

Including sustainable criteria in territorial energy plans: an application to the building sector in Sicily

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ABSTRACT: In this paper an overview of the design criteria adopted within the new Sicilian regional energy plan has been critically reported. Particularly, it is here pointed out the role played by the sustainability constraints referring to the limitation to the recourse to fossil fuels and the important role played by the new European Directive on the Energy Efficiency of Buildings (EPBD). The penetration in time of renewable energy sources has been argued, in sigh of reducing the energy consumption at the year 2012 up to 20% of the present ones. Moreover, these new induced energy performances of buildings have been matched with the changes in indoor thermal comfort conditions.

Keywords: energy performances of buildings, indoor comfort; renewable energy sources

1. INTRODUCTION

Civil sector, mainly referring to residential and commercial buildings, encompasses a large part of the final energy consumption of developed countries. In Italy, for example, as far as 35% of the country energy uses are aimed at the management of buildings in order to efficiently operate them and confer them suitable indoor comfort conditions.

Such important segment of the energy consumption is obviously taken into account when new planning actions take place in a given territorial context. In Sicily, within the building up of the Regional Energy Plan (that is mandatory foreseen in a national country law), the civil sector is highly taken into account.

In turn, to the sector an increasing environmental characterization is also attributed, mainly due to the new awareness of people concerning the saving of the

natural environment and also according to the new standard and rules released by the European Union, with the aim of accomplishing the Kyoto protocol goals.

Through the present paper an overview of the design criteria adopted within the new Sicilian regional energy plan (to which present authors have co-operated) will be critically reported. Particularly, it will be pointed out the role played by the sustainability constraints induced by the necessary limitation to the recourse to fossil fuels and the important role played by the new European directive on the Energy Efficiency of Buildings (EPBD), that is mandatory in all the member States. The increasing trend in the use of renewable energy sources is discussed, in sigh of reducing the present energy consumption at the year 2012 up to 20%.

Moreover, the new induced energy performances of buildings will be matched

with the changes in indoor thermal comfort conditions.

2. MAIN FEATURES OF REGIONAL ENERGY PLANS

The Regional Energy Plan is essentially a programmatic tool by means of which each region can open to its energy- environmental policies.

The importance of such tool has been already highlighted, in Italy, by both the Ministerial Decree 112/98 and the Law 10/91. The need of a suitable tool for energy planning of territory has been, successively, taken again by the so-called "*Protocollo di Torino*" [1], which defines, among its goals, the need of a co-ordination of energy-environmental policies between various regions, with the aim of reducing greenhouse gas emissions; it singles out, moreover, a set of engagements directed toward the sustainable development. The drafting of suitable energy-environmental plans at a regional level is among these engagements.

As is well known, energy is one of the most important productive factors for the economy of a country, since it involves, directly or indirectly, all the sectors of the human life. Therefore, the energy planning is to be considered as an inter-sector tool an important point of reference for people, both private and public, willing to carry out energy activities in a given territory. It has common objectives with the energy policy of the country; its main goal is to assure the regional development by means of an energy policy respectful of needs of society, environmental conservation and people health safeguard.

Moreover, regional energy plans have to be considered as "dynamic tools", that is suitable of adjusting to changes, which can elapse during the forecast planning, of the social, economic and technological development of a country. For this reason, the accomplishment of regional energy plans calls for a constant monitoring and a

continuous control of the short and middle-term interventions.

3. THE SICILIAN REGIONAL ENERGY PLAN

The Sicilian Regional Energy Plan has been recently approved. It was drawn up owing to an agreement among the Industry Department of the Sicily Region, the Universities of Palermo, Catania and Messina, and the "ITAE", an Institute of the Italian National Research Centre.

The main objective of the work has been to provide the Regional Authority with a tool able to pursue adjustments between the energy demand, needed for the carrying out of productive and civil activities, and the energy supplying of the territory, with the aim of maximizing the relationship between economic and social benefits of the energy supplying and its total costs, included those environmental and social [3, 4, 5].

3.1 Strategies of the Sicilian Regional Energy Plan

The strategies of a regional energy plan must, above all, guarantee the sustainable development of the territory with regard to the existing productive and service activities; at the same time, the energy plan must assure a considerable continuity of activities by the plan horizons (2012). In this perspective, both the adoption of better technological innovations (Clean Technologies) for industries with high energy intensity, and the incentive for the development of renewable energy sources, play an important role.

In particular, as regard the Sicilian civil sector, the choice of possible strategies has been made taking into account the extremely important role of such sector: it, in fact, must guarantee global comfort conditions to the final users, that is thermal, acoustic, lighting comfort and indoor air quality.

The main challenge of civil sector is supplying more and more high building

standards, trying limiting at the same time the related energy costs. From this point of view, the main mission of the energy plan is not reducing energy consumptions, but the identifying of the points of ineffectiveness, with the aim to improve them and to limit the specific consumptions.

The Sicilian Regional Energy Plan has been drawn up paying attention not only to the concept of “energy saving”, but, above all, to the achievement of higher “energy efficiency”. This approach will allow the starting of a process of continuous optimization of energy consumptions and, as a consequence, a phase of transition from episodic energy savings to structural savings.

A particular attention has been also paid to the transport sector since it is responsible of high levels of pollutants into the atmosphere. Among the strategies for this sector, it is possible to cite the modal shift, the use of cleaner fuels (for example hydrogen) and the adoption of a proper plan for the regulation and control of the urban traffic.

3.2 Regional energy framework

In this section, a general framework of the regional energy consumptions is described, with the aim of underlining the incidence of the civil sector in the regional context [6, 7, 8]. At this regard, with reference to data deduced from the Regional Energy Balance of the year 2003, the percentage incidence of various macro-sectors on final energy consumptions has been assessed and reported in Table 1.

Table 1 – Sicilian energy consumption and percentage incidence in 2003

Macro-sector	[ktep]	%
Agriculture and Fishing	234	3.4
Industry	2213	32.1
Civil	1550	22.5
<i>of which: residential</i>	<i>990</i>	

Transport	2905	42.1
Total	6902	100.0

Figure 1 shows the percentage distribution of regional energy consumptions subdivided into macro-sectors in 2003.

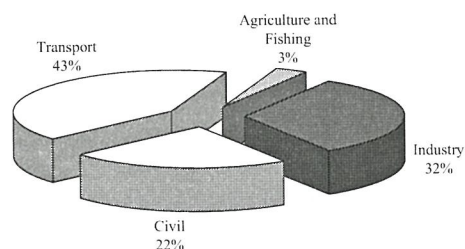


Figure 1 – Percentage distribution of regional energy consumptions for macro-sectors

3.3 Civil sector

The analysis of the structure of the energy end uses in Sicily had pointed out that about 22% of the regional energy consumptions is attributable to the civil sector (both residential and commercial). In particular, the greatest amount of energy consumptions of the civil sector is affected by the residential one: in 2003, in fact, it had consumed about 63.8% of the total consumptions of the whole civil sector.

The energy analysis of the regional civil sector has been rather complex. In fact, besides some typically energetic problems, others referring to the structure of building park and to the prevision on the mean life of used technologies, have arisen. At this regard, it is important to underline the following points:

- energy consumptions of the civil sector are characterized by a wide diffusion of utilization points; they strongly depend by the user behaviour and the management of the winter and summer climatisation systems; they are, moreover, strongly affected by climatic conditions which, owing to their variability during the years, do not allow

an accurate prevision of the energy requirements;

- there is a lack of available data on the regional building park and on the thermal-physical features of buildings;
- the evaluation of the energy and environmental costs of the proposed actions are strongly affected by the duration of the mean life of technologies and by the return-time of interventions;
- economic analyses are based on costs of technologies and building components, the marked of which quickly changes causing a variability of the values of reference.

Moreover, the rules and standards context regarding the building sector is today in a state of ferment, owing to the drawing up of the European Directive on the Energy Efficiency of Buildings (EPBD).

4. PLAN'S SCENARIOS

The reduction of energy consumptions surely is one of the most important ways to guarantee in the future energy availability and environmental protection, along with the improvement of the energy efficiency for the production of goods and services [9]. As well known, the amounts of energy needed for satisfying a proper requirement are strongly affected by the kind of the involved technologies, the ways of their utilizes and the different energy sources. As regard energy saving, the residential sector plays an important role thanks to both numerous possibilities of intervention and the margins of potentially attainable saving.

In order to improve energy efficiency of civil sector it is necessary to plan a very complex and detailed methodology of intervention. And, in order to obtain considerable energy savings in the mean-long period, it is important that the selected scenarios are supported for a sufficiently large period of time.

Moreover, it is important to develop an effective activity of monitoring of the

undertaking activities: the activity of monitoring of energy consumptions is in itself an intervention of energy saving, since it pays attention on user's consumptions.

In this work, some of the main areas of intervention have been analysed in order to reduce energy consumptions of the regional residential sector; moreover, concrete actions, for each areas, have been proposed, suggesting from time to time the possible attainable energy savings.

These actions, at the same time, are a synthesis of the technological framework currently available for possible interventions regarding energy saving in residential sector.

In order to calculate the possible energy and environmental savings reachable in the Sicilian civil sector, in this work authors referred to the technical schedules proposed by the *Italian Authority for Electric Energy and Gas* for computing primary energy consumptions regarding those interventions included in the Ministerial Decree 24 April 2001 (*article 5, comma 1*).

4.1 Definition of the attainable potential energy savings and the following scenarios of plan

The drawing up of the regional energy plan was preceded by the definition of possible potential energy savings and, as a consequence, by the possible plan's scenarios, as reported in the following:

- *theoretical potential*, that is the maximum capacity of incidence on final consumptions. Starting from this potential, a new scenario, called *theoretical scenario*, has been defined, for which has been hypotheses that all the inefficient technologies are substituted by higher efficient technologies. This scenario is, therefore, realistically feasible, but in wide periods of time;
- *viable technical potential*, that is the potential energy saving at which the plan aims (*tendential scenario*). This

potential is different from the previous one for an inertial coefficient of penetration, which is affected only by the energy dynamics of free market of goods and services. The tendential scenario describes the natural development of the energy system in relation to the energy requirements at 2012 without any action for the reduction of consumptions and the increase of the energy efficiency;

- *objective potential*, which has been determined starting from the viable technical potential, and then defining some coefficients of penetration for the forecast action, variable from 2007 to 2011. This potential has let to define the *accessible scenario*, that is the scenario which will allow to reach the wanted values of efficiency. This scenario has arisen from the assumption of hypothesises on penetration degree that each intervention can really achieve, on the basic of both technical and technological features of intervention, and capacity of introduction within social context.

In order to rationalize the energy use and reduce energy consumptions due to the climatization systems, the possible interventions should taking into account both the possibility of operating on building-equipment system and on the energy sources; at the same time, they should affect the life style and the operational choices of families [12].

Some possibilities of intervention have been evaluated, verifying from time to time the real technical feasibility and calculating the energy saving potential and the balance between costs (supported by public bodies) and benefits, both in terms of reduction of demand and increasing of efficiency and environmental impacts due to the realization of the intervention itself.

As regard the estimated interventions for rationalizing the energy use in the regional

residential sector, we can cite the following [13]:

1. installation of one-family and four-star efficiency gas-boilers;
2. substitution of gas-heaters with open chamber and pilot flame with watertight chambers and piezoelectric starting;
3. substitution of single glasses with double glasses;
4. heat insulation of outside walls;
5. heat insulation of roofs;
6. substitution of incandescent lamps with solid fluorescent lamps;
7. substitution of household appliances with more efficiency similar products;
8. substitution of electric boilers with methane ones;
9. installation or substitution of high efficiency conditioning plants.

A synthesis of the attainable energy savings with the forecast different interventions for residential sector of Sicily Region is reported in Table 2.

Table 2 – *Synthesis of the attainable energy savings [ktep]*

Potentials of scenarios			
Action	Theoretical	Viable technical	Objective
1	34.1	23.9	9.56
2	61.5	49.2	19.7
3	51.3	48.8	4.9
4	264.1	258.8	25.9
5	143.3	140.4	14
6	82.1	61.1	34.5
7	77.3	62.6	12.5
8	72.5	48.1	12
9	13.2	11.2	5.6
Total	799.4	704.1	138.7

For each proposed intervention, a synthetic scheme has been predisposed, called “*action scheme*”, which can address interventions of energy planning in the residential sector.

Action schemes include in short the main features which reveal the sector in itself; in fact they include:

- title and a brief description of the forecast action;
- objectives of the action;
- standards of reference;
- promoting committees and people involved;
- description of strategies of action in accordance with the prefixed energy planning objectives;
- possible energy and environmental benefits by means of synthetic indicators of energy and environmental efficiency (for example, €/TEP of saved primary energy and €/ton of CO₂ avoided).

The aforementioned indicators link energy and environmental issues with economic ones, and, at the same time, they can utilize for hierarchizing, by means of an unique grid of evaluation, the forecast actions of the plan. Moreover, they can steer public administrations into the choice of priorities of intervention.

Figure 2 shows a graphic representation of the two proposed energy and environmental indicators, €/TEP and €/tCO₂.

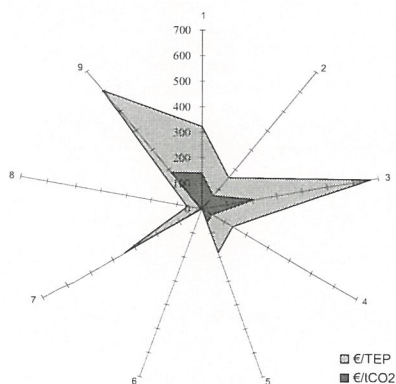


Figure 2 – Graphic representation of the energy and environmental efficiency indicators, €/TEP and €/tCO₂.

Finally, in this work, the true energy consumptions of the residential sector have been evaluated, along with the efficaciousness of the proposed actions, both in terms of energy and environment, with a particular care to the Kyoto Protocol.

5. CONCLUSION

The present analysis shows a synthetic review of the energy interventions taken into consideration within the regional energy plan of Sicily, recently released.

Five main objectives have been pursued:

1. the improvement of the energy efficiency of the sector;
2. the reduction of the recourse to the fossil fuels;
3. the improvement of the utilization of renewable energy;
4. the reduction of the greenhouse emissions, according to the indications of the Kyoto protocol;
5. the emerging of new professional figures that operate in the field of the energy efficiency and the renewable energy use.

Three proposed scenarios have been designed in order of copying, at different levels, the above cited goals. These scenarios represent the technical framework within which suitable policy actions can be adopted by the local administration in order of readdressing the energy and environmental features of the Sicilian development in a sustainable track.

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