ARPAT activity and air quality in geothermal areas of Tuscany

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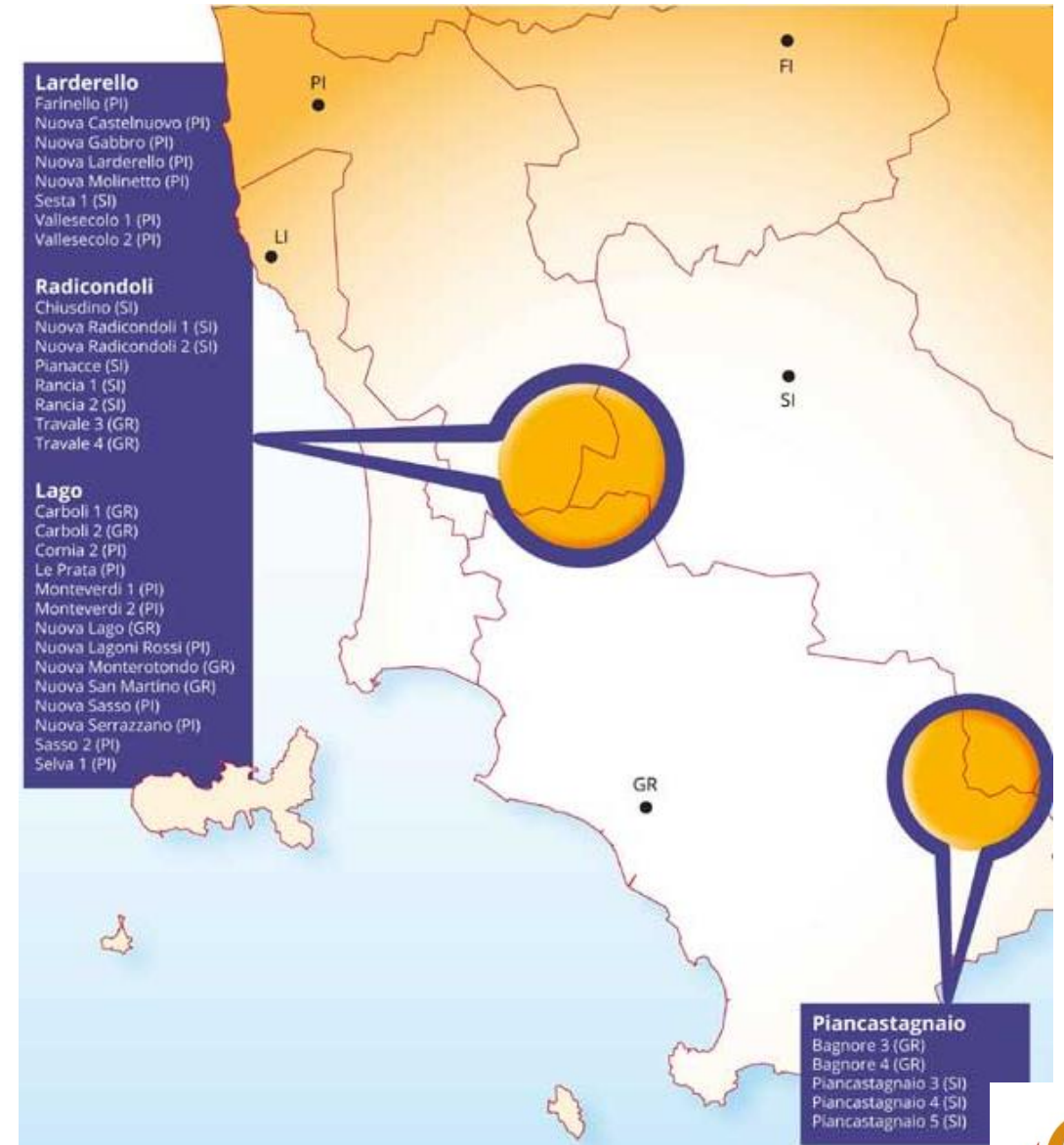**Environmental Protection Agency of Tuscany (ARPAT)**

The Tuscany's areas of the Colline Metallifere (**"Traditional area"**: Larderello, Lago, Radicondoli, Travale, Chiusdino) and Monte Amiata (**"Amiata area"**: Bagnore and Piancastagnaio) have specific geothermal anomalies, that makes particularly convenient the energy exploitation.

In these areas today **33 geothermal power plants are active**, i.e. 37 total production groups, managed by ENEL Green Power Italia S.r.l..

Environmental Protection Agency of Tuscany (ARPAT) was established in 1995 by Regional Law n. 66; ARPAT supports the Tuscany Region, which is the Authority responsible for issuing permits for the construction and operation of power plants.

The environmental **impacts of geothermal power plants are assessed by ARPAT**. In addition, ARPAT has duties to **supervise the proper operation of the plants** and to **monitor the environment in order to contain the impacts according to current European and national standards**, in compliance with the permits issued.

In particular, ARPAT examines the following environmental aspects for these facilities: **noise**, **atmospheric emissions**, **water discharges and impacts on groundwater**, **management of excavated earth and soil pollution**, **waste and radioactive waste management**, **exposure to electromagnetic field**.

Before their construction and commissioning, **geothermal plants are examined to assess their environmental impact in accordance with Legislative Decree 152/2006 ("Environment Act")**, which transposed Directive 2014/52/EU and Directive 2011/92/EU of the European Parliament and of the Council on the "*assessment of the effects of certain public and private projects on the environment*" into Italian law.

For example, **recently ARPAT evaluated** -as part of the environmental impact assessment- **the following new Organic Rankine Cycle plants**:

- 2017-2019: «Poggio Montone» 5 MW, Piancastagnaio (SI) and Santa Fiora (GR)
- 2018-2020: «Qualtra» 10 MW, Castelnuovo di Val di Cecina (PI)
- 2019-2021: «Cascinelle» 9.99 MW, Abbadia San Salvatore (SI)
- 2022-2023: «Mazzolla» 10 MW, Pomarance (PI)
- 2023: «Monterotondo 2» 5 MW, Monterotondo Marittimo (GR)

Existing geothermal power plants involve polluting emissions (H_2S, Hg, CO_2), with consequent atmospheric impacts.

Given the importance of their energy production (the 33 geothermal power plants produce 5000 MWh per year, more than 30% of Tuscany's needs), **in 2010 the Region of Tuscany defined a framework of coherent rules for the authorization and operation of the plants in order to limit their impact on the environment, and in particular on ambient air quality** (Regional Decree n. 344), subsequently specified by Regional Law 7/2019:

- application of the best available technologies
- setting of emission limit values (H_2S, Hg, SO_2), to be included in the permits, and target values (H_2S, Hg, As, NH_3, SO_2, H_2BO_3)
- minimum plant operating requirements
- plant management and maintenance protocol

The Regional Decree 344/2010 has also established that the operator (ENEL GREEN POWER) has to "***develop a large-area diffusion model with which to estimate air quality in terms of concentration of the various pollutants*** (*H₂S, As, Hg*) … ***The specific methodology for the modelling applications to be carried out in the various geothermal areas****, identifying the type of numerical models and the data set of meteorological data most relevant to the area in question,* **will have to be agreed with ARPAT**».

Therefore, according to ARPAT instructions based on US-EPA and EEA Guidelines, **between 2014 and 2016 CESI on behalf of ENEL has been carried out two studies have using techniques for modelling pollutants' air dispersion**, with which it has been possible to extend the knowledge of the impacts also to areas and pollutants (As, Hg) not monitored by ARPAT and ENEL air quality network.

In particular, **the study on the "Traditional area" has estimated the impacts of emissions in 2012**.

On the other hand, **the study on the "Amiata area" was conducted in two emission scenarios**: one dating back to **about the year 2000, when the plants were older** and the current emission abatement techniques were not yet available; the second to the **end of 2014, after the installation of the AMIS system** (Hg and H_2S abatement system).

ARPAT has checked and validated these studies, which highlight the **significant improvements brought about by new technologies and recent management techniques introduced in compliance with the regulations of the Tuscany Region**.

In addition, based on this in-depth work, **the Regional Health Agency of Tuscany (ARS) has been able to conduct some epidemiological assessments, with specific reference to the "Amiata area"**.

Figura I.9 - Concentrazioni di H₂S in aria ambiente: confronto tra stime (MOD, in rosso) ottenute dall'applicazione modellistica e misure (OBS, in blu) della stazione di monitoraggio di Piancastagnaio (PICA) appartenente alla rete di ENEL Green Power. In alto il confronto relativo allo scenario "pregresso" (qui le misure si riferiscono all'anno 2002; i valori stimati sono riferiti alla meteorologia dell'anno 2014), in basso quello relativo allo scenario "attuale" (anno 2014)
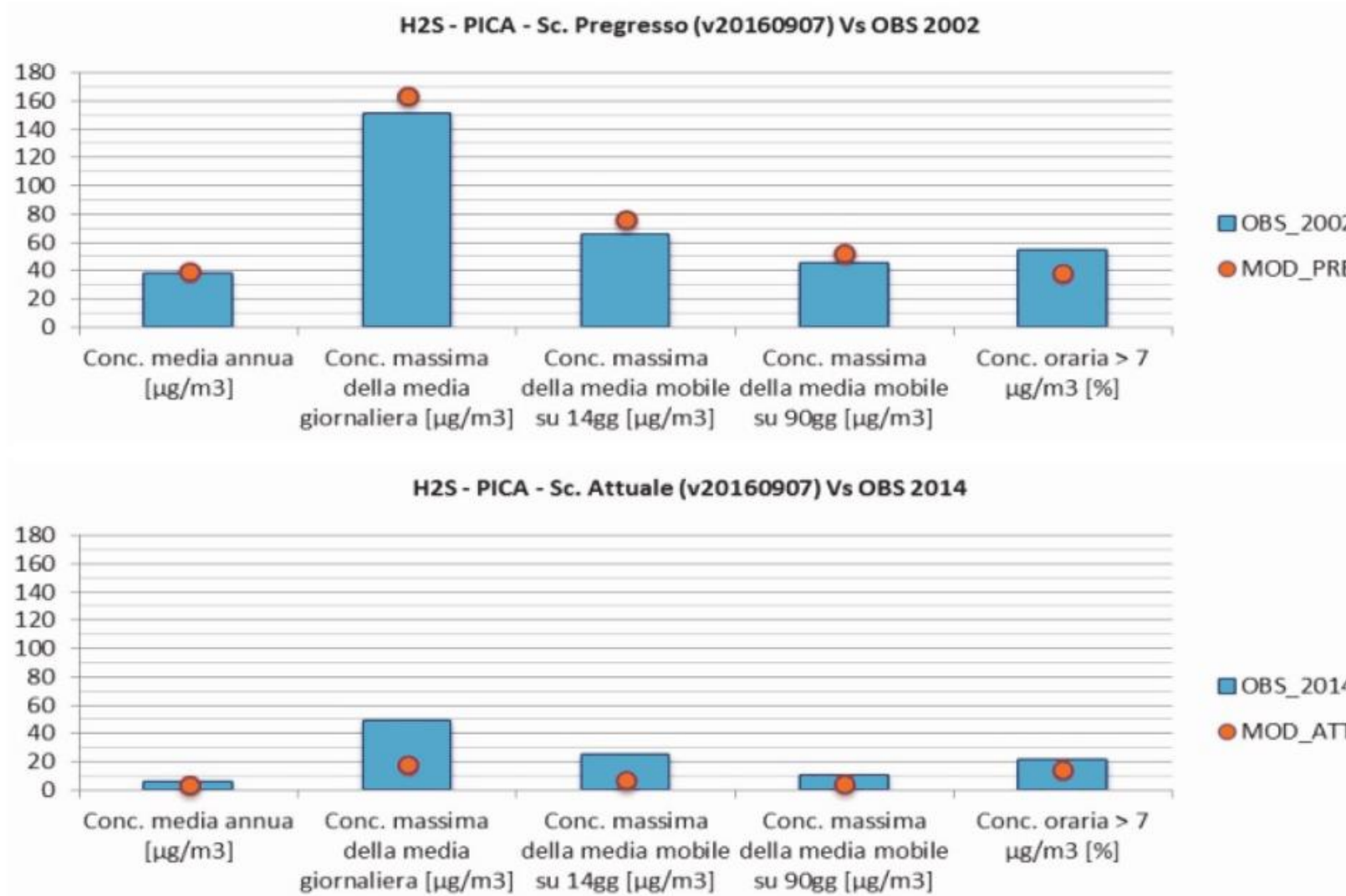
The following communications (Alessandro Bagnoli, ARPAT; Cesare Pertot, CESI; Daniela Nuvolone, ARS) will discuss the informations and results of environmental monitoring, modelling simulations and epidemiological studies conducted on these basis in recent years.

Detailed informations are available on the following websites:

- **Tuscany Region "Geotermia"**: https://www.regione.toscana.it/-/geotermia
- **ARPAT "Impianti geotermici"**: https://www.arpat.toscana.it/temi-ambientali/sistemi-produttivi/impianti-di-produzione-di-energia/geotermia/progetto-geotermia
- **Regional Health Agency of Tuscany (ARS) "InVetta"**: https://www.ars.toscana.it/aree-di-intervento/determinanti-di-salute/ambiente-e-salute/geotermia-e-salute/186-invetta.html