

EGEC comments on the European
Parliamentary questions on emissions from
geothermal in Monte Amiata

August 2017



Table of contents

1. Introduction	3
Background information on geothermal energy in Europe.....	3
Background information on geothermal power production in Monte Amiata	4
The impossible impact on the quality of drinking water	4
CO ₂ emissions: a natural process channeled in the plants, not a combustion	4
Radioactivity: no observable effect of geothermal on the environment	5
EU and regional authorities account for CO ₂ from geothermal.....	5
Support schemes for geothermal energy	5
2. Geothermal energy and drinking water.....	6
3. CO ₂ emissions from geothermal power plants	7
4. Support for geothermal electricity	9
5. Amendments to the EC proposal for a recast Renewable Energy Directive	10
5.1 Amendments from members of the European Parliament	10
5.2 EGEC inputs and proposal	14

1. Introduction

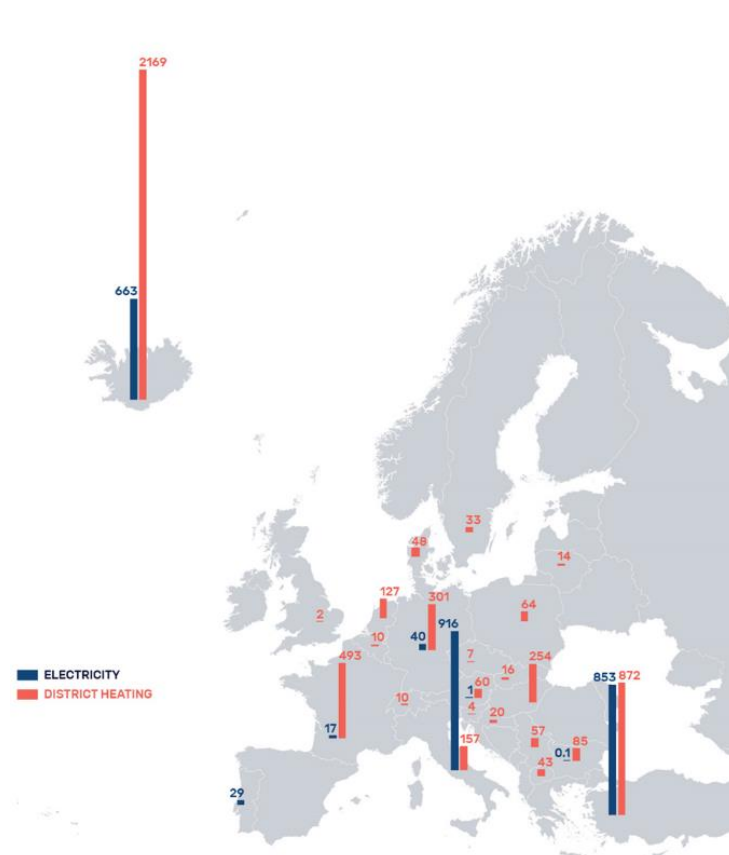
The Parliamentary questions submitted on the issue of emissions related to geothermal energy regard three main issues:

- Interference with the aquifer for drinking water in Monte Amiata;
- Increased CO₂ emission in geothermal production in Monte Amiata in comparison with the other areas;
- Emission of radioactive substances in Monte Amiata fluid.

The issues have notably been analysed and evaluated in administrative appeals for Bagnore 4 by the TAR (Regional Administrative Court) and the Council of State. The two courts have validated the legitimacy of the granting of authorisations, and they have also verified the inconsistency of the arguments of the plaintiffs.

Background information on geothermal energy in Europe

Figure 1. Installed capacity for electricity and district heating in 2016 (MW)



102 geothermal power plants are in operation in Europe, including 6 in Monte Amiata, as detailed below. Therefore, 96 plants are not concerned by the questions on Monte Amiata.

280 geothermal District Heating Plants are in operation in Europe.

Hundreds of other direct uses systems are operational for leisure, balneology, and agro-food industry.

Around 1.7 million of geothermal heat pumps are running in Europe for heating, cooling and domestic hot water supply.

Background information on geothermal power production in Monte Amiata

Table 1. Geothermal power plants in Monte Amiata (Italy): production of 661,5 GWh in 2015

Location	Power Plant Name / Type	Year Comm.	Capacity Installed 2016 MWe	Gross Electric Production GWh 2015
Tuscany, Mount Amiata	Bagnore 3	1998	20	152,3
	Bagnore 4	2014	40	20,2
	Bagnore Binary	2013	1	4,6
	Piancastagnaio 3	1990	20	166,8
	Piancastagnaio 4	1991	20	158,4
	Piancastagnaio 5	1996	20	159,2

The impossible impact on the quality of drinking water

On the issue of the interference between geothermal power production in Monte Amiata and the aquifer for drinking water, monitoring conducted with 11 piezometers and by inspection of the springs of the Fiora aqueduct demonstrates the non-relation between flow rate and levels of potable water and geothermal production. The development of the potable aquifer follows the drought cycle with a delay of more than three years.

Any interference between freshwater aquifers and geothermal wells is prevented and made impossible as the wells are made by a continuous steel pipe from bottom to top, covered with a concrete cast on their whole length. This is a benefit for the environment, but it also serves for the right operation of the plant.

CO₂ emissions: a natural process channeled in the plants, not a combustion

Regarding the issue of CO₂ emissions by the Monte Amiata plants, it is a typical Italian phenomenon. The emissions are caused by the dissolution of some types of rocks in high enthalpy reservoirs, which dissolves them in the form of gases such as CO₂ in the water of the reservoir. When looking closely we observe that the quantity of extracted CO₂ is similar in all the reservoirs of Tuscany fields. Considering the fluid extracted across Tuscany as a whole, non-condensable gas (mainly CO₂) accounts for around 3-4% in weight of the total flow rate of the extracted fluid (vapor + liquid) for geothermal power production.

The CO₂ present in the hot water extracted for geothermal power production, is due to the presence of carbonate rocks constituting the reservoir, their dissolution producing CO₂. In any case, there would be naturally occurring CO₂ emissions in these geothermal areas, even without the plants, although at a lower level. The plant's CO₂ emissions are thus not higher than the emissions of a natural gas plant, and quite different in nature.

Radioactivity: no observable effect of geothermal on the environment

Radon emissions, which are responsible for radioactivity, are present in all endogenous fluids, and the fluids in Monte Amiata are not among those with a higher concentration. In any case, releases in Becquerel in geothermal areas of the region, which have been measured for over twenty years at the station for Air Quality control. They are below the natural background in these areas and they are comparable with other areas with a volcanic geology. There, the natural background for radioactivity is notably explained by the natural degassing of the ground.

Amiata fluids contain radon emission like every endogenous fluid. They have, however, a lower rate than elsewhere, and it is comparable with the natural degassing of the ground in other areas of volcanic origins – meaning that geothermal power plants do not significantly modify the radioactivity of the environment.

EU and regional authorities account for CO₂ from geothermal

The emissions resulting from the extraction of the geothermal fluids containing CO₂ are accounted for by the regional Tuscany authority, and thus recorded in the EU registries of greenhouse gas emissions. Data collected both at the [regional level](#), and listed by the [European Environmental Agency](#) (in the energy production and distribution section, emissions from geothermal energy are taken into account) are publicly available online. Since these emissions are accounted for, they are not ignored, and the CO₂ emission from geothermal power plants in Monte Amiata is not under-estimated when considering the benefits of using renewable energy sources. GSE clearly notes that CO₂ savings are measured by comparing caused emissions to avoided emissions¹.

Support schemes for geothermal energy

Regarding support schemes, the Monte Amiata power plants depend on the Italian framework for support to renewable electricity production. As shown in the table below, there are different premium awarded to geothermal plants according to their performance on limiting emissions.

Only new plants benefit from the incentivized price (Bagnore 4) of 84 euro/MWh. Older installations are competing on the energy market with an incentive that only applies to the extra production in comparison with the historical average (about 25% of production; the remaining part is not subsidized).

Table 2. Incentives and premium for geothermal energy in Italy per Ministerial Decree D.M. 23/06/2016

Capacity (MW)	Base incentive rate (€/MWh)	Duration of support (years)	Premium (€/MWh)		
			Total reinsertion of geothermal fluid, zero emissions	First 10MW in newly developed zone	95% reduction of H ₂ S and Hg
0-1 MW	134	20	30	30	15
1-5 MW	98	25	30	30	15
>5MW	84	25	30	30	15

¹ Eurostat reports the electricity production. In Italy, Terna and GSE provided the data.

EEA reports on CO₂ emissions from geothermal in Europe, for Italy, data comes from the Istituto Superiore per la Protezione e la Ricerca Ambientale.

Advanced technology	200 ²	25		30	15
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2. Geothermal energy and drinking water

Extract from the Parliamentary question (1)

The effects of geothermal activities on Monte Amiata on the freshwater aquifer are set out in the article available at <http://www.sciencedirect.com/science/article/pii/S0377027315002620> and in the research commissioned by Tuscany Region: geothermal activity sends pollutants that are present in the geothermal fluids up towards the freshwater aquifer, and removes water from the Fiora springs. These springs are drawn upon by the Fiora aqueduct, which supplies 700 000 users.

EGEC answer

The presence of a large natural geothermal system in Mount Amiata undoubtedly has had an effect on the arsenic content in the water, but it is important to distinguish the mineralization effects of the natural geothermal system in an history of thousands of years, from the one of industrial development of geothermal system for power production of the last 50 years.

The cited article in the European Parliament question to the European Commission (here referred to as Borgia et al., 2015) and the report for the Tuscany Region cannot be used as proof that geothermal activity sends pollutants to and removes water from the freshwater aquifer. Such an effect would require a hydraulic connection between the freshwater aquifer and the geothermal reservoirs, which has been debated in various papers, and numerous reports for Tuscany Region (many have been cited in Barazzuoli et al. 2015). The hypothesis of Borgia et al., 2015 are questionable and inconsistent with actual data. In particular:

- the catastrophic collapse of the volcanic edifice and its hydrogeological implications is strongly disputable and against evidence, as the paper to which Borgia et al., 2015 replies discusses in detail (Barazzuoli et al. 2015).
- the reported dramatic lowering of the groundwater timetable is not supported by data. As a matter of fact, the cited water table depth reconstructed on the base of geophysical data is comparable to the one recorded after 40 years of geothermal exploitation (Manzella, 2008).
- the available geochemical data of Mount Amiata freshwaters show no evidence of contamination by geothermal waters, as discussed in Barazzuoli et al. 2015, as well as in other papers (e.g., Pierotti et al., 2016).
- hydrogeological and meteorological monitoring in the Amiata area, which started only on 2010, at present shows a clear correlation to meteoric trend, but no correlation to industrial development.

Extract from the Parliamentary question (2)

² Highest figure, in case the T°C of the geothermal fluid is 151°C. Formula of the tariff: $200 - (T - 151) * 0,75$.

Although it challenges these conclusions, the study commissioned by the Tuscany Region states (in Annex C1) that there has been a gradual increase in arsenic levels in at least one of the Fiora springs, and therefore in the aqueduct.

At some locations, the water supplied by the aqueduct already contains arsenic concentrations that are close to the maximum permitted. An increase in arsenic and a rise in pollutants represent a potential danger to human health.

The Drinking Water Directive lays down measures for water which, while not breaching the limits laid down, represents a potential danger to health. Italy does not appear to have taken any such measures, nor to have addressed the issue in the reports sent to the Commission up to 2013.

— With reference to the answer to Question E-008184/2016, has the Commission assessed Italy's compliance with EU legislation in this field? If not, when does it intend to do so? — Does the Commission intend to raise this matter with Italy? If so, when and how?

EGEC answer

The measures to be taken in favor of public health are very important. They are, however, beyond the realm of industrial development of geothermal energy and the scope of this answer.

References (beside those cited in Barazzuoli et al., 2015)

Barazzuoli P., Bertini G., Brogi A., Capezzuoli E., Conticelli S., Doveri M., Ellero A., Gianelli G., La Felice S., Liotta D., Marroni M., Manzella A., Meccheri M., Montanari D., Pandeli E., Principe C., Ruggieri R., Sbrana A., Vaselli V., Vezzoli L. (2015): COMMENT ON: "Borgia, A., Mazzoldi, A., Brunori, C.A., Allocca, C., Delcroix, C., Micheli, L., Vercellino, A., Grieco, G., 2014. Volcanic spreading forcing and feedback in geothermal reservoir development, Amiata Volcano, Italia. J. Volc. Geoth. Res. 284, 16-31". Journal of Volcanology and Geothermal Research, 303, 1-6, 2015.

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Doveri M., Ellero A., Gianelli G., La Felice S., Liotta D., Marroni M., Manzella A., Meccheri M., Montanari D., Pandeli E., Principe C., Ruggieri R., Sbrana A., Vaselli V., Vezzoli L., 2015. COMMENT ON: "Borgia, A., Mazzoldi, A., Brunori, C.A., Allocca, C., Delcroix, C., Micheli, L., Vercellino, A., Grieco, G., 2014. Volcanic spreading forcing and feedback in geothermal reservoir development, Amiata Volcano, Italia. J. Volc. Geoth. Res. 284, 16–31". Journal of Volcanology and Geothermal Research, 303, 1-6, 2015.

Manzella A. (2008): La geotermia in Amiata: luci ed ombre. Atti del Simposio "Stato del territorio e delle risorse naturali in Toscana" organizzato dall'Ordine dei Geologi della Toscana. pp. 267-276, Ottobre 2008.

L. Pierotti, G. Cortecchi, F. Gherardi (2016): Hydrothermal gases in a shallow aquifer at Mt. Amiata, Italy: insights from stable isotopes and geochemical modelling. *Isotopes in Environmental and Health Studies*, 52:4-5, 414-426, available at: <http://dx.doi.org/10.1080/10256016.2015.1113958>

3. CO₂ emissions from geothermal power plants

Extract from the Parliamentary question (1)

The geothermal power plants on Monte Amiata produce 11% of Tuscany's electricity, causing CO₂ equivalent emissions that are higher than those from a gas-fired power station of equal capacity. The substances emitted into the atmosphere come from fluids that are extracted from thousands of metres below the ground; without human intervention, they would mostly remain confined underground.

EGEC answer

The CO₂ emission factor of the Amiata geothermal plants is high, and comparable to (and not particularly higher than) a gas-fired power station of equal capacity.

The difference is that the CO₂ produced by a gas-fired power station is due to combustion, while those of geothermal plants are due to the naturally occurring high concentration of CO₂ in the geothermal fluid. Both the composition of the reservoir rocks, which are rich in carbonates, and the shallow magmatic processes contribute to the natural enrichment of carbon dioxide. The Amiata area has CO₂-rich gas emission from natural manifestation, as reported also in literature (e.g. Tassi et al., 2009): since CO₂ has a high fugacity, it is naturally emitted by the soil and by the natural thermal/volcanic manifestations. It is known that geothermal power development has strongly reduced the amount of surface manifestations.

Present-day natural discharge of CO₂ through soil is less than CO₂ discharged from geothermal plants (following Frondini et al., 2009, they are 2.1-2.8 10⁹ mol a⁻¹ and 5.8 10⁹ mol a⁻¹, respectively). The correct estimate of the CO₂ emission factor of the geothermal power plants, however, should take into account the emission factor from the soil before the industrial development. If the actual discharge of CO₂ in the area is 8 (2.2+5.8) 10⁹ mol a⁻¹, and it was 5 10⁹ mol a⁻¹ before industrial development, the correct value to attribute to power plants is 3 10⁹ mol a⁻¹, and not 5.8 10⁹ mol a⁻¹. As a matter of fact, this natural flow was not measured before industrial development, since the latter initiated at a time (1950-60's) when environmental factors were not monitored. So we are left to speculations, but it is highly probable that the recorded value of CO₂ emission from Amiata power plants is overestimated.

In conclusion: CO₂ emissions from geothermal power plants in Amiata area, i.e. those that do not remain confined in the ground due to human intervention, are a) natural and b) inferior to those of a gas-fired power station of equal capacity.

Extract from the Parliamentary question (2)

Geothermal energy is one of the renewable energy sources that is benefiting from incentives because the use of renewables is one of the measures being adopted to reduce CO₂ emissions.

EGEC answer

The inclusion of an energy source among renewables does not refer only to CO₂ emissions: geothermal energy is an indigenous, sustainable and renewable energy source; therefore, it has the right to benefit of incentives since it contributes to saving from import of fossil fuels which produce CO₂ by combustion.

Extract from the Parliamentary Question (3)

Is it true that the CO₂ emissions caused by the Monte Amiata geothermal power plants are not included in the EU registries of greenhouse gas emissions? Is it true also that Italy is including the electricity from Monte Amiata in its estimates of the reduction in CO₂ emissions achieved using renewable energy, by considering this electricity as a source of CO₂ savings when it is actually a source of considerable emissions?

EGEC answer

Greenhouse gas emission from Italian geothermal power plants cannot be treated as the equivalent of a gas-fired power station. They should be treated as a specific Category c.B.3 "Other emissions from energy production", with proper national regulations.

The emissions resulting from the extraction of the geothermal fluids containing CO₂ are accounted in EEA reports. For Italy, data comes from the Istituto Superiore per la Protezione e la Ricerca Ambientale.

4. Support for geothermal electricity

As the issue of emissions from geothermal power plants is, in the European Union, one that arises specifically in Italy's plants, the support framework governing geothermal plants responsible for CO₂ emissions is the national Italian framework.

First, it must be noted that emissions from geothermal plants in Monte Amiata are indeed measured, monitored and accounted for by the regional authorities. The Italian GSE notes that the rules for measuring avoided greenhouse gases emissions are the same for all types of installations, and are consistent with Eurostat requirements: the emissions of the fossil electricity mix substituted by renewables is measured, and then lifecycle emissions are compared for the renewable power compared to the displaced fossil one. As for geothermal, lifecycle emissions include the emission caused by non-condensable gas in the geothermal fluid during its extraction. Avoided CO₂ emissions from geothermal plants do account for geothermal plant's own emissions.

Then the support to geothermal power plants varies according to the size of the plant, its technology and its age. First generation plants, such as the ones in Monte Amiata, have very low marginal rates, are quite competitive in the electricity market, being amortised assets, and thus do not receive support. However, new projects are generally characterised by the full reinjection of geothermal fluid, zero emissions of carbon dioxide or 95% reduction of H₂S and Hg. The Italian support system reflects this state.

5. Amendments to the EC proposal for a recast Renewable Energy Directive

5.1 Amendments from members of the European Parliament

Amendment 349

Dario Tamburrano, David Borrelli, Piernicola Pedicini, Eleonora Evi

Proposal for a directive

Article 2 – paragraph 2 – point a a (new)

Text proposed by the Commission	Amendment
	<p><i>(aa) 'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth exploited with processes fulfilling the criteria set out in art 7(1);</i></p>

Or. en

Justification

Transformation of geothermal energy into heat or electricity does not always happen in a sustainable manner compared to equivalent non-renewable energy sources. In some particular cases it has been proven that plants exploiting geothermal energy can cause CO2 equivalent emissions that are higher than those from a gas-fired power station of equal capacity, and that they have higher emissions of other extremely harmful pollutants, like hydrogen sulphide, arsenic, mercury, among others, than a coal-fired power station of equal capacity. Those plants have so far received the support reserved to renewable energy sources and the energy they produced has been accounted into the share of energy from renewable sources by member States, even if ultimately not contributing to the objectives of this Directive nor towards meeting environmental and climate objectives. This is why it is of utmost importance to differentiate between sustainable and not sustainable exploitation of geothermal energy and to promote the former with respect to the latter. The indicated threshold corresponds to the weighted average of the CO2 equivalent emissions per KWhe of the worldwide population of geothermal power plants, as calculated by the International Energy Agency. It is of utmost importance to differentiate between sustainable and not sustainable forms of exploiting geothermal energy, and to incentivise the former with respect to the latter through the provisions of the present Directive.

Amendment 350

Dario Tamburrano, David Borrelli, Piernicola Pedicini, Eleonora Evi

Proposal for a directive

Article 2 – paragraph 2 – point a b (new)

Text proposed by the Commission	Amendment
	<i>(ab) 'geothermal energy' considered as energy from renewable sources for the purpose of this Directive is the geothermal energy exploited by plants which are not hybridized with fossil or waste combustion processes, and that have CO2 equivalent emissions inferior to 120gr/kWhe, on a monthly average.</i>

Or. en

Justification

Transformation of geothermal energy into heat or electricity does not always happen in a sustainable manner compared to equivalent non-renewable energy sources. In some particular cases it has been proven that plants exploiting geothermal energy can cause CO2 equivalent emissions that are higher than those from a gas-fired power station of equal capacity, and that they have higher emissions of other extremely harmful pollutants, like hydrogen sulphide, arsenic, mercury, among others, than a coal-fired power station of equal capacity. Those plants have so far received the support reserved to renewable energy sources and the energy they produced has been accounted into the share of energy from renewable sources by member States, even if ultimately not contributing to the objectives of this Directive nor towards meeting environmental and climate objectives. This is why it is of utmost importance to differentiate between sustainable and not sustainable exploitation of geothermal energy and to promote the former with respect to the latter. The indicated threshold corresponds to the weighted average of the CO2 equivalent emissions per KWhe of the worldwide population of geothermal power plants, as calculated by the International Energy Agency. It is of utmost importance to differentiate between sustainable and not sustainable forms of exploiting geothermal energy, and to incentivise the former with respect to the latter through the provisions of the present Directive.

Amendment 609

Dario Tamburrano, David Borrelli, Piernicola Pedicini, Eleonora Evi

Proposal for a directive

Article 4 – paragraph 4 c (new)

Text proposed by the Commission	Amendment
	<p><i>4c. Member States shall support electricity from geothermal energy only if produced by plants with CO₂ equivalent emissions inferior to 120gr/kWhe, on a monthly average, and which are not hybridized with fossil or waste combustion processes. Member States may set a lower emissions limits for granting support schemes.</i></p> <p><i>Geothermal electricity produced by plants which are not fulfilling the criteria defined in the first paragraph shall by no means receive public support.</i></p>

Or. en

Justification

Transformation of geothermal energy into heat or electricity does not always happen in a sustainable manner compared to equivalent non-renewable energy sources. In some particular cases it has been proven that plants exploiting geothermal energy can cause CO₂ equivalent emissions that are higher than those from a gas-fired power station of equal capacity, and that they have higher emissions of other extremely harmful pollutants, like hydrogen sulphide, arsenic, mercury, among others, than a coal-fired power station of equal capacity. Those plants have so far received the support reserved to renewable energy sources and the energy they produced has been accounted into the share of energy from renewable sources by member States, even if ultimately not contributing to the objectives of this Directive nor towards meeting environmental and climate objectives. This is why it is of utmost importance to differentiate between sustainable and not sustainable exploitation of geothermal energy and to promote the former with respect to the latter. The indicated threshold corresponds to the weighted average of the CO₂ equivalent emissions per KWhe of the worldwide population of geothermal power plants, as calculated by the International Energy Agency.

Amendment 665

Dario Tamburrano, David Borrelli, Piernicola Pedicini, Eleonora Evi

Proposal for a directive

Article 7 – paragraph 1 – subparagraph 4 a (new)

Text proposed by the Commission	Amendment
	<p><i>For the calculation of a Member State's gross final consumption of energy from renewable energy sources, electricity and heat from geothermal energy shall be accounted only if produced by plants with CO₂ equivalent emissions inferior to 120gr/kWhe, on a monthly average, and which are not hybridized with fossil or waste combustion processes. Member States may set a lower emissions limits.</i></p> <p><i>Geothermal heat and electricity produced by plants which are not fulfilling the criteria defined in the first paragraph shall not be considered renewable energy for the purpose of this Directive and shall by no means be accounted by Members States in the calculation of their share of energy from renewable energy.</i></p>

Or. en

Justification

Transformation of geothermal energy into heat or electricity does not always happen in a sustainable manner compared to equivalent non-renewable energy sources. In some particular cases it has been proven that plants exploiting geothermal energy can cause CO₂ equivalent emissions that are higher than those from a gas-fired power station of equal capacity, and that they have higher emissions of other extremely harmful pollutants, like hydrogen sulphide, arsenic, mercury, among others, than a coal-fired power station of equal capacity. Those plants have so far received the support reserved to renewable energy sources and the energy they produced has been accounted into the share of energy from renewable sources by Member States, even if ultimately not contributing to the objectives of this Directive nor towards meeting environmental and climate objectives. This is why it is of utmost importance to differentiate between sustainable and not sustainable exploitation of geothermal energy and to promote the former with respect to the latter. The indicated threshold corresponds to the weighted average of the CO₂ equivalent emissions per KWhe of the worldwide population of geothermal power plants, as calculated by the International Energy Agency.

5.2 EGEC inputs and proposal

Article 2 – paragraph 2 – point a

European Commission proposal	Proposal for a Compromised Amendment
<i>(e) 'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth;</i>	<i>(c) 'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth;</i>

- The objective of the Article 2 of this directive is to define energy sources, it is the Article 7 that sets criteria on whether the use of an energy source can be qualified as renewable.
- Geothermal power plants are typically not hybridized with fossil or waste combustion processes. When it happens, as for other renewable electricity plants, only the RES part is considered renewable.
- The CO₂ equivalent emissions in terms of g/kWhe, on a monthly average, cannot be a criterion for considering an energy source renewable or not. Regarding the CO₂ emissions, a full life cycle assessment has to be done for each energy source; then a comparison can be done.
- Some types of conventional geothermal power plants in Europe (only in Italy for the EU) release gases into the atmosphere during the power conversion process due to the presence of naturally occurring dissolved gases contained in these geothermal systems. This is treated at the national level as it comes from a national specificity of the geology.
- Actors of the geothermal sector need this definition, which is already enshrined in regulations, to remain. The definition of geothermal energy in this Directive is also a positive signal for an innovative energy sector.

Article 4 – paragraph 4 c

European Commission proposal	Proposal for a Compromised Amendment
	<i>4c. — Member States shall support electricity from geothermal energy only if produced by plants with CO₂ equivalent emissions inferior to 120gr/kWhe, on a monthly average, and which are not hybridized with fossil or waste combustion processes. Member States may set a lower emissions limits for granting support schemes. Geothermal electricity produced by plants which are not fulfilling the criteria defined in the first paragraph shall by no means receive public support.</i>

- The Italian support system reflects this consideration: Ministerial Decree D.M. 23/06/2016

- This aspect is not relevant for other EU member states, and it is treated at national level.

Article 7 – paragraph 1 – subparagraph 4 a

European Commission proposal	Proposal for a Compromised Amendment
	<p><i>For the calculation of a Member State's gross final consumption of energy from renewable energy sources, electricity and heat from geothermal energy shall be accounted only if produced by plants with CO₂ equivalent emissions inferior to 120gr/kWh, on a monthly average, and which are not hybridized with fossil or waste combustion processes. Member States may set a lower emissions limits.</i></p> <p><i>Geothermal heat and electricity produced by plants which are not fulfilling the criteria defined in the first paragraph shall not be considered renewable energy for the purpose of this Directive and shall by no means be accounted by Members States in the calculation of their share of energy from renewable energy.</i></p>

- This must be treated at national level.
- To make comparisons between geothermal power production and other energy sources power production more realistic, an analysis of complete fuel-cycle emissions associated with these energies should be completed.
- It should be highlighted that the processes of natural CO₂ generation happen independently of geothermal exploitation. The industrial exploitation of a geothermal system is based on mining the heat from rocks by using the geothermal fluids as vectors, without any specific process of CO₂ generation.
- In general, geothermal power plants have a distinct environmental advantage. Where there is a high natural release of CO₂ from the geothermal field prior to development, these emissions should be deducted from any increase in the emission rate recorded after the power plant development.
- The fact that geothermal power plants are more environmentally benign than conventional plants should be recognised by Public authorities. Replacing fossil fuel electrical generation with geothermal energy will result in a significant net reduction of greenhouse gas emissions and all their associated effects.