

*"Energy is the golden thread that stitches together economic growth,
greater social equity and an environment that allows the world to prosper "*

Ban Ki-moon, New York, September 24th, 2014

"Having the thread is not enough, you must also know how to embroider"

Renato Papale, Pisa, December 24th, 2015



El Regalo de Pachamama

This story was written on Christmas Day 2015, to explain my vision on the development that the exploitation of geothermal energy can give to the Andean Region. In my tale I describe something that could happen on Christmas Day of 2020; it begins with a monologue by an Italian (Neapolitan) girl who talks with her Chilean friend in El Tatio, at dawn.

<<The llama meat is tasty. It's very similar to a goat tender meat. But it doesn't have fat: pure muscle. It tends to remain dry, during cooking. Do you agree? I do not understand why you Chileans insist to cook it grilled... it should need a little bit of sauce ... But no, no, please! Do not put ketchup!

I prepare llama meat at "Genoese" style... Of course, I cook it by myself! Where do I find it? Look, in Italy we have llama meat. You do not believe me? It is not as fresh as this, however, it is good. There is frozen, in the supermarket. There is a chain of supermarkets, a Tuscan cooperative, that imports typical products directly from the production countries. The llama that I buy comes from right here, from the farms of Toconce. Yes, I saw it on the map, it's a nearby "pueblo", about twenty kilometers from here.

You've never been before? So, look, I've an idea: if there is time after we go and see the llamas at the farm. But, yes, we have time: it is early in the morning now, and we've all day. To get there, it will not take more than half an hour: there is the

narrow-gauge train that arrives to Linzor and then slides down the canyon, yes, as you call it, the quebrada... the farms must be spectacular. I hope we can visit... They breed llamas to be exported worldwide. I wonder how many animals they have...

But you know what I heard? It seems that until five years ago the llama meat was not in the restaurants of Santiago; even in specialized ones, with all varieties of roasted meat. It seems strange to me, but they told me so. Ah, you confirm that...

They say that through the entire Alto El Loa region there was not even an approved slaughterhouse, and the llama breeders had to kill them by himself and to sell the meat on the sly. I do not believe ... Today is a very rich market, they should earn a lot of money...

Five years ago, llama meat could be tasted only here in the Andes. The guide told me that if you went to Lasana, in the restaurant in front of the archaeological site of Pucara... the same as there is now, but at that time was not so large as it's

today... It was a wooden hut. As it is now, sure... but much smaller. In short, it seems that in the restaurant, if you wanted to taste the llama, you had to ask it in low voice, as if it were a prohibited good... And it was really forbidden, because they slaughtered secretly ...

At that time, it seems that there were only a few dozen llamas throughout the entire region, most of them bred in Taira. It is a pueblo that is now famous. You must visit it: it is in a beautiful valley. The guide led me there yesterday afternoon, while you were doing your trek on the small cone of the Poruña volcano. From San Pedro, where we left, follow the lava rock coming down from Poruña, up to the ford of Santa Barbara; then ascend the river El Loa, that creeps into a canyon... yes, of course, a quebrada.... The valley is very green. First, it's wide, with stony side walls. Then it suddenly narrows and is closed on both sides by two rows of compact volcanic rock monoliths. They're angular columns, such as basalt ones, however, they are red. They look like red giants that protect the valley. The blazing sun with its light and shadows draws grim expressions on their faces...

They told me that five years ago in Taira, without electricity, there were only three elderly people and thirty llamas. It seems the song of Domenico Modugno, do you remember? "We are only three, three bandits and three donkeys ..." No? it's a pity. Does not matter. It's an old song, you could not know. My dad used to sing it...

In summary, now in Taira there is a cooperative of young people who run a small lake for fishing trout and twenty bungalows. During this season it's all full... In the pastures they have stopped breeding llama and they keep only alpacas for valuable fiber. They explained to me that with European funding and a project of the University of Camerino they imported from Peruvian farms in Toccra a hundred monochromatic black alpacas, and then selected a generation of curly alpaca.

They are small in size. "Negrita de Taira" they named them. Of course, you've heard of them! They're famous. In short, these alpacas produce three kilos of black fiber per year per capita, with a fineness of less than 20 microns. Now in Taira is an artisan factory for washing, sorting and carding; all the second-hand equipment comes from Biella (Italy), where were to be dismantled. And then,

there is a hand-made garment manufacture, marketed under the trademark of origin. It seems that they have an exclusive contract with an Italian designer who next year will come on the market with this new line of black alpaca, with the brand and more ...

They say that he pays the fiber fifty euro the kilo. Think: one hundred and fifty Euros a year per animal. And that's just the material; Then there is the work, paid...

But I was saying about Genoese cooking style! No, it has nothing to do with basil pesto. The Genoese is a Neapolitan recipe, made with onions... I do not know why they name it so! Genoa town has nothing to do with it... It is a sauce for cooking meat. Like a ragù sauce, however, not based on tomato, but made by onions.

Mind, you need a lot of onion. Then: for eight people put two kilos of onions sliced into pieces in a pressure cooker with a little water. Of course, in a pressure cooker. First, you do before, but more, can you imagine how the onion can be cooked here, without pressure cooker? It would be a jelly. At four thousand meters, water boils at 80 Celsius degrees ... Then mash the onion... And brown it in olive oil and red wine. Eventually, you cut the meat into pieces and put it to cook into the sauce...

But what a noise there is! We cannot talk ... How many people will be there, in the room, for breakfast? I think at least five hundred. But yes, look: the tables have eight seats each, and they're almost all full. In the room below are six-by-four, twenty-four tables. Twenty more are in these two rows along the window, you see? Ah, no, there are more: not counting the rectangular tables with six seats on that other side! ... Many more! And then also calculates all the people who are still at the buffet, with the plate in his hand ... Today is Christmas; during the holidays there should be more guests than usual.

If they say they have over half a million visitors a year... The average is more than a thousand a day. Yes, of course, not everyone will come to eat at the Sanctuary Lodge after the aurora show. However, a best part... And why did they call it "sanctuary"? Although in Machu Picchu is the same, do you remember? The Lodge at the exit of the archaeological site they call it "sanctuary" but

it is a restaurant for hundreds of customers a day... Oh, you say that the sanctuary relates to the nature reserve? It seems to me however a blasphemy... Everyone goes to overeat, in the "sanctuary" ... Bah? "Restaurant" I would call it. It was not so cool term but more appropriate...

Nice was, however, the show! What do you say? It was awesome, wasn't it? The lights, the colors, the music... but how do they synchronize the music with the puffs of geysers? There is no orchestra, it's all recorded! You say that there is a computer connected? But no, I do not think... You say they can? Rather I think that the geysers are so regular that they can rely on it to play recorded music...

Bah! But who cares how they do: it was beautiful and it's all. And then, when they turned lights off suddenly and the night sky appeared? Wonderful!

Of course, it was worth waking up so early... but why during the night? Okay, it needs the dark, but why not in the evening after dinner? it would be

less tiring! The temperature, you say? They explained? No, I was distracted, maybe. So, let me check if I understand: before dawning it is the coldest hour of the day, and the steam becomes

white and thick, while during the day it disappears? Look, it's really true! From the window now, around the geothermal park it seems all flat and dry, whereas before sunrise it

was full of steam, it looked like the Solfatara, hundred times larger ... The Solfatara! ... Why, you do not know it? It is a geothermal field in Pozzuoli, near Naples, inside a crater... Look, it is famous.

They made films, wrote books... Of course, it's not as big as El Tatio, it does not have the record of the largest geothermal field in the hemisphere, but it is well known, come on! The Solfatara...

Anyone goes there on trips with the schoolmates...

I'm joking. You cannot know the Solfatara. But when you come to Naples I'll bring you there, so you'll tell me if it's as beautiful as El Tatio...

So, what we do when we've had our breakfast? It's not yet eight o'clock and we have the whole day ahead... Pass me the brochure with a map of the park. We said Toconce, the llama farms. Here is the train timetable... Almost every hour. Then, from there you can also proceed to Turi... Ah, yes, I really want to do a bath in the spa pool at three thousand meters above sea level before we leave.

No, here in El Tatio I do not have the courage, I

think I can get too cold...

But you can do it, if you want, I'll wait for you...

Then, the first thing before moving away, we make a visit to the Archaeological Park with the guide. He'll let us see the drilling tools used by the Larderello Company almost one hundred years ago, and then those of the Chilean Corfo in the 80s, and the workers' campsites...

The air up here is so dry that after forty years still everything is perfect without any trace of rust...

What exaggeration? It's written here. So, let us see... I also want to see the pastures of vicuñas, the greenhouses of tomatoes and auberges fed by drip irrigation, and then "bofedales", that is the wetlands that were created by water from the geothermal Plant... The whole area around the power plant is a garden in the desert, full of animals. Here is a photo of a nest of partridges on an industrial steel armoring...

Uh, what a pity! ... We missed it! ... What? The "chaccu"! Look, here is written that in November, during spring, they carry out the capture and shearing of vicuñas. It's called "chaccu". In the previous days, people from pueblos collect them all in the Rio Salado valley, around the greener pastures. Then, waving colored flags, they push the animals within the temporary precincts made of nets on both sides of the valley, that gradually narrow downward. They push vicuñas slowly (to not scare them) to the bottom of the networks, where a large circular chamber is, in which eventually they collect them; they take the animals, so shear and release them one by one.

Here is written that in the valley every year they capture many hundreds of animals. Only the hair on the back is thin, and each animal produces about three hundred grams of valuable fiber. After hand selection it is sold to spinning companies in Italy for some as one thousand euro per kilo... One euro per gram! What is it, gold?

So, how much is the Garibaldi's poncho worth? But you do not know anything! How can you ask: who is Garibaldi? He was like Simon Bolivar for you, that's who he was ... The difference is that Garibaldi came here in South America, while Simon Bolivar never came to Italy. And even Simon Bolivar had a poncho of vicuna. I saw it at his home in Lima, Peru.

Of course, however, I would appreciate a lot a vicuña scarf like the one we saw yesterday in the bed and breakfast in Caspana... let me think...

Today is Christmas... well, now, I send a text message to whom you know, and I tell him that I'll spend a hundred euro in his name for the gift he has to give me... What time is it now, in Naples?

Okay, okay, it's noon. At this hour he's buying pastries to take to his aunts for Christmas lunch...

He is going to eat tortellini soup and reinforced salad, with capers and cauliflower... Come on, it will be a pleasure for him too, if I write to him sending my auguries for Christmas...

Here is written that the harvesting of the vicuna fiber is a concession by the State, given to the pueblos of Caspana and Linzor, where there are also women who then make a hand selection of the hair and carry out the first carding... That's why the B&B landlady last night had vicuna products on sale closed inside a locked cupboard...

Do the math: three hundred euro for each animal, for a country like Caspana is a lot of money... And then in the pueblo they have also the sale of hand-made products in all hotels and B&Bs...

After the tour to the Archaeological Park, the electric minibus will take us back here at "Sanctuary" for a snack. But no, I did not mean that we're going to have lunch here. Rather, now we can prepare some sandwiches with bread and some cheese and ham from the buffet, and we can carry them away...

Yes, it's a "everything included" breakfast...

I know that they offer also the long tour, which goes to Laguna Colorada in Bolivia to see the pink flamingos, but I do not want to do it. Meanwhile,

we must go through a valley in nearly five thousand meters above sea level, and I am afraid that I feel bad. And then, it takes all day ... Instead we'll be back here at the end of the morning, and then at one o'clock we take a train to go to Toconce farms, then to Turi for a bath, as we said.

Yes, come on, that we'll have fun anyway, and instead of flamingos we'll see llamas and take a bath... Then, in Turi there is another electric public bus for Caspana, where we'll return soon, on time to take our luggage and have another tour in the pueblo (remember that I must choose my vicuna scarf) and then we'll go back to Calama...

I agree that the B&B that you booked on the Internet is very nice, on top of the hill near the funicular stop... it looks like being at Vomero... No, I do not tell you what Vomero is. Google it on the Internet, with your smartphone!

In the pueblo, you saw? they were all excited that in February the UNESCO Commission will come to give them the title of "World Heritage". They do not talk about anything else! It is another project that was born in Italy, thanks to a "twinning" with the "Sassi" of Matera. It was done by some Chilean Universities in collaboration with the Faculties of Architecture of Naples and Florence.

And then the entire hotel system here on the Andes, who arrived to offer almost five hundred beds only in the Pueblo Caspana, is based on an Italian format, the "diffused hotel", born fifty years ago to reuse villages depopulated by the earthquake!

Caspana really looks like the Italian town of Matera... with the houses of the Neolithic age excavated in the walls of the... of the quebrada. And the cut-stone houses belonging to Inca times, and the most recent made of adobe, on the terraces; the small church, the little square, the small bridge... Of course, I only use diminutives: I felt like I was in the Crib!

Hey: during Christmas evening, under the stars, only pipers were missing... But no, I'm not deriding anything, it is a lovely place. I like the Crib. Look, in Naples we spend a lot of money every year, to make the Crib...

It deserves it, it deserves the title of "World Heritage". And then, it's a so old pueblo...

Full stop. Now it is time. We prepare two sandwiches and go to the bus. So, we agree? Archaeological Park, greenhouses, bofedales and local train to Toconce and Turi... Come on, that to visit Laguna Colorada in Bolivia we'll go back again, maybe for Christmas next year, when there will also be air service. That here we come willingly. And next year I want also to come with my boyfriend, that to move him from Naples and separate him from Mom during the holidays... a crane is needed!

You understand me, right?...>>

The two girls leave, now. I see them in the direction of the buffet, where they will surely put their purpose into practice, to hide bread and cheese for lunch in their bags... They never stopped talking! And so loudly that even if I did not want to, I could not stop listening. But actually, I was pleased to eavesdrop.

Mainly, because of the Neapolitan accent of one of the two, which is well recognized even if she was speaking Spanish... I felt the air of my hometown... And also, I was intrigued by the comments of the two young women who first come to visit the Andean region of Alto El Loa.

It seems to me they have been enthusiastic... after having worked here for the last few years, I feel a little proud of this.

Our idea at first seemed so visionary, being difficult even to communicate it... Now, that the thought has become a reality, everything seems very simple, almost predictable.

The project, in a nutshell, was something like this: in a poor and sparsely populated region, but rich in renewable energy resources in abundance, we believed that the construction of a small power plant would have created the spark to initiate the economic development, required to allow the future clients to pay for the energy they would use...

It seemed then a plan totally outside the logic of the market. But the facts have shown that those "logics" were unreasonable. In fact, what we have proposed is nothing different from the creation of basic infrastructure; the same initial "step" that allowed our Western economies to initiate development (or reconstruction after the Second World War)...

The development that emerged was extraordinary, beyond all expectations: it allowed the growth of an economy based on the environmental and cultural wealth of the territory, linked to traditional craftsmanship. The Andean pueblos of the entire Alto El Loa region have been repopulated. Young people, who had to leave their birthplaces to study and find work, are now back on the Andes, where they found living conditions and well-paid jobs, both for those who had reached high professionalism and for those who had ideas for the development of innovative commercial activities.

At the beginning, the project started slowly, shared on social media, thanks to the interest of some environmental organizations and the support of local ProLoa. Then, the crowdfunding arrived, the network of experience, the support of the Aymara and Quechua "nations", the sustainable tourism; and then the Universities, the European funds... Slowly, some small companies intervened, and finally we convinced the big investors...

Five years ago, in South America the development of geothermal energy was almost completely stopped, despite of a great apparent interest. Only in Chile were active at least 80 exploration licenses for an area of several thousand square kilometers, and another 24 applications were pending, for another 220 thousand hectares. But only one project (Cerro Pabellón) was then actually under development phase.

Along the cordillera, from south to north, there were recorded resources for more than 60 MW already available for exploitation, closed in wells already drilled long time before. But no power station was in operation or under construction. In my memory, I remember 12MW in Curacautin (Chile); 20MW in Copahue (Argentina); 20MW in Sol de Manana (Bolivia); 10MW in El Tatio (Chile).

Five years ago, someone was already beginning to talk about speculation. But the difficulties for the investors were perceived as real, due to a development model that pretended that a Plant at four or five thousand meters above sea level in the Andes would compete in the price of electricity with the power generated by a coal-fired Plant on the coast...

It was positive for the geothermal energy development to stop chasing far away electricity users, to be served by mean of expensive high-voltage lines, and rather to use the resource in the high Andes for the local development of the territory.

Some coincidences facilitated the process. In the first place, the availability of the most modern industrial technologies for the efficient use of geothermal resources (*H2ORC - High Enthalpy Organic Rankine Cycle*) and for real-time management of remote and isolated electricity networks (*smart grids*). We worked with the University Pisa to design them in terms of sustainability. For example, the pumping of water for drip irrigation and battery chargers for

electrical transport systems have been integrated into the electricity grid as tools for energy storage and efficient charge dispatching between production and demand of electricity.

And then, there were international agreements on geothermal energy as a result of the COP21 conference in Paris, the interest of the then UN Secretary General, confirmed by his successor...

And finally, we cannot forget the economic situation. Namely, the deep and sudden crisis, you remember, that five years ago hit the mining industry, until then considered the only source of wealth of the region (although obtained at the cost of the impoverishment of the environment).

This fact forced a total rethinking of industrial logics.

Finally the historic agreement between Chile and Bolivia came as a result of the judgment of The Hague Court that allowed the coordinated development of geothermal energy in both countries and the exchange of energy. It was an international agreement that opened the possibility of the progress on the Andes that we can see today, made by the geothermal development, after decades of stagnant immobility of investments.

A centennial dispute between the two countries about the so-called "Litoral Boliviano" was closed by mean of renewable energy.

Now, the whole international geothermal community competes to participate with its own piece of this puzzle. New projects are unlocked all along the Cordillera. How can you not participate in the exciting challenge of creating excellence for sustainable development on the "Roof of the World"?

First of all, it should be noted the commitment of Italy, where the idea was born first. Then, the participation of the Israelis, with the Plant technologies and experience of drip irrigation in the desert; later North Americans and French, who began experimenting the extraction of lithium from geothermal fluids, valuable component for the batteries. And not least the Icelandic investors, with the chemical plant just commissioned for the production of methanol from geothermal CO₂ (which releases oxygen as a by-product) have made possible the imminent opening of an air transportation network on the Andes, using methanol as component of the fuel.

The power plants operate with total re-injection of geothermal fluids (zero-emission), without injuring the environment. On the contrary: the supply of water for greenhouses and wetlands through the filtration of condensed steam does not cause damage and is rather an improvement in the biosphere. Now, with the release of oxygen in the atmosphere by the Methanol Plant, some fanatic proposed awarding the process the prize of the first "below-zero emission"...

In addition to the benefits for the local economy and for Andean people, the project has had the effect of demonstrating clearly that geothermal energy is not only a renewable energy source and "sustainable" in the sense that its weight is "bearable" by the environment. But rather it is able to create and "sustain" human development and the environment, to keep away the desert and create value for the surrounding natural environment. There were dissolved some misunderstandings, and it is now clear that geothermal is not a mining industry, even though it uses some of the technologies.

Unlike multinational copper mining Companies, geothermal does not excavate the land to extract the ore and take it away; to leave everything altered when the resource or the favorable economic situation are over, leaving only a huge and desolate hole in the ground. Geothermal energy on the contrary "cultivates" the resource as if it were an agricultural field, without taking away any material, but only by extracting the energy that is constantly renewed, to create local infrastructure of a growing region.

Cambia, todo cambia...

Here the two girls are back to the table, laughing at their clumsy attempt to hide the booty...

I think I will propose to accompany them to visit the power station, to show the nests of partridges and the *vizcachas* lairs along the steam pipes...

I think it's a very Merry Christmas.
Merry Christmas to all of you.

*Sanctuary Lodge, El Tatio, Chile,
December 25th, 2020.*