

GEO4CIVHIC - Most Easy, Efficient and Low Cost Geothermal Systems for Retrofitting Civil and Historical Buildings

Interviewing engineers

Luc Pockele (RED Srl) and Massimiliano Finotti (FM project)

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In their interview with the UNESCO Regional Bureau for Science and Culture in Europe in the context of the GEO4CIVHIC EU-funded project, the engineers Luc Pockele (RED Srl) and Massimiliano Finotti (FM project) reported on the potential of using shallow geothermal as green and sustainable energy. The example of the GEO4CIVHIC project with its demonstration site of Angels' Gate in Ferrara could represent a role model for a greener future.



Massimiliano Finotti and Luc Pockele on site at Angels' Gate, Ferrara - © UNESCO

Full interview with Massimiliano Finotti (FM project)

Massimiliano Finotti, engineer, director and supervision of the works who is responsible for system design, building interventions, on-site safety coordination in both design and executive phases of works and the relations with authorities and bodies. Within FM project, Mr Finotti and his team are in charge also of the realization of preliminary, final and executive projects. In our discussion with him, he expressed his belief in geothermal energy – green and sustainable energy for the future as well as how cultural heritage managers can benefit from the GEO4CIVHIC project in their management plans.



Massimiliano Finotti (FM project) interviewed at Angel's Gate, Ferrara - © UNESCO

[What are the main benefits of shallow geothermal energy as an energy source?](#)

MF: From an environmental point of view, it allows a reduction of pollutants and carbon dioxide emissions in the atmosphere and in the ground. It uses renewable energy, which is always available, free and independent from atmospheric conditions as it uses the ground resources for heat exchange. Energetically, the operating costs can be reduced up to values around 40% compared to a normal gas heating system. The geothermal energy has low maintenance costs and guarantees a long life of the system. It is safe as it does not circulate gas, there are no flues.

[SDG 7 of UN Agenda 2030 stands for access to affordable, reliable, sustainable and modern energy for all, in which geothermal energy could play a significant role. How does geothermal energy work and what are the most common geothermal installations? What are the advantages of geothermal energy in comparison to the other alternative energy sources?](#)

MF: I was born in the seventies: I remember, when I was a child, the television reports on the pollution resulting from the use of fossil substances: black clouds, polluted waters; I've always been impressed with their effects. Since then, I have always set myself the goal of making a small contribution to making the world or at least the area in which I live cleaner. I became an engineer, in my work I try to propose low-impact solutions: in consumption, in materials and in management.

I believe that even this small contribution can be part of the sustainable development. When there are favourable conditions, I try to use geothermal systems, to sensitise clients about their advantages compared to other technologies, explaining how they work deriving from the use of the ground. In addition to this, I highlight other aspects: greater efficiency, low environmental impact, long life and less maintenance. I think that the sum of the individual contributions can give an important result. Up to now I have made the most frequent installations for residential buildings but also schools and some tertiary activities.

Over the years the power generation has significantly increased: Does geothermal heat have a potential to reach the world green energy supply by 2030, which is expected to reach 80% of world supply as promised by UN Agenda for Sustainable Development? What do you think are the main challenges on this? How can geothermal energy support Europe in its plan of becoming the first climate neutral continent (net-zero greenhouse gas emissions) by 2050?

MF: The increase in energy production coincides with a greater demand deriving from industrial and tertiary uses, but also from daily people use: computers, appliances, home automation and, lastly, the development of electric cars. While until a few years ago the heating was on diesel, methane or liquefied gas, now the technology has introduced alternative machines including geothermal pumps. The advantage is the use of a 100% natural element such as the ground, but also there is no burning of fossil elements. Another aspect, as in the case of Porta degli Angeli is that it's possible to see just the heating machine and nothing else, but inside the building we will experience a pleasant feeling of an air-conditioned environment in any season. Therefore, it would be possible to evaluate the benefits in the limited environmental impact, the operations efficiency, the low noise emissions and the reduction of operating costs. The potential is remarkable compared to the negative elements that still characterize this technology, which are the installation costs, construction of the probes, characterization of the land, but like any technology, research is always underway to improve it.

How does the potential of shallow geothermal energy differ between different areas, especially in Italy? What preconditions territories and buildings should have to benefit the most from the geothermal energy?

MF: We can see geothermal energy according to two macro uses: production of electricity and use for air conditioning. The first one in Italy is not yet fully developed, mostly in the central regions, the islands and some areas in the Northern Italy. For the air conditioning part, the most favourable conditions derive from renovations or new houses, characterized by the need of high-performance buildings from the point of view of insulation, which allow low-temperature systems and therefore ideal for geothermal technology.

What are the greatest obstacles of wide implementation of shallow geothermal energy in Italy? Where and how GEO4CIVHIC project would help to overcome them?

MF: The most relevant obstacles are the costs of creating the geothermal probes, the spaces and the number they require. In Italy there are incentives and detractions for the use of these technologies, but the biggest obstacle comes from the construction of the probes. As any technology, I would say that research is the solution to improve it and reduce the negative elements.

What are the main benefits of GEO4CIVHIC project on driving implementation of geothermal energy in building retrofitting?

MF: I can evaluate the case of my competence: Porta degli Angeli. I was able to verify the professionalism in the realisation of GEO4CIVHIC: the project is well organised and the people work with dedication. These elements can create a model, something tangible and not just words. When a citizen can see and touch a work, he can better understand its characteristics, philosophy and why it was created. During the works I have repeatedly explained what a geothermal system consists of, so I think that thanks also to this commitment of GEO4CIVHIC it is possible to create knowledge, something of the development of a community.

[What main benefits can technologies developed within GEO4CIVHIC project bring to culture heritage managers? What new possibilities GEO4CIVHIC technologies in retrofitting of cultural heritage buildings could open?](#)

MF: The GEO4CIVHIC project is linked to the cultural and artistic heritage of the territory, primarily because it is for public use and everyone can benefit from it, but also because more and more Public Administrations are sensitive to the environmental sustainability. A public structure such as a museum or a historic villa can really connect the integration of cultural, artistic, historical value with a low environmental impact system such as the geothermal one.

[How affordable GEO4CIVHIC technologies for retrofitting civil and cultural buildings in Italy? How do they impact on energy costs?](#)

MF: Today, in Italy the costs for geothermal systems are still high: they are more convenient for interventions on buildings with high insulation, but they still are equally onerous. In a public context such as Porta degli Angeli, they represent the intention to create something that has a symbolic aspect of zero impact on the environment, which can be an example for the community. Clearly, the higher installation costs are then diluted in the lower management costs of the system. The Porta degli Angeli case study will allow us to study its effects.

[What effect did COVID-19 pandemic have on clean energy market in Italy and the GEO4CIVHIC project?](#)

MF: Unfortunately, the pandemic has affected the world in all its aspects, including the clean energy market. We are still struggling with thousands of infected people, restrictions and quarantines. An exact quantification is not possible. However, I can give the example of the Porta degli Angeli (the GEO4CIVHIC project) in which already in the project phase we had to deal with Covid by eliminating direct relationships with Public Bodies using video calls, feasible. During the works we had to give suspensions due to the infections of workers, the materials have undergone significant increases and delays in shipments. I imagine that such situations were the same for all Europe.

[How geothermal energy could help countries, particularly Italy, to recover after COVID-19 pandemic?](#)

MF: With the creation of new jobs related to clean energy, with the awareness that once the restrictions are over, there will be a clean and healthy environment, with the knowledge that there are ways to use clean energy even in everyday life.

[What do you think green energy market will look like in ten years, especially in Italy?](#)

MF: I see in recent years a strong development in the field of green energy, from eco-bonuses to specific regulations aimed at energy efficiency, the use of specific materials, the disposal of polluting elements: they all represent a concrete will. I am confident that Camilla, my daughter, in her future can also live in a clean and healthy environment.

Could you just in three words describe GEO4CIVHIC project?

MF: Three colours: red, green, blue: red deriving from the difficulties encountered in the design and construction, gradually overcome, green resulting from the green aspect of the project, blue like the colour of the clean sky without harmful emissions.

Full interview with Luc Pockele (RED Srl)

Luc Pockele, leader, supervisor of all demonstration sites around Europe and the owner of RED-Srl Company which is a partner in the GEO4CIVHIC project participating in the placement of the co-axial geothermal heating exchangers in the demonstration sites. As the result of one previous project - Cheap-GSHP, but with GEO4CIVHIC there are more opportunities to work on the technology. During the discussion with us, he highlighted the potential of geothermal energy, thus the benefits of geothermal need to be more widespread.



Luc Pockele interviewed in front of Angels' Gate, Ferrara - © UNESCO

How does geothermal energy work and what are the most common geothermal installations? What are the advantages of geothermal energy in comparison to the other alternative energy sources? What are the main benefits of shallow geothermal energy as an energy source?

LP: The shallow geothermal energy stands for borehole heat exchangers inserted in the ground at the maximum depth of 200m, normally 100m. They take or give energy back to the

underground. This kind of energy source is always there, not like other renewable sources, as the winds which need to blow or the sun which needs to shine: the geothermal is not visible and always available. The great obstacle is the high cost of the drilling operations, which can represent between 30 to 50% of the total cost, meaning that the investment of geothermal plant needs to be ready from the beginning. Another obstacle is that very few people is aware of the potential of the geothermal energy: in the long-term it's the heating and cooling system with the highest return, but it is necessary to overcome the initial investment which need to be facilitated with some subvention or support. Another advantage of shallow geothermal energy is that in heating mode it usually uses 3kw or 3 units of energy. From underground it is necessary to add 1 unit of energy or 1kw of electricity for the heat pump providing a total of 4kw or 4 units of energy to the building. This means that this type of energy as well as being renewable, usually also has a greater power than other types of energy.

How geothermal energy could help countries to recover from the Covid-19 Pandemic and from the current energy crisis?

LP: The shallow geothermal heating and cooling system is in the long run the most economical investment, because of the operating cost savings. with the decarbonization initiatives now and the high costs of fossil fuels, geothermal energy becomes more and more attractive. On one side there is a lot of support from governments on the recovery plans which could be invested into shallow geothermal energy and overcome one of the barriers, which are the high initial capital costs. But also, it helps strongly in the decarbonization because on one site the renewable energy source is totally free and environmentally friendly and always available, and secondly in the electrification and the decarbonization of the power supply we would also eliminate the use of fossil fuels for the electrical energy for the heat pumps, which means that int the long run shallow geothermal energy is an important contributor to the decarbonization, the green deal, the recovery plans: it fits in all the objectives of the initiatives of the Commission.

What are the greatest obstacles of wide implementation of shallow geothermal energy in Europe? In what countries and how GEO4CIVHIC project would help to overcome them?

LP: The biggest obstacle is the high cost of the drilling operations, which is sometimes 30 to 50% of the total cost meaning that there is the need an economic amount ready from the beginning for having the geothermal energy plant. Another obstacle is that very few people are aware of the potential of this energy: it is the heating and cooling system with the highest return in the long-term, but you need to overcome the initial investments which need to be in many cases, facilitate with some subvention or some more. Another obstacle is that geothermal plants demand a surface: the heat exchangers need to stay in a part that is 6-7 meters and for that, you need space, but most of the residential buildings have gardens and it is also possible to drill in inclined angles to increase the exposed surface in the underground, there are solutions for that. Another obstacle is that when the market picks up, I'm afraid that the drilling capacity in certain countries will be limited.

In 2019, another H2020 project was concluded, Cheap-GSHP, which was also focused on installation of shallow geothermal systems. What kind of game-changing innovative systems and tools are developed within the GEO4CIVHIC project?

LP: The Cheap-GSHP project started in 2015. In 2019 we developed innovative co-axial heat exchangers and we implemented the installation method: on one side we increased the energy extraction rate from heat exchanger, while on the other side we accelerated the installation process with the result that the costs of the installation and of the drilling (the most expensive part of geothermal plants) were substantially reduced, particularly in the area where borehole stability when it was not good. In Cheap we also developed CO₂ delivered heat pumps with higher temperatures, so we could avoid having the investment in eliminated radiators with other terminals like radio panels or fan coils. In GEO4CIVHIC we developed the prototype of heat pumps further for high-temperature terminals. So, the total cost of shallow geothermal will decrease with the one side drilling cost and on the other side, avoidance of the terminal changes. In GEO4CIVHIC we also developed compact drilling machines able to drill in built environment: usually you dig in big surfaces with lot of space. But without installation methodology and with the compact machine developed in GEO4CIVHIC, we overcome this barrier opening the market segment in built environment and in historic sites.

Could you describe GEO4CIVHIC project in few adjectives?

LP: If I had to describe the GEO4CIVHIC project in few adjectives I would say innovative, fit for historical and cultural buildings in built environment and green.