

Tuscan Geothermal energy, when underground resources are a development leverage for territories

An important example of territories pursuing their own development model, which meets life quality, conservation of the environmental and cultural heritage and new technologies, thanks to agreements between territories and the industrial subject

DOI 10.12910/EAI2017-031

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The two Tuscan geothermal areas, location of the Italian geothermal power plants, are in the south-central parts of the region. Thanks to these territories, Tuscany can be considered the world cradle of geothermal energy, since first experiments to use geothermal steam to turn on a light bulb were performed in 1904 in Larderello, whereas the world's first geothermal power plant (250 kWe) was installed in the same place, in 1913. In 2015, power plants installed in Tuscany, with a total

capacity of 915.5 MWe, produced about 6,200 GWh, making Italy the main geothermal power producer in Europe.

Low population density, small villages, geothermal power plants, rural landscapes, historical evidences and poor infrastructures (roads, telecommunications, etc.) mainly characterize the Tuscan geothermal areas. This results in socio-economic marginalization problems, depopulation and unemployment, but also industrial specialization, high level of know-how in specific sectors, and

niche and non-mass tourism flows. Until some years ago, small companies mainly represented local activities. Sectors of these companies are mostly represented by agriculture, followed by commerce, building and manufacturing industries. The number of companies operating in the tourism and hospitality sectors was lower and it concerned medium-low market segments, even if the sector is growing year after year.

The territories of geothermal energy in Tuscany can exemplarily illustrate a model of socio-economic-cultural-

environmental development that has been peculiar over ages. Even today, in this part of Tuscany millennial memory, quality of life, beauties of historical and landscaping heritage, valuable natural resources from the bowels and the surface of the earth, heritage of knowledge and experiences constitute an *unicum* that deserves to be mentioned.

It is a polychrome area with territories bound by the *fil rouge* of sub-surface resources (first a history of mines, then geothermal). The sub-soil that has interacted with and

characterized the surface in a wonderful way; from these guts resources, have emerged what have been a vehicle for the development of these territories and which can still act as an attraction for future investments. A Living Laboratory, where the constant search for the right balance between natural resources, innovation, technology and historic and landscape heritage, has led the efforts of local communities.

It is difficult to imagine these lands as they are today without the work of the man who bent at their will the

natural forces in valleys that were not always so sweet and welcoming. Human intervention has sometimes altered, plagiarized and subjugated natural resources. This landscape is the result of the millennial human transformation to make the territory more suitable to the needs of the communities that inhabited it.

It is not easy to imagine how these territories would be now, without industrial geothermal cultivation, but perhaps it is more interesting to imagine how these landscapes can become, without pursuing the utopia





of stiffening everything in the space of a postcard reserved to a few.

Initiatives to promote the sustainable development of geothermal areas

In order to promote the local socio-economic development, also through compensations to municipalities where there existed geothermal exploitation permits, in 1988 local authorities of the traditional geothermal area founded the Consortium for the Development of Geothermal Areas (CoSviG), also with the aim of coordinating technical and financial fulfilments in charge to local authorities to

manage these funds. Now the Consortium plays an important role as an operational arm of its stakeholders (14 municipalities, 3 provinces, 4 unions of municipalities, and the Tuscany Region) in initiatives aimed at proposing a model of local development in line with the vocations and economic activities of these territories.

Since the second half of the 2000s, mechanisms to redistribute revenues of the geothermal energy exploitation were set up, in order to advantage local populations but also to reduce the environmental impact of industrial activities. Geothermal Municipalities, the Regional Authority and ENEL signed the

General Agreement on Geothermal in 2007, and the implementing Voluntary Agreement in 2009. The main goal of those Agreements is to propose a local development model on issues concerning topics in line with the vocations and the local economic traditions of these territories.

CoSviG has promoted the creation of development paths involving all economic and social actors in the territories. A roadmap for sustainability was conceived from the diversification in production and use of energy from renewable sources, combined with the social, cultural and environmental peculiarities of the area and technological innova-

Two infrastructures owned by CoSviG: CEGLab and Sesta Lab

CEGLab is a centre of advanced expertise in geothermal energy, created by CoSviG (the Consortium for the Development of Geothermal Areas) with the help of Tuscany Region, in order to contribute to the dissemination of innovation and to technology transfer for the promotion and direct use of heat from underground. CEGLab is conceived as an applied research laboratory for geothermal-related issues, to perform experiments and tests on prototypes and products which can contribute to improve geothermal technologies in terms of resources and plants. It operates in synergy with other in-

frastructures dealing with applied research on geothermal energy, so as to create a network of laboratories that may be expanded.

SestaLab is one of world's leading laboratory for "full scale testing" of gas turbine combustors to study the pressurized combustion process. Acquired by CoSviG in 2014, the experimental area's mission has been to replicate combustor real conditions in terms of pressure, flow and temperature since the beginning. A design based on test results allows to meet final users' need (emission, environment etc.). It is fundamental to get new Oil&Gas and Power Generation market shares. The most important Gas Turbine Manufacturers have run a test at least once in SestaLab.

tion. Actions related to this model can produce results for encouraging/multiplying design, even private, consistent with the Country's land development strategy.

The development model that CoSviG is experiencing in Tuscany is based on actions to support:

- Infrastructures for tourism and trade sectors;
- Restoration of some ancient villages, making them more attractive to visitors;
- Infrastructures for generating distributed energy from renewable sources (wind, biomass, geothermal):
 - wind farm (subsequently expanded);
 - installation and remodeling of installations of telescopic geothermal heating in urban centres;
 - biomass plants for buildings not reached by district heating networks;
- ICT infrastructure for innovation;
- Structures and tools for applied research and technology transfer on energy;

- creation of a centre of excellence for geothermal energy and technology transfer on renewable energy sources;
- creation and management of CEGLab (Laboratory of the Centre for Excellence for Geothermal Energy-Larderello);
- acquisition and management of SestaLab (Sesta Testing Laboratories), one of the world's leading real-time gas burning labs;
- coordination of the activities of the Regional Technology District on Energy and Green Economy - DTE^{2V};
- Infrastructures for production areas;
- Territorial marketing projects, territorial promotion and investment attraction;
- Support to local entrepreneurs with disbursed grants and guarantee funds for access to credit bank;
- Training Agency;
- Renewable Energy Food Community (the first in the world) consisting of agrifood producing companies using renewable energy and Tuscan raw materials, founded by CoSviG with Slow Food Toscana

and Slow Food Foundation for Biodiversity.

CoSviG's development model, thus, allowed the *promotion of the territory* in its peculiarities and characteristics, by the promotion and dissemination of initiatives linked to RES, energy saving and efficiency in the respect of local communities and their traditions and vocations.

Besides promoting RES plants and energy efficiency measures through research, innovation and technology transfer activities, the final aim of CoSviG is, therefore, to build a local development system, which can result in an integrated and homogeneous growth model. Thus, actions related to this model can produce results for inducing/multiplying complementary projects, including private initiatives, consistent with the strategy for sustainable development and dissemination proposed by the territory. In this context, CoSviG and Enel Green Power signed, in January 2017, an agreement to support one-year experimental cultivation of the cyanobacteria *Spirulina (Arthrospira platensis)*, in order to test techno-

economic sustainability conditions to produce, in a geothermal environment, this microorganism used in nutraceuticals. Cultivations are using waste heat and CO₂ from a geothermal power plant and are monitored by properly trained technicians. This staff will be available to subjects wishing to enter this sector, once the experimentation is completed. The final aim of this project is indeed to make these territories more appealing to companies intended to invest in these territories using locally available resources, as well as to expand the production chains that geothermal heat can support.

From the promotion of local resources to the promotion of sustainable energy and energy efficiency at regional and international level

In order to promote the use of sustainable energy and energy efficiency, CoSviG also carries out several activities at regional and international level.

In this connection, CoSviG has coordinated the Innovation Pole on Renewable Energies and Energy Saving (PIERRE) and is now the managing body of the Technology District on Green Energy and Economy (DTE2V) of the Tuscany Region. The DTE2V is a regional technology district grouping about 80 subjects among companies, laboratories and research centres (as well as universities) working in the energy and green economy sectors. Its main aim is to increase the competitiveness of Tuscan companies working in the latter sectors, through:

- technology dissemination, forecasting changes in the reference sectors;

- business matching/matchmaking, promoting matching among economic players, in activities for technology innovation and for the adoption of strategies for marketing and to approach to new markets;
- creation and enhancement of know-how in the reference sectors;
- searching for funds for innovation in regional or European funding programmes, through ESCOs, financial intermediaries, etc.

The DTE2V acts, therefore, as a bridge between research and companies, in order to promote their innovation capacities and competitiveness in the market.

The Technology district acts in 4 different technical-scientific areas:

- Introduction of the liquefied natural gas (LNG) as a new energy carrier;
- Increasing the penetration of the electricity carrier;
- Increasing the production of energy from renewables, with focus on geothermal energy, its direct uses and integration with other renewables and energy efficiency measures;
- Interconnection of systems, such as electricity grid, electrical and thermal systems, hydraulic and electrical systems.

At international level, CoSviG and part of its territories, with their long-standing experiences, participated in Geothermal Communities and GeoDH: two projects co-founded by the European Commission and aimed at promoting the use of geothermal heat in district heating and other systems such as heat pumps.

Sustainable exploitation of geothermal resources

Geothermal plants provide a significant contribution to the electricity balance from renewable sources in Tuscany. However, this electricity conversion is not exempt from environmental drawbacks. Thus, there is a need for the development of appropriate technologies to reconcile the geothermal electricity plants with the renewable nature of the energy resource.

Geothermal energy should be considered globally as a renewable resource, the use of which contributes positively to the energy and environmental balance of the countries where it is cultivated.

In Italy, according to a leading history of experience and expertise in using this resource in its various aspects and with the different features it manifests itself, fears and rejection have grown in recent years. Whilst believing that geothermal a renewable and strategic energy source for our Country, can be cultivated in a context of sustainability, the problem of environmental impacts improvement should be addressed. The destiny of geothermal energy cannot be left in the hands of business ventures or local committees. The property of the geothermal resource – a public good – belongs to the territories where it manifests itself. If used well, it can directly and indirectly create a development driver in vast areas of a country. Acceptability problems related to this source of energy - at least the use of high and medium temperature – partly derive from an industrial past, where, although within regulatory constraints, the occupational data was prevalent in relation to environmental issues. The Tuscan Region, where the main

geothermal potential is concentrated, has also moved not to vanquish the great work it has done since the 1990s to ensure a correct and sustainable use of this resource.

In order to not to give up definitively a resource that can be decisive in future energy and environmental balances, alongside the development of technologies that will ensure more efficient use of geothermal energy, strong sharing paths are needed to choose plant locations and in the authorization procedures.

Conclusions

The development model being experimented in Tuscan geothermal areas is based on efforts to foster a sustainable way to develop territories characterised by geothermal energy, and where geothermal energy can be helpful to local communities and at national level. Indeed, a natural resource, if well managed, may represent an important development driver, rather than a source of negative externalities.

This model, built around the industrial use geothermal energy, can be exported to other territories characterized by the exploitation of important locally available resources, in order to generate a source of opportunities for both business actors and local communities, and with the final aim of promoting a development system that meets the criteria of sustainability.

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