario that Italian municipalities can define their climate change adaptation and mitigation measures in the framework of an integrated sustainable urban development policy.

This approach assumes that only a definite synergy between local authorities, the regions and the Central State can guarantee the design and concrete implementation of GHG emissions reduction measures.

Such a promising outcome will offer greater efficiency of efforts and a more coherent harmonization of adaptation efforts at the national and local levels.

In the case of Martellago, the changing environment has promoted a beneficial reaction by stimulating voluntary measures to limit GHG emissions. Martellago is a small town of about 20,000 inhabitants, far less than the minimum numbers required by law for the implementation of energy plans. The environmental awareness shown by the municipal officers of this town is pointing out sustainable solutions for the developmental issues that this area is facing, such as a growing urbanisation trend, the marginalisation of agricultural activities, and intensification off road traffic in a land characterised by high vulnerability due to the proximity to the Venice Lagoon.

The Municipality of Martellago: Description of the Area and Planning Needs

The area of Martellago is part of the drainage basin flowing into the Venice Lagoon and, therefore, is integrated in a wide and relevant environmental system, managed by the planning tool named PALAV (Plan of the lagoon and Venetian areas).

During the elaboration of the Plan of Territorial Order (PAT), a planning scheme was foreseen by Regional Urban Law 11/2004 for the territorial government of the municipality. The local administration of Martellago considered the option of an appropriate tool to be used for territorial planning, in line with the need to ameliorate the urban, territorial and environmental quality as well as responding to sustainable development principles (Oliva F., 2005). The methodological need was to identify a quantitative and qualitative parameter that could perform as a synthetic quality index for the interventions that are foreseen in the municipal area, to support planning choices in a shared and consolidated manner.

The technicians considered GHG emissions as the main indicator for the intrinsic quality of the Plan. Two strategic goals were set: the first was to respect the main targets of the Kyoto protocol (reduction of the total GHG emissions, equivalent to 6.5% of the 1990 levels by the period 2008–2012) for the local share; while the second was to implement a housing development plan with “zero impact”, in order to foster urban growth without negatively impacting environmental conditions, by systematically ensuring efficiency in the planning exercise.

These priorities have been articulated in a series of sectoral objectives, as follows:

a. reduction of emissions from the residential system through greater energy efficiency in new buildings as well as in buildings under restoration;
b. offsetting emissions from all new GHG sources by the establishment of new green areas, according to typologies and specifications of the Plan;

c. a reduction in emissions from road traffic through the optimization of street networks and the incorporation of intensive vegetation belts along streets.

In addition to these developments, an additional planning objective was added, which was connected with GHG limitation and directly focused on the reduction and control of pollution from PM10 (Jaecker-Voirol and Pelt, 2000).

One stipulation was that the program had to be to be implemented and updated, and adequate to the planning and control needs of small-scale municipalities like Martellago.

The urban plan reflected in the PAT of Martellago had to consider two factors: the town's territorial position, which can favour a low-density expansion and the reallocation of tertiary functions from the Venice area; and the positioning around the Lagoon, which poses environmental challenges, and for which there is a need for ecological preservation (by a re-naturalisation of the river banks with an orientation east-west, and by a of the non-built territories) through the enhancement of the natural systems converging towards Laghetti Park. Laghetti Park is an area that is recognised as an European Site of Community Importance (SCI) and is located in the central area of the municipal territory. These systems present a North-South trend, and this fact allows an action of complementation and interconnection with the river network. The proposed structure is based on a "wider green-belt conception," one designed to protect the Lagoon area. This protection is multifunctional, as it includes hydraulic regimen control, the reduction of flowing nutrients, the consideration of the articulation of landscape and environmental systems, and the prevention of conditions of local climate alteration.

Emission Control from the Residential Sector

The first step was to assess current GHG emissions, comparing them with 1990 levels and then reducing them by 6.5%. This would allow estimation of the CO_2 excess, which would need to be made up for specific adaptation measures. The first approach to the quantitative evaluation had been accomplished by a geo-referenced location of the buildings in the municipal area; each one was then identified by a geo-code and a specific file. By such coding, each property could be categorized by classes of age and building typologies (Table 12-1).

Table 12-1: Age classes of buildings in Martellago

Construction periods	Number of buildings
Before 1800	111
1801-1900	47
1901-1945	174
1946-1961	435
1962-1971	1017
1972-1995	1328
After 1995	331

This data could be interlinked with the utilization (in percentage) of each energy vector, in order to estimate the current consumption relations. Considering just two years of reference, 1990 and 2006, for PAT purposes, the relation between consumed energy sources are reported in Table 12-2.

Table 12-2: Table 12-2: Repartition of energy vectors in 1990 and 2006. Source: Data from Autorità per l'Energia Elettrica ed il Gas, 2004.

Energy vector	% 1990	% 2006
Gpl	0,03	0,05
Gasoli	0,06	0,02
Natural gas	0,78	0,78
Electricity	0,13	0,15

Each age class of building showed a different pattern of energy transmittance and yearly thermal need. This estimation had been realized through the attribution of transmittance values and of annual energy need values to the different residential building typologies.

The assessment relieved the physiological amelioration of the energy characteristics of the building, both by considering the house covering, and by considering the adoption of appropriate heating systems. The application of provisional models allowed an evaluation, for the year 2012, the levels of CO_2 emissions as 10.307 tons, while the data for the reference year 1990 showed emissions of 11.807 tons (Della Ragione L. et alii 2005). Therefore the forecast, only attributable to the technological amelioration, is equal to 12.7%, but it is even more significant, considering a population growth from 18,506 inhabitants in 1990 to estimated 21,055 inhabitants in 2012 (+13,8%). In this perspective, the evaluated CO_2 emissions per capita will drop from 0.64 t/yr to 0.49 t/yr.

Such a result will not only be ensured by the change of energy values and by improved heating technologies, but also by a larger application of new building regulations, requiring an energy certification for each building. This will allow evaluation of the energy performances of new buildings together with the restructured pre-existing buildings.

A system has been implemented to evaluate the efficiency of buildings in accordance with the principle of environmental sustainability. The plan distinguishes between compulsory requirements and volunteer compliance. Compulsory requirements depend on current regulations in the fields of environment, energy savings and security. Volunteer compliance are in some cases, further restrictions with respect to the legal threshold values, or building advice for reducing the environmental impact of the new construction.

As a complement to this strategy, some collateral tools are being studied, in order to stimulate the compliance of qualitative methods, by transforming the administrative impositions into economic opportunities. For instance, the achievement of energy efficiency levels can allow the benefit of a volumetric bonus. This option will permit the community to share the added costs deriving from efforts towards the objectives of satisfying social interests, including the reduction of GHG emissions.

The Vegetation Component

A further objective of the Plan is to decrease the local CO_2 emissions caused by population growth, by adaptation measures that can sustain local community development without causing deterioration of environmental conditions. While in the building sector the strategy is to adopt technological innovation in order to increase energy efficiency, mainly by sharing collectively the intervention costs, this sector needs to identify some adaptation measures that can compensate for the sector's ongoing emissions. The main possibility is the addition of adequate vegetation, which has the capacity to balance consistent CO_2 emissions (Lorenzini G., 1983).

To this aim, the planning process for Martellago undertook a quantitative and qualitative project for a green component that could counterbalance emissions of CO_2 produced by heating plants, transport means and new real estates. This was expected to be done by fixing them in vegetation biomass and organic substances to the soil.

The planning exercise was preceded by two parallel analyses: the first one to calculate the impacts of new settlements generated by the population increase, in terms of added emission; the second one was to strengthen the capacity of the local vegetation to absorb the CO_2 emissions (McPherson G., 1994 - McPherson G., 1998).

The first analytic phase was the realization of a system to calculate the added emissions that would foresee the following inputs:

1. primary energy need (kwh/m^2 year) of the new building;
2. number of equivalent inhabitants of the new building;
3. superficies (in m^2) of the new building;
4. energy vectors utilized for heating purposes and their CO_2 contribution; and
5. relocations generated by the new settlements and caused by added number of population.

The second analytic phase is aimed to assess the available green areas within the municipal area, both in order to evaluate its compensation capacity of the current emissions, and particularly to draw strategic indications to utilize for the design of new interventions. This analysis has lead to the following articulation of green structures in the territory of Martellago:

i) Forest areas of great dimension, considered as “green lungs” of high efficiency and effectiveness in respect to the proposed functions, serve in the strategy of territorial naturalization, are difficult to achieve in peri-urban contexts (Paletto A. et al 2006).

ii) Trees outside forest areas: all trees or groups of trees that are located in areas that do not belong to the categories “forests” or “other wood systems”, as they do not reach the minimum thresholds for extension, coverage, width and height at maturity that are fixed for these categories. Wood systems like e.g. hedges, hedgerows, plantations, can easily be diffused in the territory, and increase the environmental and landscape complexity of the sites. If positioned next to the CO_2 emission targets, they favour absorption and also contribute to the creation of specific micro-climates (APAT, 2003; Borin and Maccatrozzo 2005).

iii) Private green areas: these are present in areas of low inhabited density, and represent a resource that needs to be maintained, in order to reproduce the soil, to guarantee the maintenance of non-impermeable superficies, and to limit emissions that, without these areas, would necessitate very large areas specifically devoted to forests or woodlands.

The third phase of this study focused on the evaluation of the CO_2 absorption capacity of vegetation systems. The absorption capacity from the atmosphere is essentially dependant on various factors, such as the types of species of plants which are utilized in the proposed vegetation systems, their treatment and maintenance, the particular environment in which they are placed, and, of course, the age of the plants. A simple evaluation model was implemented to assess the atmospheric CO_2 fixation capacity as a function of abaci plants linked to the urban planning for the expansion areas.

In this way it was possible to establish the size and magnitude of green areas to assign to the municipal administration and to give indications for the realization of private green areas that would be required to achieve the "zero emissions" objective.

The Transport Component

It is well known that a relevant part of the GHGs emissions are derived from the transport sector. Therefore, it is essential to include this aspect of the equation in any emissions control plan. The approach of the plan was to quantify and fix the CO_2 emissions derived from the equivalent inhabitants by means of transportation, and to set the objective to reduce their emissions into the atmosphere. In this case a model was established to evaluate existing transportation conditions, in terms of circulating vehicles, traffic conditions and driving styles, and to foresee future trends (Berta G.L. et al. 2000).

The data on emissions from this sector was obtained comparing the population increase with some economic coefficients recorded by the Venice Province Chamber of Commerce for the years 1991 – 2001 (Sistema Informativo Camerale, 2001). These parameters were used to calculate emissions for the years 1990 and 2000. For the analysis of future trend for the year 2010, the reference model is based only on a correlation between the number of vehicles and the population.

Based on the number of inhabitants in the Martellago municipal area, the CO_2 emissions have been estimated for the years 1990 and 2000. It is possible to estimate future trends of CO_2 emissions from the traffic increase due to projected demographic growth. Trends were evaluated for the different vehicle classes in use in Italy as a whole. A scenario has been developed based on a GDP growth of 2% and a light decrease in the growth trend of the overall car stock (Berta G.L. et al, 2000). Considering the same classes of vehicles, the emissions scenarios have been built, both for Venice province and for the Martellago municipality, for the year 2010.

In order to evaluate the per capita emissions and demographic development, planners excluded relative values for heavy vehicles (3.5 t or more). These must be calculated within their respective productive sectors. The obtained value was then divided by the 2010 estimated population. The result is that, for the municipality of Martellago, the emission charge is about 1050 kg CO_2eq per year per inhabitant.

This reference value has been compared with a series of alternative viability solutions, capable of reducing greenhouse gases and having different social, economic and landscape impacts. The solution is expected to allow a significant decrease in greenhouse gas emissions by 2010, from 8819 t/year (the “do nothing” scenario) to 4856 t/year.

These values only consider the emissions from the primary transport network within the Municipality. Total emissions from transportation includes a much larger networks, such as motorways and other roads within the same municipal area, which is expected to reach 54,000 t/year by 2012.

Finally, the proposed interventions, based on a development and utilization of vegetation, were also considered as functional when capturing the suspended particulates, in particular PM10, which is dependent on suspended dusts, organic material dispersed by vegetations, inorganic material produced by natural agents, industrial processes, combustion in general, and, of course, vehicles traffic. Vegetation does accomplish the fundamental functions of containing the atmospheric pollution induced by vehicle traffic: vegetation has the effect of purifying and filtering various gases and particulate pollutants. The purifying effect of vegetation is certainly linked to the volume of the foliage, but also to other intrinsic and extrinsic characteristics of the plant. Vegetation can reduce pollution in various ways: by absorption of polluting agents, by modification of atmospheric characteristics, and by the separation of the source of emissions from elements that are most negatively affected.

Plants, within certain limits, can act as air filters by fixation of the atmospheric dust particles. The interception of solid particulate by the leaves can occur by sedimentation, by impact due to air currents, and by deposition through precipitation. Moreover, vegetation can also extract from the atmosphere relevant quantities of pollutants. In light of these functions, the urban plan called for establishing vegetation corridors in areas that are most conducive to protecting residential areas.

Concluding Remarks

According to national Law 10/91, the urban plans for city areas of more than 50,000 inhabitants must define a specific means by which municipalities will use renewable sources of energy. This is the Municipal Energy Plan (Piano Energetico Comunale - PEC). The general aim of the PEC is the integration of energy factors in territorial planning, to promote strategic choices for the amelioration of the environmental state of the urban area and for the promotion of the rational use of resources, in line with sustainable development principles. Some smaller towns, including Martellago, are voluntarily complying with this regulation.

This approach, which is still rarely applied in Italy, significantly changes regional and urban planning, as it requires innovation in the method of decision making, and in the response of planners to residential settlement, the physical environment and to transport needs.

The case presented in this paper is one of the first experiences of coupling urban development needs with the environmental needs, by mainstreaming the energy-climate change policies in the whole planning process. Three components mainly design the planning process undertaken by the urban planners for the municipality of Martellago: 1) the analysis of the energy needs of the final users, in order to produce a municipal energy balance; 2) the analysis of traffic mobility and other major local GHG producers, in order to address the needs of settlements development from an energy point of view; and 3) the development and implementation of mechanisms for dealing with the municipal PAT, including building regulation; the identification of action that is needed to meet specified objectives, and the transfer of responsibility to the relevant technical administration offices.

What has been proposed is not an experiment, but a true planning tool presenting various environmental goals: a reduction of CO_2 emissions; control of the impact of PM10, either by transport policies and also by planning, reforestation and management techniques; an increase of use of renewable resources, particularly biomass from a re-conversion of marginal vegetation and from a proactive management of the vegetation cover; and the realization of energy saving by utilizing new technological options, coupled with sustainable building and urban regulations.

Dissemination activities are also proposed in order to stimulate other local authorities to follow the sustainable energy planning option, in order to unify the efforts towards to reduction of GHGs which need the broadest cooperation at all governmental levels.

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