



**IEA** GEOTHERMAL

# **IEA Geothermal Implementing Agreement**

## **Italy Country Report 2014**



**Figure 1** The recent addition of Bagnore 4 (40 MW).  
(Photo courtesy of ENEL Green Power)

## 1.1 Introduction and Overview

In Italy, electricity generation is only in Tuscany whereas direct uses are scattered all across the country, mainly for bathing and district heating purposes. An overview of the activity carried out in 2014 will be presented in this chapter.

The total installed capacity reached a historic maximum of 915 MWe, with 37 units and a production of 5,916 GWhe. The heat delivered through direct uses is 11,065 TJ from 1,355 MWth, with about 1/3 of the installed capacity being used by heat pumps. The calculation procedure for direct uses has changed since the last data collection and so data are not directly comparable. We can only highlight that in 2010, using the same accounting procedure, the installed capacity for direct uses was 1,015 MWth, so the effective five years increase is about 340 MWth.

In the Larderello-Travale area, the positive results of deep drilling and careful resource management with reinjection programs and chemical stimulation have made it possible to increase steam production, despite the long and intensive exploitation history. Five additional units were thus installed in the

period 2009-2013 with a total capacity of 100 MW, of which 40 MW represents a net capacity increase, while 60 MW replaced old units, decommissioned because they became obsolete.

In the Mount Amiata area, after many years in which all activities were stopped due to pending acceptability problems from local communities, Enel Green Power obtained permission to resume drilling and construction activities in 2012. In the timeframe of 2012-2013 three additional units were thus installed with a total capacity of 60 MW to replace old units, and some new wells were drilled successfully; in 2014, the new 40 MW Bagnore 4 was commissioned.

In 2013, Enel Green Power installed the first binary power plant in Italy (Gruppo Binario Bagnore 3 - 1 MW) which is located in Bagnore Geothermal Field (Mount Amiata) and uses the liquid phase after the primary flash of geothermal fluid.

In 2015, the Cornia 2 power plant will be upgraded adding a biomass fired boiler, allowing superheating of geothermal steam. This upgrade will increase the power output from 12 MW to 17.3 MW.

**Table 1** Geothermal energy use in Italy for 2014.

Electricity	
Total Installed Capacity (MW <sub>e</sub> )	915
New Installed Capacity (MWe)	40
Total Running Capacity (MWe)	807
Contribution to National Capacity (%)	1%
Total Generation (GWh/yr)	5,916
Contribution to National Demand (%)	2%
Target 2020 ( Capacity, MWe)	1,080
Direct Use	
Total Installed Direct Use (MWth)	1,355
New Installed Capacity (MWth)	n/a
Total Heat Used (TJ/yr)	11,065
Total Installed Capacity for Heat Pumps (MWth)	568
Total Net Heat Pump Use (TJ/yr)	3,318
Target 2020 (Total Capacity, MWth)	2,500

na – data not available

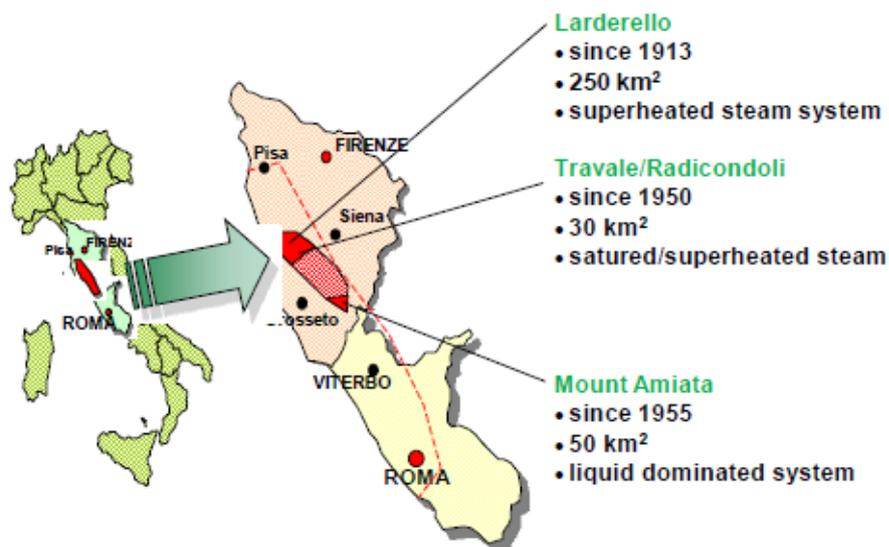
All of the plants in operation are located in Tuscany, in the two productive sites of Larderello/Travale and Mount Amiata (see Figure 2); all the plants are owned and operated by Enel Green Power.

As of 31 December 2014, the following figures have been achieved:

- Wells in Operation: 304 for production, 62 for reinjection and 125 as reserve or field control; 96 wells have depths greater than 3 km.
- Gathering Systems: 205 km of steam lines, 294 km of reinjection pipes.
- Power Plants: 37 power units, 4 of 60 MW, 5 in the range 20-40 MW, 3 old units below 15 MW, a new 1 MW binary plant and the majority (25) with the standard unified design of 20 MW.
- Capacity: the installed capacity of 915 MW<sub>e</sub> is unevenly split in the two locations: Larderello/Travale with 795 MW<sub>e</sub> of dry steam units, and Mount Amiata, where 121 MW<sub>e</sub> of flash plants (and one small binary unit) have been installed in the water-dominated field.

A small new additional binary unit on the separated water stream at Bagnore 3 was completed in 2014 (Figure 3). It has a capacity of 1 MWe and was commissioned in early 2013.

## 1.2 Highlights and achievements



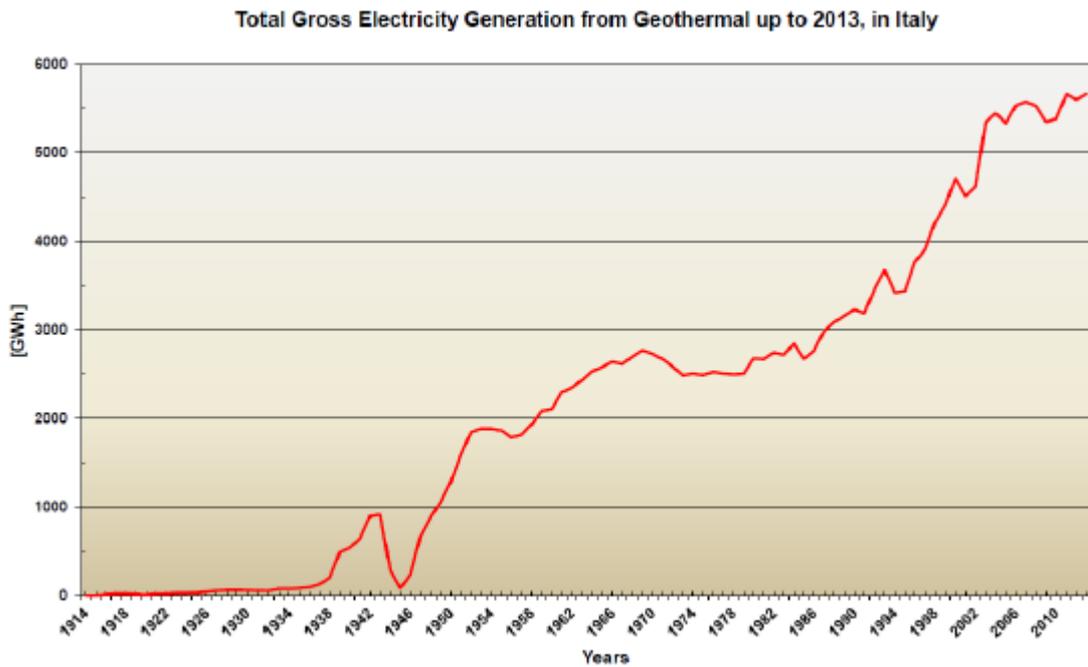
**Figure 2** Geothermal areas in Italy.



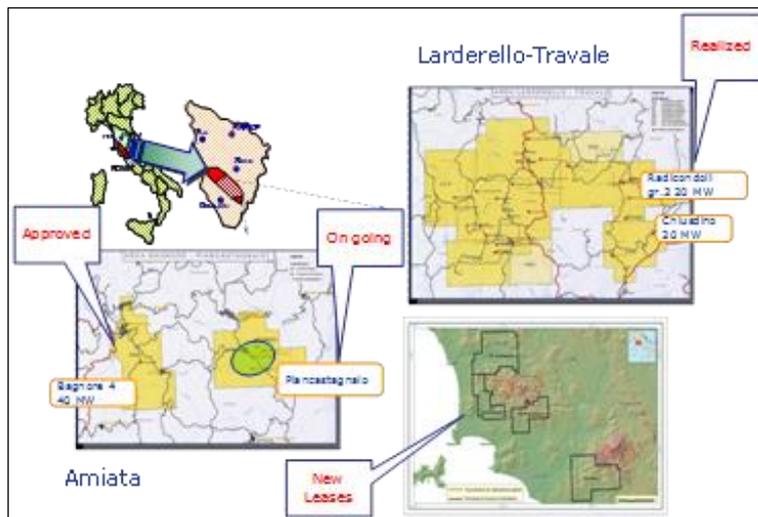
**Figure 3** Binary plant on Bagnore 3

After more than 100 years of exploitation, the Larderello field is still a sustainable development that is able to provide electricity (Figure 4).

The Enel Green Power business plan for Italy is strongly focused on geothermal development in Tuscany, with several new projects planned (Figure 5): a new 40 MW plant in Bagnore; and exploration in the new leases surrounding the Larderello and Mount Amiata areas, aimed to identify an exploitable geothermal fluid with temperatures suitable for a binary power plant.



**Figure 4** Historical trend of electricity production in Italy.



**Figure 5** Planned Enel Green Power activities

In the period between 2010 and 2014, a total of 25 wells were drilled in Italy, for a total drilled depth of 64.9 km. 17 of these wells were make-up wells drilled in the Larderello (7) and Travale/Radicondoli (10) fields, as part of the maintenance programs to counteract natural decline of geothermal production.

In the Mount Amiata area, the first two production wells of the development program were drilled. Another three drilled wells were for the reinjection/injection program. Also, three wells were drilled for monitoring the shallow aquifers (piezometers), as was required for the new production plant at Bagnore 4.

### 1.3 National Programme

Geothermal energy is included in the national energy strategy to reduce greenhouse gas emission. Italian policy gives support to the development of renewable resources using a different approach, in terms of tariff, according to the size of the plants, through a new law on incentives for renewable electricity which has been in force since July 2012.

The incentives will apply only to a limited number of plants, to be officially shortlisted. It is possible to bid for lower incentives in order to enter into the RES quota. This process can be limiting if a great number of plants ask for incentives, but it is unlikely that this will be a problem in the near future because the quota is high enough for geothermal development.

A plant acknowledged as fully innovative, with a non-commercial technology, is recognized through an all-inclusive tariff of 200 €/MWh for fluid temperatures of up to 150°C; the incentive will be reduced using a linear formula from 200 €/MWh at 151°C down to 137 €/MWh at 235°C.

The standard tariff is in three levels, for:

- Plants below 1 MW, it is 135 €/MWh.
- Plants between 1 MW and 20 MW, it is 99 €/MWh.

- Greater than 20MW plants, it is 85 €/MWh.

An additional premium is offered to plants with special characteristics:

- 30 €/MWh for a total reinjection plant (zero emission).
- 30 €/MWh for the first 10 MW installed in a new area, without existing plants.
- 15 €/MWh for plants with H<sub>2</sub>S and Mercury abatement of at least 95% of the emission.

### Royalties

The “Exploration Permit” holder must pay 325 €/km<sup>2</sup> for an annual lease. The “Mining Lease” holder must pay 650 €/km<sup>2</sup> for an annual lease. In the case of medium-low enthalpy resources, the above-mentioned values are the maximum (they could be lower).

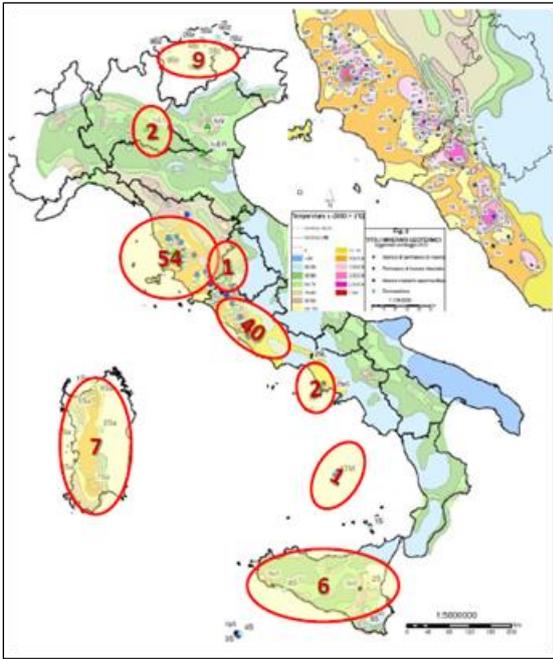
For electrical power generation, the “Mining Lease” holder must pay out (only for plants greater than 3 MW power):

- 13 € for each MWh generated to Municipalities on whose territory the “Lease” are included.
- 19.5 € for each MWh generated to Regions on whose territory the “Lease” is included.

### 1.4 Industry status and market development

A new Law liberalised access to the geothermal market, opening possibilities for new players to enter into the geothermal business, through the concession of an “exploration lease” from the regional authority. In a couple of years several new leases have been requested, in many different Italian regions, as shown in Figure 6.

The total number of new requests is around 120. It is foreseeable that an impressive amount of development and increasing geothermal electricity will occur in Italy in the near future.

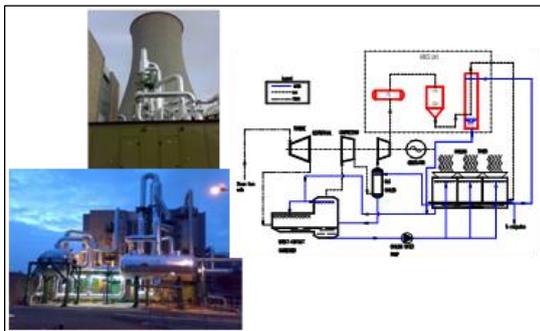


**Figure 6** Geothermal licences, applications and gazetted areas as at 31 December 2012.

### 1.5 Environmental Acceptance

The strong interaction between geothermal activities and the territory of Tuscany, a region so important for its landscape and tourist attractions, has formed a serious hindrance to developing new high enthalpy projects, especially in the Mount Amiata area.

As an important investment for reducing the odour emissions in H<sub>2</sub>S of Italian power plants, Enel Green Power installed 26 abatement systems (AMIS plant, Figure 7). These have a patented original design, and have shown very good results in improving the local acceptance of geothermal development.

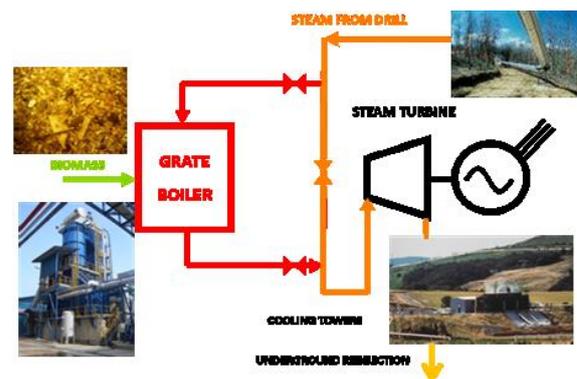


**Figure 7** The Enel Green Power AMIS system.

To create a constructive and mutually beneficial relationship with the territory, Enel has begun a number of initiatives with the intent of reducing environmental drawbacks and increasing acceptability. New design solutions have been envisaged to reduce the noise and visual impact of drilling pads, gathering systems and power plants.

### 1.6 Research, Development and Demonstration/Deployment

An important activity that is going on in Larderello is the improvement of an existing geothermal power plant named Cornia 2 by using biomass. The existing geothermal power plant (rated 19 MW) is currently running at reduced capacity (13,7 MW). Steam parameters and the original thermal cycle are suitable for biomass firing integration using local biomass. The project consists of a geothermal integrated biomass power plant composed of a superheated boiler for geothermal steam with a combustion grate supplied by local forest woodchip, agricultural residues or special crops. This example represents the first, innovative, geothermal integrated biomass power plant in the world and allows an increase of about 5 MW electric (Figure 8).



**Figure 8** The geothermal biomass integrated project.

### 1.7 Future outlook

After more than 100 years of exploitation, Larderello is still alive and able to maintain sustainable production, through the deep drilling and reinjection programs.

In the second productive location at Mt. Amiata, local opposition from committees against geothermal energy is slowing down the large potential development of the Bagnore area, despite the indirect benefit of district heating and greenhouse systems of Floramiata, one of the largest complexes in Europe. However, the entire approval process is finally completed, and the construction of the new plant is ready to start.

New zones have been opened to geothermal research in Tuscany and other regions, targeting fluids suitable for electricity production through binary cycles, in the medium enthalpy levels.

The new incentive law is not enough for sustaining an important investment in the geothermal sector, even though the Italian resource is much more generous than other countries.

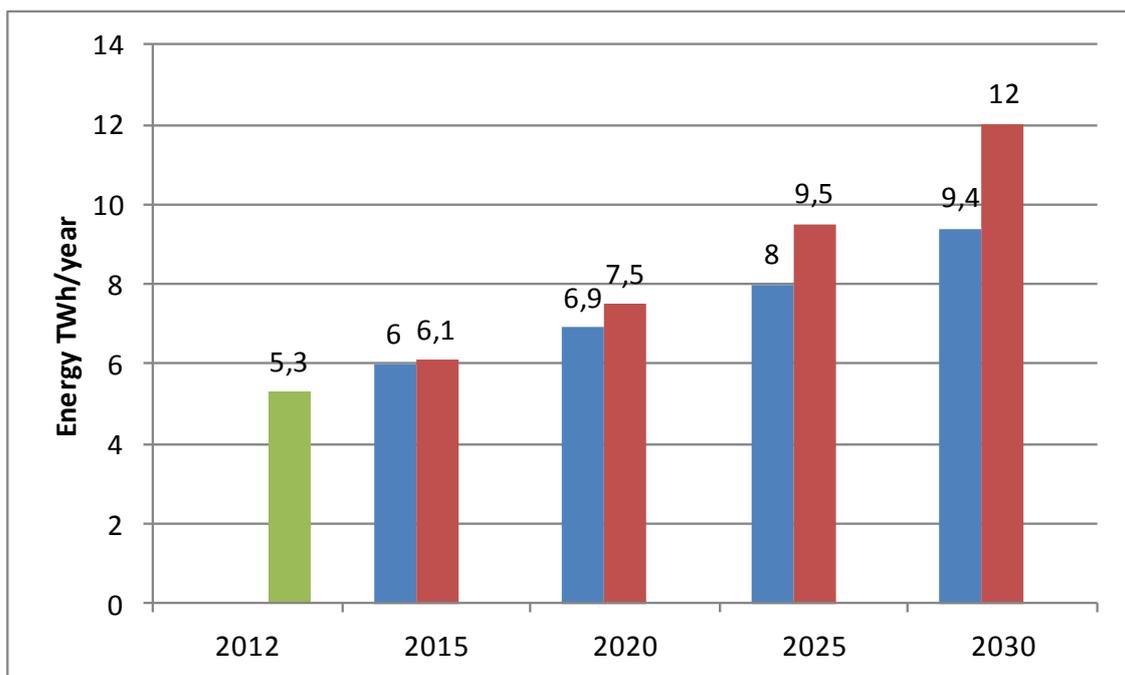
Without a modification of the present incentive scheme, it is unlikely that there are good prospects for development in the medium to long term. This is despite the fact that geothermal energy, due to its base-load capability, can be considered as a highly valuable resource for the electricity

system in any country, but especially in Italy, where solar PV and wind are strongly increasing their market segment.

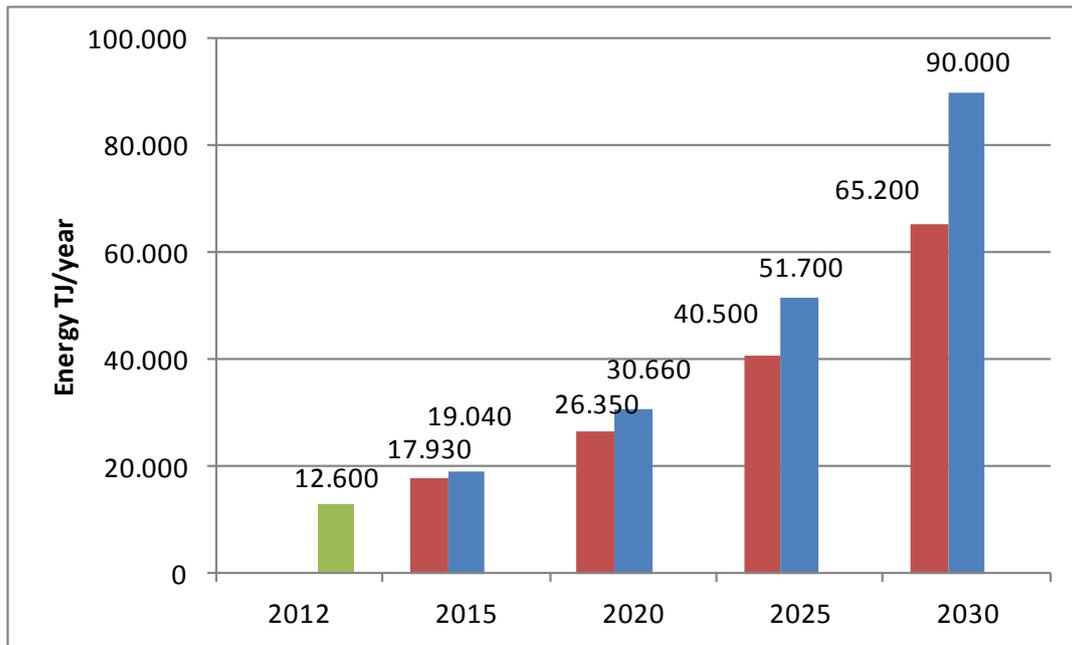
**Table 2** Geothermal targets for Italy for 2020.

Electricity			
Total Installed Capacity	2014 (MW <sub>e</sub> )		915
Target Capacity	2020 (MW <sub>e</sub> )		1,080
Direct Use			
Total Installed Direct Use	2014 (MW <sub>th</sub> )		1,355
Target Capacity	2020 (MW <sub>th</sub> )		2,500

The Unione Geotermica Italiana (UGI) has evaluated two different scenarios for future use (minimum/maximum), extending to the year 2030. Figure 9 shows the forecasts for geothermal electricity production, while Figure 10 is for direct uses.



**Figure 9** Geothermal electricity gross production forecasting in Italy.



**Figure 10** Direct geothermal heat utilization growth in Italy.

## 1.8 Publications

Buonasorte G., Cataldi R., Franci T., Grassi W., Manzella A., Meccheri M. and Passaleva G. (2011) Previsioni di crescita della geotermia in Italia fino al 2030 - Per un Nuovo Manifesto della Geotermia Italiana -, Ed. Pacini, Pisa, , 108 pp.

Razzano, F. and Cei, M. (2015) Geothermal power generation in Italy 2010-2014: country update report. Proceedings World Geothermal Congress, Melbourne, Australia, April 19-25.

Cataldi, R., Grassi, W., and Passaleva, G. (2013): Geothermal development in Italy 2010-2030 -A challenge to win, Proceedings of the European Geothermal Congress 2013, Pisa, Italy.

Cataldi, R., Conti, P. (2013): Energy balance of the Italian hydrothermal spa system, Proceedings of the European Geothermal Congress 2013, Pisa, Italy.

Conti P., Cataldi R., Grassi W. and Passaleva G.(2015): Geothermal Direct Uses in Italy: Country Update for WGC2015. Proceedings World Geothermal Congress, Melbourne, Australia, April 19-25.

Montemaggi, M., Romagnoli, P. and Bertani, R. (2013) Geothermal power generation for Italy. Proceedings European Geothermal Conference, Pisa, Italy, June 3-7.

Sabatelli, F., Mannari, M. and Parri, R. (2009) Hydrogen sulphide and mercury abatement: development and successful operation of AMIS technology. Transactions GRC.

## 1.9 Authors

Paolo Romagnoli  
Geothermal Center of Excellence  
Enel Green Power  
via A. Pisano 120  
56122 Pisa  
ITALY  
E-mail: paolo.romagnoli@enel.com

Ruggero Bertani  
Innovation & Sustainability  
Enel Green Power  
via A. Pisano 120  
56122 Pisa  
ITALY  
E-mail: ruggero.bertani@enel.com

## ***To Find Out More***

**If you are interested in learning more about the IEA Geothermal Programme,  
or you wish to join the IEA-GIA:**

### ***Contact:***

#### ***IEA-GIA Secretary***

**c/o GNS Science**

**Wairakei Research Centre**

**Private Bag 2000**

**Taupo 3352**

**NEW ZEALAND**

**Tel: +64-7-374 8211**

**Email: [iea-giasec@gns.cri.nz](mailto:iea-giasec@gns.cri.nz)**

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