Aspromonte National Park: a study of the energy flows as a support tool for the sustainable management of protected areas

M. R. Giuffrè¹, V. Grippaldi² & R. F. Nicoletti³
¹DASTEC, Department of Art, Science and Techniques of Building, Faculty of Architecture of Reggio Calabria, Italy

Abstract

The Aspromonte National Park, which is set entirely in the province of Reggio Calabria, is a protected area of 70,000 hectares. It has been the subject of a preliminary study aimed at detecting and investigating the most important issues in the field of energy, with the purpose of supporting a sustainable energy plan. This paper presents a summary of the main results obtained from the analysis of the energy flows, which are spread over the territory of the protected area itself and parts of the small towns whose territory belongs only partially in the area of the Aspromonte Park. The analysis has been carried out in three different steps: collecting the required territorial data, analysing the consumption of energy, and evaluating the potential of the renewable resources already existent in the aforementioned territory of the Park. Through the creation of suitable maps, it has been possible to discern the areas having the highest potentiality with regards to the use of renewable sources of energy. The representation of the results is thus a useful tool which can be used in the process of planning and management of the area itself and which is also, along with other cultural, social and environmental information, the first step towards the definition of a Sustainable Energy Plan for the area of the Aspromonte National Park.

Keywords: sustainability, renewable energies, protected areas.

1 Introduction

The issues and problems related to energy are indeed central ones among the politic and development strategies of the EU members; in fact, EU in the recent
program “Intelligent Energy for Europe” has underlined, among the main goals, the increase of 1% a year of the energy efficiency and the increase of use of energy from renewable sources, within 2010, as of 22.1%.

The objectives proposed by the Energy and Transport General Department are actually a challenge to achieve in the next few years.

The aim of this paper is to supply the starting tools for an oriented information system, which is of paramount importance to support the policies of sustainable development; in particular, with regards to protected areas, this implies the necessity to analyse the energy flows and the level of efficiency of the networks of distribution of energy.

An analysis of the sources of energy in a wide and complex territory, as the National Aspromonte Park one, cannot set aside the analysis of the existing relations among anthropic system, socio-economic and environmental system.

In this particular case, the process of management of anthropic systems is pretty inadequate to make the many variables involved work as best as possible; hence, all the initiatives, aimed at enhancing the knowledge about the activities in the area of the Park and the adjacent ones, are of paramount importance.

The issue of environmental impacts and sustainability of development is a very important part of this frame, which also increases the overall complexity of the analysed problems.

A study about the Aspromonte National Park aimed at defining the tools for a Socio-Economic Plan for the Park is described in this paper, which reports the results of the analysis of the consumption of power and the main aspects from which this study originates.

In fact, the aim of the study is describing the results of the analysis of the energy flows in the whole territorial system of the Park, and the methodology which has been used to detect the typical aspects of the use of energy in the territory of the Park itself.

The identification of the typical schemes of the consumption of energy in the territory of the Park provides the preliminary data whose further analysis and detection allow to define the apt and suitable scenarios for a rational and sustainable Development Planning.

2 The territory involved in the study

The territory which has been analysed is included in the boundaries of the Aspromonte Park consist of 70.000 hectares and 36 municipalities. The part of territory involved in the study is exactly equivalent to the area included in the boundaries of the Park and the one that comprehends the territory of the Municipalities, given that the overall balance of the energy flows mainly depends onto anthropic activities carried on in the municipality areas. The analysed area is, with regards to its orography, pretty complex, in fact some parts of it are actually coastal ones whilst other ones are about 1500 metres high. In Figure 1 the boundaries of both the Park and the municipalities involved in the study are shown.
3 The demand of power supply

A preliminary analysis has shown that electric energy is the main source of energy being used in the territory of the Park, hence the decision to deepen the detection of the demand of energy with regards to this particular type of power.

It is noticeable that carrying on the analysis of the demand of power supply to the territorial scale, allows to obtain interesting results especially with regards to the fact that the tools used to detect the consumption of energy also allow to create thematic maps that contain information regarding both spatial and time parameters.

In the following description, the structure of the available data is reported and it is possible to notice that there is a lack of in depth details referred to the time and space distribution of the data regarding the consumption of energy.

3.1 The data provided by ENEL

The data used for the analysis have been supplied by the Italian electric company (ENEL) and in particular, by the branch of it that distributes the energy. The database consists in a series of 1930 records reporting the municipality, the category of activity and the consumption of energy per year referred to 2001.
With regards to the structure of the Informative System from which the data have been obtained, it is important to underline that:

- the current method used by ENEL for evaluating the consumption of energy and the related database is mainly based onto the survey of the consumptions for each individual user (in particular, the energy meters reading) with annual reading and integrations with statistical studies;
- the position of the meter readings is not geo-referred hence it is not possible to analyse the consumptions of energy with disaggregated methodologies;

Besides, it has to be underlined that the network of distribution of energy is structured in five levels of aggregation, in particular: Municipality, Area, Street, Line, Socket. In particular, the municipality represents the whole area of the town; the Area is obtained sectioning the municipality area in few units; the Street represent the aggregations of about one thousand users and it corresponds to a group of streets of the town area or, for instance, a quarter; the Line represents a functional electric branch composed by some hundred users; the Socket is the power meter of a user. It has been esteemed that the optimal level of aggregation of the data should be referred to the monthly or seasonal consumptions either of the Street or the Line; nonetheless, in spite of the fact that the data are all included in the Informative System, the data regarding the Street and the Line are not actually available for the analysis. Besides, the data regarding the Sockets are not releasable by the Electric Company due to the necessity to protect the privacy of the users. Actually, the above mentioned Information System has been setup mainly for general procedures of administrative management, and then the requested data for a detailed analysis are not easily available.

3.2 The annual consumption of energy

In order to analyse the different anthropic activities, the existing about one hundred product categories have been aggregated in eighteen groups, as shown in Table 1.

As shown in the table, the annual overall consumption of energy in the analysed area is about 283 GWh/year.

The distribution of consumption of energy per activity and per area is shown in Figure 2, which represents the consumption of energy with regards to aggregated categories.

In order to point out the size of annual consumption with regards to each group and each municipality, suitable charts that show the distribution in frequency of the consumption have been created.

In particular, these charts are aimed at evaluating, with regards to the territory of the Aspromonte Park, the demand of energy per category; besides, they allow us to identify the percentages of the consumption of energy with regards to geographical distribution.

The frequency of consumption related to housing category, shown in Figure 3, demonstrates that in most of the cases the annual consumptions is about 2GWh/year.
Table 1: The annual consumption of power for aggregated categories.

<table>
<thead>
<tr>
<th>Code number</th>
<th>CATEGORY</th>
<th>Consumption (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Houses</td>
<td>144688</td>
</tr>
<tr>
<td>2001</td>
<td>Industry</td>
<td>3386</td>
</tr>
<tr>
<td>2002</td>
<td>Building industry</td>
<td>6200</td>
</tr>
<tr>
<td>2003</td>
<td>Commerce</td>
<td>18578</td>
</tr>
<tr>
<td>2004</td>
<td>Tourism</td>
<td>14789</td>
</tr>
<tr>
<td>2005</td>
<td>Food industry</td>
<td>15037</td>
</tr>
<tr>
<td>2006</td>
<td>Health services</td>
<td>4577</td>
</tr>
<tr>
<td>2007</td>
<td>Civil service</td>
<td>3219</td>
</tr>
<tr>
<td>2008</td>
<td>Transports</td>
<td>1743</td>
</tr>
<tr>
<td>2009</td>
<td>Enterprise</td>
<td>4111</td>
</tr>
<tr>
<td>2010</td>
<td>Education</td>
<td>1776</td>
</tr>
<tr>
<td>2011</td>
<td>Industry (with regards to energy)</td>
<td>670</td>
</tr>
<tr>
<td>2012</td>
<td>Manufacturing activities</td>
<td>136</td>
</tr>
<tr>
<td>2013</td>
<td>Communications</td>
<td>3710</td>
</tr>
<tr>
<td>2014</td>
<td>Irrigation</td>
<td>978</td>
</tr>
<tr>
<td>2015</td>
<td>Services to infrastructural networks</td>
<td>27254</td>
</tr>
<tr>
<td>2016</td>
<td>Services to waterworks</td>
<td>28113</td>
</tr>
<tr>
<td>2017</td>
<td>Other</td>
<td>4527</td>
</tr>
</tbody>
</table>

Figure 2: Categories and related consumption of energy.
Figure 3: Distribution in frequency of the energy consumption with regards to houses.

Figure 4: The main consumptions for the municipality of Cosoleto.
This result provides important information in order to identify possible interventions aimed at producing energy to be used in a given category.

A further analysis can be made by elaborating histogram charts, as the one shown in Figure 4, about the municipality of Cosoleto, and which reports the category in the x-coordinate and the consumption in the y-coordinate. The chart allows us to display the consumptions in terms of absolute value with regards to each category that, when aggregated, forms the category of housing. This approach allows us to point out the maximum, minimum and mean consumptions with regards to each category; this information allows not only to evaluate the level of socio economic development of each municipality involved in the study, but also, to underline the differences existing between the municipalities.

The information attainable from the described graphs can be further analysed with regards to the consumptions of energy related to the single municipality. This approach allows us to analyse this issue more in-depth, going from the evaluation of the i-th category to the evaluation of the individual characteristics of each municipality. The analysis per single municipality is therefore aimed at identifying the relative and absolute contributions of each of the aggregated categories; besides, it represents the necessary database that allows us to draw possible scenarios of future development.

![Figure 5: The prevalent consumptions for the town of Cosoleto.](image)

Instead, in Figure 5 it is represented the distribution of consumptions in terms of relative percentages; in particular, the chart shows the results with regards to the town of Cosoleto.
3.3 The thematic maps

With reference to the structure of the database supplied by ENEL, it is noticeable that it’s quite difficult to create a thematic map of the consumptions, with regards to aggregated category, having a spatial resolution larger than the municipality level; nonetheless, it is possible to use, with regards to some of the categories, further variables.

For example, with regards to the category of houses, the variable to be used is represented by the number of buildings not set in the urban areas: in fact, if further informations lack, the ratio between number of inhabitants scattered over the territory and those living in the urban areas allows to esteem the requirement of energy of a given territory.

Figure 6: Thematic map of the consumption for the housing category.

A thematic map presenting the consumption of energy related to the housing category without reference to its distribution over the territory is shown in Figure 6.

4 Conclusions

The results obtained from the study allow to draw some important conclusions regarding methodological aspects; in particular, with regards to the
implementation of a SIT aimed at the development of the protected area referred to the use of the energy and especially, of the energy obtained by renewable sources.

In fact, the presented results show that the information attainable from the proposed charts are actually preliminary ones, hence, the necessity of a more in-depth study appears evident; at present though, the existing system of organization and management of data cannot supply such results, in the short period.

Analysing the results obtained from the analysis, it is noticeable that, even though there are great differences between the municipalities involved in the study, the main categories are those regarding the housing, the services to waterworks and transports.

This first stage of information regarding the amount of annual consumptions, the considered categories and the relative percentages of each municipalities, defines the distribution of the existing level of economic development of the territory and can be used as a starting tool for the definition of apt scenarios of both intervention and development in the field of energy.

References