

## Urban and environmental planning for the protection and valorization of low temperature geothermal resources

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### Abstract

Ground heat is a territorial and environmental resource. This resource is suitable for heating and cooling by means of open or closed loops. Its correct use implies to take into consideration the renewability limits of the resource (heat or water) and the environmental, social and economic sustainability, in order to avoid or to limit negative impacts.

Up to 1995 in Italy specific authorities and plans, all focused on the concept of sustainable development, dealt with defining the rules of how to use the environmental resources.

Since 1995 several regional urbanistic rules are created and focused on the important role that land planning oriented to sustainable development can play for the correct use, valorization and protection of the environmental resources.

The quantitative evaluation of geothermal resource and its economical suitable use can thus conveniently be handled inside the planning process. Important factors in the evaluation process are also hazard and risk concepts, considering the human factor as a driving force on the surrounding environment.

In addition, the Strategic Environmental Evaluation, which must be included into any urban plan, strengthens the correct use of the natural resource by assuring all objectives of environmental compatibility, along with economic and social sustainability, are reached.

This paper aims at showing the technical, administrative and environmental advantages of managing the geothermal resources within the regional, provincial and local planning process.

### 1. URBAN AND ENVIRONMENTAL PLANNING FOR THE TERRITORIAL GOVERNMENT.

The Urban and territorial planning system that emerges from the regional laws enacted in Italy in the

second half of the nineties, is significantly different from that given by the Planning Law of 1942.

The planning process is now structured on three territorial levels (regional, provincial and municipal) characterized by a different level of detail of the cognitive frameworks.

The changes occurred in the urban and territorial planning system created a new relationship between the land and urban planning and the territorial government.

The numerous regional laws enacted after the reform of Title V of the Constitution, have been termed “laws for the territorial government” to emphasize the greater role played by the land planning and management in the government of the territory.

The concept of territorial government cannot be limited to the regulation of land use that has traditionally been the central activity of urban planning.

Indeed the government of the territory must include the “landscape and soil conservation, the local development, the mobility and infrastructure, the protection of ecosystems and architectural heritage, the proper use of natural resources, the social and economic development”.

Acknowledging the addresses of the European Union these laws have faced several problems of:

- consideration and integration of the rules and legislation related to soil conservation, prevention and protection from “natural risks”;
- coordination and integration of the legislation concerning the protection and enhancement of cultural, and environmental Heritage and the correct use of Earth resources;
- coordination and integration of the legislation and guidelines concerning the environmental compatibility and evaluation procedures, the social and economic aspects, the energy efficiency;
- Identification of the tools and methods for the implementation of the policies of land government, moving towards the institutional cooperation and the

optimization of relationships between the different planning tools.

With particular attention to the protection and proper use of geo-environmental resources, the “municipal level planning” plays a key role. In fact, the cognitive and legislation framework created for regional or sectorial planning (i.e. National/Regional Energy Plan, Water Protection Plan, etc.) can conveniently flow into and be detailed at the “local level”.

## 2. DEVELOPMENTS AND ADDRESSES OF THE RENEWABLE ENERGY LAWS.

Due to the significant increase in the use of renewable energy, the Directive 2009/28/EC, highlights the need to promote more efficient applications “*through building regulations and codes*” and “*the need to ensure that architects and planners properly consider an optimal combination of renewable energy sources and high efficiency technologies in their plans and designs*”

It is relevant to note that “*Member States shall recommend to all actors, in particular local and regional administrative bodies to ensure equipment and systems are installed for the use of electricity, heating and cooling from renewable energy sources and for district heating and cooling when planning, designing, building and renovating industrial or residential areas. Member States shall, in particular, encourage local and regional administrative bodies to include heating and cooling from renewable energy sources in the planning of city infrastructure, where appropriate*”

In Italy the Legislative Decree 387/2003 and the Law 99/2009 (finalized to the promotion of the use of electric energy from renewable sources) in application of the Directives 2001/77/EC and 2009/28/EC has regulated the authorization procedure for renewable energy power plants and introduced a “*Single Authorization*” issued by regional or local administrative bodies in accordance with the requirements and standards for the protection of the environmental, landscape, historical and artistic heritage.

The Legislative Decree 22/2010 (legislation on exploration and production of geothermal resources) also identify the installation to be subjected to environmental screening, those to be subjected to EIA and states the needs to always refer to the Regional Landscape Plan.

As of the heat production from geothermal resources, the Legislative Decree 22/2010 states that the authorization for installations with a capacity of less than 2 MWt (both closed or open loop) are managed by the Regions.

Regions shall, in particular, take the appropriate measures to ensure that simplified and less burdensome authorization procedures are established.

This can conveniently be managed inside the territorial planning system that can efficiently promote the use of low temperature geothermal resources ensuring a correct use both in terms of energy efficiency and environmental protection.

## 3. THE GEOTHERMAL RESOURCES MANAGEMENT IN THE URBAN AND ENVIRONMENTAL PLANNING PROCESS.

For the renewable energy plants which have to obtain a “Single Authorization”, it is necessary to set up a particular regional process, which can be made easier if it is possible to take into account the relevant instruments of environmental, land and landscape planning. Several Regions have regulated the use of some alternative sources for electricity production through these instruments. For example, the region of Calabria has regulated the use of renewable sources for electricity production, relative to wind and photovoltaic mini-installations, within the Regional Territorial Landscape Framework which is being drawn up.

More conveniently, the use and regulation of the low-temperature resources energy can be handle inside the regional planning process.

The problems related to the construction of useful cognitive frameworks can be now more easily solved thanks to the research and technology development.

Thanks to the research development many environmental and geological data oriented to the construction of feasibility maps are now better identified. Complex analysis taking into account environmental, economical, and city-planning information and data, now more easily be managed thanks to the GIS tools<sup>1</sup>.

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<sup>1</sup> *The model worked out by ENEA (the National Agency for New Technologies, Energy and the Environment) in cooperation with the University Roma Tre - Department of Geological Sciences “STRUTTURAZIONE DI UNA BANCA DATI IN AMBIENTE G.I.S. PER LO SVILUPPO DI IMPIANTI INNOVATIVI FINALIZZATI ALLA GESTIONE DELLE GEORISORSE” (Mottana A., Campolunghi M.P., 2010) represents a strategic instrument to support the environmental planning which can be used by local Authorities in order to identify territorial geothermal potentials and for the planning of management activities.*

It is worth noticing that the building up of specific cognitive frameworks plays a key role in the urban and landscape planning process. The same frameworks can be very useful for the definition of the “geothermal vocation” of a territory. In addition, the Strategic Environmental Evaluation, which must be included into any territorial plan, strengthens the necessity of detailed cognitive frameworks.

The scope of the Strategic Environmental Evaluation is, in fact, to assure that all objectives of environmental compatibility are reached along with economic and social sustainability.

If we consider the territory as a basic resource, as a development system and as a place of social and economic investments, the analysis of the territory should be considered in terms of collection and organization of data on its conditions. The analysis aims at detecting territorial restrictions and potentiality, at foreseeing development trends as well as at assessing the interrelation among the different sectors of analysis.

Urban and land planning has to be based on the clear and reasoned explanation of its purposes, therefore choices have to be made: “on the basis of the knowledge, systematically acquired, of the physical, morphological and environmental characteristics of the territory, of its resources, values and restrictions, of its current uses, of the provisions concerning demographic trends and migratory flows, as well as of trends of social and economic changes. The decisions taken for the territorial development have to be defined by comparing its economic values, the social needs, and the environmental sustainability”.

The setting up of an environmental cognitive framework is a complex process because it has to allow to:

- structure a hierarchy of environmental problems;
- identify the best use of the different “environmental components” in terms of economic development;
- check the availability of information necessary to tackle any possible geo-environmental problem;

To this end, it is essential to build up a cognitive framework of the natural and environmental system. This framework, among other things, will contain physical and morphological aspects focusing on geological hazards and risks as well as on geo-environmental resources. Therefore it offers important information for the evaluation and correct use of low-temperature geothermal resources.

Geological analysis and cartographic tools describing these aspects can be more or less detailed according to the level of planning (Regional, local, etc.) and the planning purposes.

The analysis of the conditions of a territory cannot be just a detailed account of the potentiality of its natural resources, conversely it should be designed in order to

contribute to the proper use of these resources, taking into account the value and the vulnerability of the resource itself, its protection and its enhancement.

The analysis of geo-environmental resources has to be carried out going beyond the traditional and well-known thematic cartographies of analysis and synthesis, in order to obtain tools which can be used as indicators allowing the feasibility/compatibility evaluation oriented to the sustainable transformation, management and development of the territory.

At the “municipal planning” level, the integrated process of strategic environmental planning and assessment makes it possible to respect all the key steps, such as:

- including the development of the geothermal heating and cooling systems among the Plan objectives;
- assessing the sustainability of the objective;
- defining the actions through which the objective can be best pursued;
- assessing the compatibility/cost-benefit ratio of actions;
- monitoring the results of the actions.

The cognitive framework required in the first phase of macro-scale analysis can be used to produce preliminary synthesis cartography allowing a basic assessments of the territorial geothermal potentiality. This cartography plays a key role in the step of individuation of the objectives of the Plan.

The data and information to be used for the development of feasibility/compatibility maps have to be selected in order to realize maps working as “environmental indicators”. In this way the maps allow differentiated evaluations on the feasibility and compatibility of a planning actions but also on their advisability and necessity.

The criteria that we have pointed out (Pizzonia A, Pizzonia V, 2006) Exclusion, Repulsion, Attraction, Necessity (ERAN criteria), are very functional to this.

The map will illustrate a division of the territory based on the following criteria:

#### • EXCLUSION (E)

It expresses conditions and characteristics of an area which prevent particular transformations and/or planning actions. Geological and geo-environmental conditions make it no possible (or very problematic) the feasibility of the action programmed.

#### • REPULSION (R)

The area presents a high degree of resistance to the planning action (territorial transformation). The transformation can be done but it is economically not convenient or problematic for the environmental conditions.

#### • ATTRACTION (A)

The area should be preferred for transformation/planning action.

- NECESSITY (N)

The area requires interventions necessary to remove or to mitigate criticalities and risks.

It is so possible to obtain maps which do not necessarily quantify problems, but which are able to highlight problems, opportunities and necessities (indicators of weakness, of necessity, etc.), supporting the selection of the objectives of development of an area.

For the structural phase of the Plan, where the choice of actions and a first assessment of their feasibility and compatibility take place, more refined geo-environmental profiles and more appropriate indicators are required, thus allowing the assessment of the most favourable geothermal conditions and a mapping of the territorial feasibility for geothermal installations.

The Italian “Urbanistic laws” regulating the contents and the general objectives of the urban and environmental planning, also allow more detailed analysis on geological and hydrogeological conditions (geotechnical and geognostic investigations, borehole drilling, soil sampling, etc.), as it happens, for instance, for the seismic microzonation.

The resulting data, cannot replace in any case the detailed investigation required for the installation project, but allow to characterize the “geothermal vocation” of the municipal land and provide the key information necessary to the sustainable use of the resource.

#### 4.CONCLUSIONS

The “geothermal vocation” of an area, which depends on geological and hydrogeological factors, can be evaluated during the assessment of the cognitive framework, which, according to the new “Urbanistic Rules”, must be included into any territorial planning process.

Thanks to this preliminary evaluation the sustainable use of low-temperature geothermal resources can be included in the territory development objectives.

Further phases of the planning and evaluation process will define specific aspects such as the best use of the resource and the sustainability and feasibility of intervention.

Managing the use of low temperature geothermal resources inside the urban and environmental planning process ensure a correct use not only in terms of energy efficiency and environmental protection but also in terms of economic sustainability that can efficiently promote the use of low temperature geothermal resources.

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