

Factors for Geothermal Energy Development in Peru

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ABSTRACT

In the full year of 2012 Peru's GDP expanded by 6.3 percent, driven by private/public investment and also by an 8.4% increase in domestic demand. This expansion was the largest in South America followed by Chile at 5.8%. High growth rates, macroeconomic stability, trade openness and financial liberalization are some of the positive characteristics driving Peru's growth and increasing its demand for energy. Current and medium term traditional energy solutions can't meet the growing demand and Peru has also made a commitment to support renewable energy generation to meet the growth. Geothermal energy is now strongly positioned to fill the demand. Richly endowed with geothermal resources (particularly in the south where some of the largest development projects are underway), Peru is poised to be a leader in geothermal development in South America. In order to pave the way, companies active in Peru's geothermal development market, have joined together to work proactively with communities and government to drive the geothermal initiative. Revised federal regulations, community activism and the engagement of regional and local government has geothermal energy positioned to be a socially accepted complement, and a viable alternative, to a new energy matrix that will facilitate the socio-economic development of Peru.

Introduction

“Over the past five years, Peru has made great strides in its development. Its achievements include: high growth rates, low inflation, macroeconomic stability, reduction of external debt and poverty and significant advances in social and development indicators, among others. Since the early nineties, the country has embarked on a series of reforms of which fiscal consolidation, trade openness, exchange rate flexibility, financial liberalization, higher reliance on market signals and prudent monetary policy,

including strong buildup of reserves, have been key components ... The main rating agencies, Standard & Poor's, Fitch, and Moody's, upgraded Peruvian sovereign debt to investment grade level....” (World Bank, 2013)

In the full year of 2012 Peru's GDP expanded by 6.3 percent, driven by private/public investment and also by an 8.4% increase in domestic demand. This expansion was the largest in South America followed by Chile at 5.8% (World Bank, 2013).

According to Peru's Ministry of Economy and Finances, Peru will continue growing. Between 2012 – 2015, there is expected to be a GDP expansion between 6.0% and 6.5%. By 2015 the GDP per capita will increase to US\$ 8300 about 40% larger than the GDP per capita in 2011 (Ministerio de Economía y Finanzas de Perú, 2012).

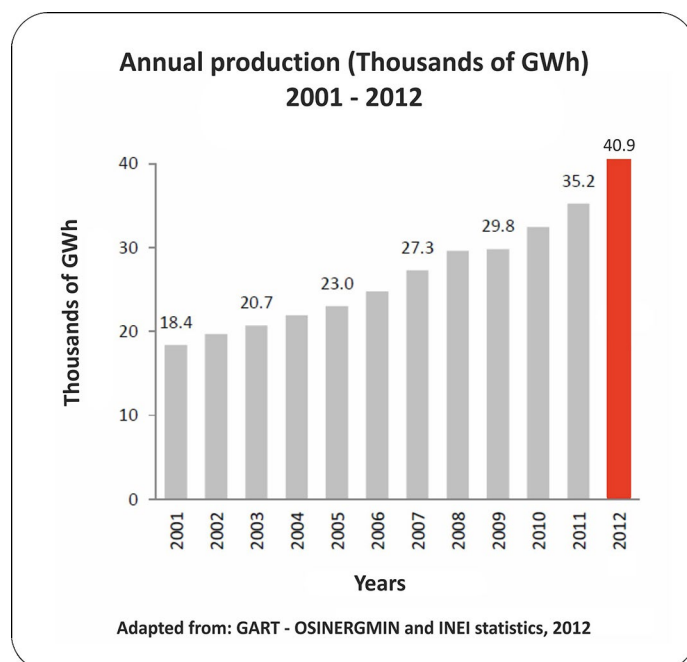


Figure 1. Increase in energy production (GWh) Peru 2001 – 2012 (OSINERGMIN, 2012a & INEI, 2013).

Energy Facts

With the recent economic growth in Peru, increase in energy demand has also occurred. In fact, this has been reflected in a remarkable increase in Peru's energy production of more than 122% between 2001 and 2012: (Figure 1).

For 2012, the Economic Operative Committee of the Interconnected National Power Grid (COES/SINAC) reported a total production of electric power of 37,321.18 GWh which represented an incremental growth of 5.97% compared to 2011 (COES/SINAC, February 2013).

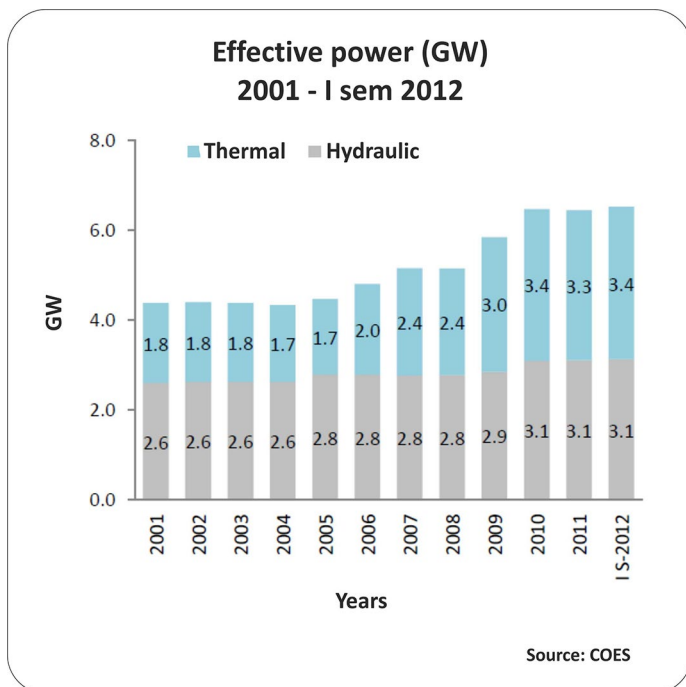


Figure 2. Effective generated electric power 2001 – 2012 Peru (in OSIN-ERGMIN, 2012a).

Between 2001 and 2012, 56 % of the effective electric power introduced into the system came from hydroelectric sources and 44% from thermo-electric sources. Since 2009, with the input of new natural gas power plants, thermo-electric sources contribute the most to the total effective electric power output (Figure 2).

For the next 5 years it is estimated there will be an average growth of 8.8% in energy demand (Table 1) (Ministerio de Energía y Minas, 2013). Approximately 500 -

Year	Power Demand	
	MW	%
2012	5 291	6.6%
2013	5 698	7.7%
2014	6 267	10.0%
2015	6 875	9.7%
2016	7 526	9.5%
2017	7 993	6.2%
Average 2013 - 2017		8.8%

Table 1. Electric power demand 2012 and forecast 2013- 2017 in Peru (Ministerio de Energía y Minas, 2013).

Average Growth Rate	Year to be achieved	Max. Power Demand (MW)				
		4,000	8,000	16,000	32,000	64,000
4.7%/Year	2009	2024	2039	2054	2069	
7.0%/Year	2009	2019	2029	2039	2049	
10%/Year	2009	2016	2023	2030	2037	

Table 2. Power demand scenarios in Peru (Herrera Descalzi, 2011).

600 MWe will need to be added every year to the system in order to satisfy the demand.

Government long term projections indicate that with the current (2012) GDP growth (6.3%) power demand could double in about 10 years (Table 2) (Herrera Descalzi, 2011).

Early in the last decade, to meet the growing demand, the government held great expectations for generation from the Camisea Natural Gas field as well as from massive hydro electric projects mostly located in the Amazon jungle. Ten years later these expectations have changed dramatically. Now, there is uncertainty around the actual size of the gas reserves and its use (e.g., for internal use or export commitments) as well as environmental and social concerns associated with the construction of large hydroelectric projects (Herrera Descalzi, 2011).

For both, hydro and gas power generation projects, the granting of social licenses for development has been a serious challenge. Several hydroelectric projects have been questioned and rejected by communities. As a result, to name one example, in 2012 Peru's Ministry of Energy and Mines (MEM) postponed Puno's Inambari 2030MWe hydroelectric project until the year 2020 (Megaproyectos, 2012).

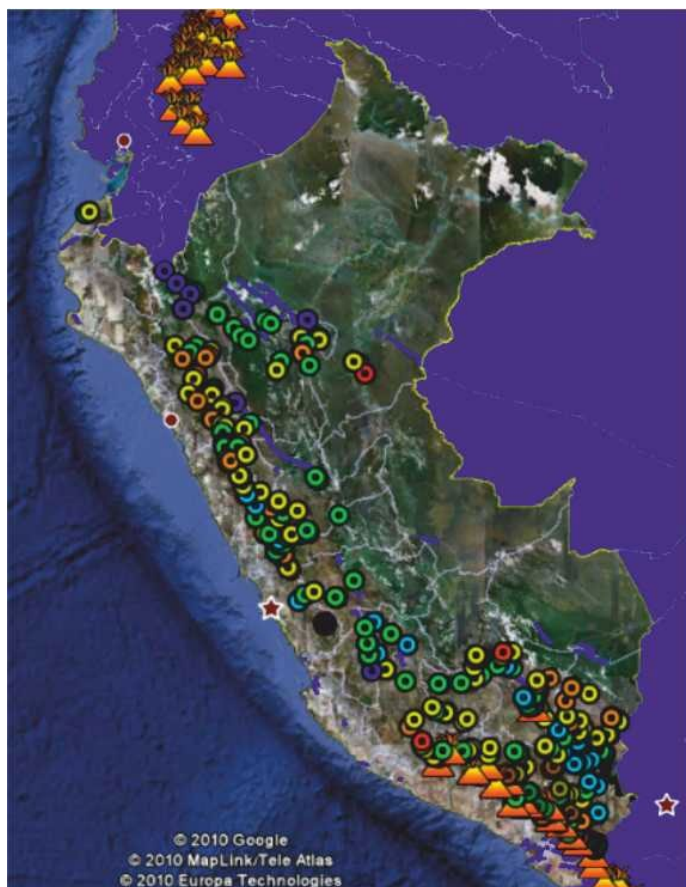
Adding to this situation, according to the Ministerio de Energía y Minas (2013), power production faces further supply shortages due to specific infrastructure issues, such as:

- Retirement of obsolete generation units (140 MWe for the period 2013 – 2017);
- High concentration of solids in suspension that could reduce hydro electric power output by 500 MWe;
- Hydro electric generation capacity could be reduced by 22% during low water periods;
- Problems with Camisea natural gas field that could represent a shortage of 2360 MW (~40% fo the national power offer);
- Maintenance of the Mantaro hydro electric complex that could take out of the system 880 MWe (17% of the country's capacity).

Government officials and experts from the energy sector have expressed concern about the actual power reserves (Gestión, 2013a and 2013b). While the Minister of Energy and Mines indicated that the power reserve in 2013 could reach 46%, the President of the interconnected Power Grid System (COES/SINAC) indicated that those estimates are too optimistic. For COES/SINAC a more accurate estimate is 15% (Peru21.pe, 2013a).

In addition to the demand issue there is the location of the power supply outlets. It is estimated that currently about 80% of the electric power offer is located in Lima and vicinity (Gestión, 2013a). The North and South of the country have a deficit of

Figure 3. Geothermal manifestations in Peru from INGEMMET's data base.



electric power precisely where some of the most important mining projects are located. The situation is such that in order to satisfy the demand, several mining companies like Southern Peru Copper Corp., Buenaventura and Vulcan have built (or are building) their own power generation systems (Gestión, 2013a and 2013b).

In this setting, renewable energy is considered an important component of the current and future energy matrix for Peru. During the last five years new regulations and actions have been proposed and implemented providing incentives for the development of renewable energy sources. Up to 5% of the total electric power generated (excluding hydraulic power) will come from renewable sources and the percentage participation of renewables will be increased every five years.

Based on Supreme Decrees N° 050-2008-EM and N° 012-2011 that promote investments for electricity generation from renewable sources, two energy auctions for renewable energy took place in 2009 and 2011. A total of 358.9 MWe were granted (excluding

RER Technology	Offer awarded		Average price awarded (US\$/MWh)	Average plant factor
	Power	Energy		
	MW	GWh		
Hydraulic	282.7	1,856.2	57.8	73.4
Wind	232.0	986.8	75.6	48.6
Solar	30.9	169.0	70.4	62.8
Biomass	96.0	215.9	200.9	25.9
Total	641.6	3,227.9	73.5	56.8
Total without hydro	358.9	1,371.7	94.7	43.8

Table 3. Results of renewable energy auctions Peru 2009 – 2011 (Consorcio R.GARCÍA Consultores S.A., et al. 2012).

hydro). Average prices ranged from 70.4 to 200.9 US\$/MWh with average plant factors ranging from 25.9% to 62.8% (Table 3). Geothermal resources were not included in these because no projects with proven reserves were yet available.

The Geothermal Option

With more than 500 geothermal sources manifestations and 61 potential geothermal fields (MEM & JICA, 2012) identified throughout the country (Figure 3), with a preliminary estimated potential of around 3,000MWe (Vargas & Cruz, 2010; Think-GeoEnergy, 2011, Rimari, 2012), Peru's geothermal potential is one of the most attractive in South America. It is estimated that Peru could be the second South American country in exploiting geothermal energy (BNamericas, 2012).

Peru's geothermal resources are strategically located in areas where most of the largest mining projects are located (Figure 4 and 5). According to OSINERGMIN (2012b), the development of geothermal sources could increase installed generation capacity

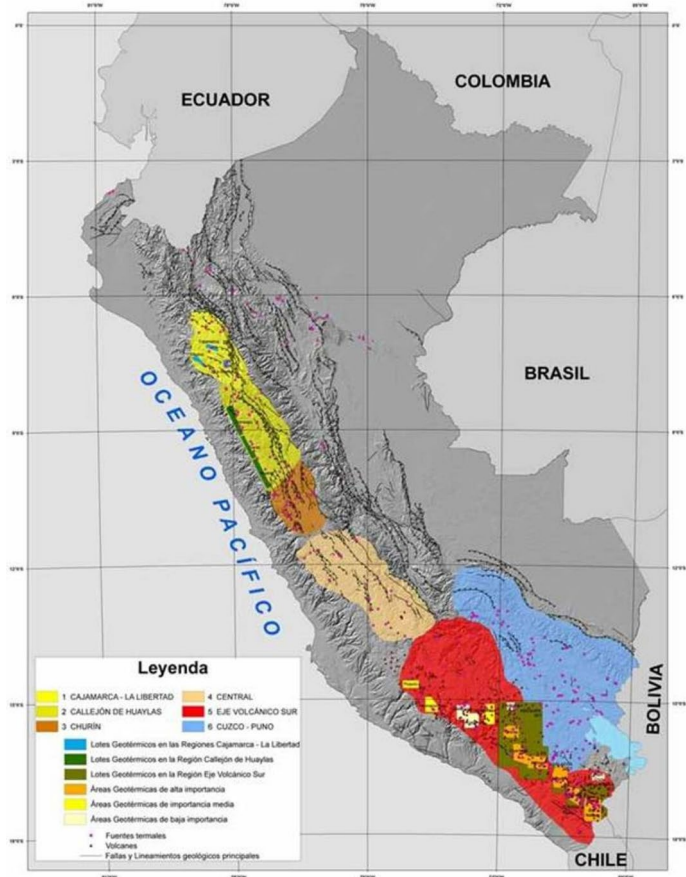


Figure 4. Peru's geothermal areas (Vargas & Cruz, 2010).



Figure 5. Mining projects and geothermal zones in Peru. (Geocatmin INGEMMET-Peru).

in southern Peru where currently there are mining investments for US\$31,797 million (59.5% of the country’s total mining investment). According to the same source, geothermal power generation in Southern Peru could improve the country’s power reserves.

Peru’s geothermal law enacted in 1997 is one of only two available in South America. Its bylaws have been repeatedly improved and adapted, being the most recent update in 2013. The current regulatory framework has attracted interest from several geothermal companies who have applied for government authorizations for exploration. By May 2013, 31 areas have been granted under the auspices of the Ministry of Energy and Mines (MEM) through the National Electricity Directorate (DGE) (Mendoza, M, 2013 & El Peruano, 2013).

In July 2012, with the idea of working in a proactive and coordinated fashion, the geothermal companies operating in Peru constituted the Peruvian Geothermal Association (APG Spanish acronym). The APG has been instrumental in articulating the different players of the geothermal industry in Peru. It has also facilitated the generation and implementation of administrative/environmental protocols.

From the social perspective, thanks to the inter-institutional communication work among national, regional and local govern-

ments, communities and geothermal company representatives, the geothermal industry has been accepted by local communities. There is congruence between the geothermal industry approach and practices, and local inhabitant’s idiosyncrasy and culture. Several geothermal companies have received community authorizations to perform surface exploration activities in different geothermal areas located in Moquegua, Puno and Tacna regions.

In a recent study endorsed by Peru’s Ministry of Economy and Finances, the Ministry of Energy and Mines and the Interamerican Development Bank, a “New Sustainable Energy Matrix” (NUMES - Spanish acronym) was proposed for Peru (Consortio R.GARCÍA Consultores S.A., et.al. 2012). This initiative proposes new policies, adjustments to the current regulatory framework and plans for the implementations of the NUMES. One of the plans, “The Renewable Energies Plan” proposes that by year 2040, 17.3% (~4321 MWe) of the total electric power generated shall come from renewable sources like mini hydro, wind, solar, geothermal and biomass. Out of this total it is estimated that geothermal will be the most important supplier with 34.7% followed by wind with 31.1% (Table 4)

Technology	New capacity (MWe)	Percentage
	Total	%
Mini - hydro	496	11.5%
Wind	1,342	31.1%
Solar	360	8.3%
Geothermal	1,500	34.7%
Biomass	623	14.4%
Total	4,321	100%

Table 4. Projected power capacity and contribution by renewable energy sources in Peru year 2040 (Consortio R.GARCÍA Consultores S.A., et.al. 2012).

Tariff Rates

Peru’s tariff rates rank among the lowest in the region (0.057 US\$/kWh/distributors to 0.132 US\$/kWh/residential - OSINERGMIN, 2012a). However, officials and authorities from the energy sector have warned of the imminent increase in tariffs originated from the imbalance between offer and demand from current low cost (and older established infrastructure) sources such as the hydroelectric.

According with COES/SINAC, because there are no new hydroelectric developments in line beyond 2016, starting in 2017 and ending 2022 there will be a power supply deficit of about 980 MWe. The report also indicates that even in the case where the southern pipe gas project (Gasoducto del Sur) is built on time, there will still be a deficit of about 490 MW (Gestión, 2013c). These deficits, the report indicates, could be covered by more expensive power generated by thermal plants (Gestión 2013c).

Regarding the magnitude of the tariff increase, there is disagreement between government officials and experts from the energy sector. While government officials consider the construction of the “Gasoducto del Sur” will affect tariffs by not more

than 4.4%, COES/SINAC considers the tariff increase could be as high as 10%, (Peru.pe, 2013b, c). For Herrera Descalzi, a former Minister of Energy and Mines, even the 10% increase could be surpassed if gas production troubles continue (Herrera Descalzi, 2011). There is speculation that gas prices could jump from the current 2.50 US\$/MMBTU to 12.00 US\$/MMBTU (similar to Chile's prices) (Gestión, 2013c).

The current regulations that provide incentives for energy development projects from renewable sources also provide mechanisms and incentives. These include early recovery sale taxes, accelerated depreciation for purposes of payment of income tax and, preferential dispatch among others incentives (Rimari, E. 2012).

Challenges

Despite the evidence of the geothermal resource potential, its political/social acceptability, the regulations in place, and the actions implemented by the different stakeholders of the geothermal industry in Peru, there are still issues that need to be worked out:

- Administrative timing and protocols need to be adjusted and better defined. The time frame considered for the different geothermal development phases and activities in the current regulation do not match the actual administrative procedures. There are delays in the granting of approved administrative procedures;
- There is the need to generate and implement clear protocols, guides and procedures for environmental and social licenses approvals. So far, geothermal companies have been granted the environmental and social approval instruments to proceed with surface exploration. However, the process has been slow causing delays that are compromising the companies' ability to meet the deadlines considered in the regulations. Procedures and timing as to the environmental permitting for the successive exploration drilling phase are still unclear.
- There is the need for clear policies regarding the distribution of the benefits derived from the geothermal industry. The geothermal industry needs to avoid situations like the ones experienced by other industries (e.g., mining), that had caused social unrest and project development disruptions.
- There is the need to adjust the regulations, tuning them with friendlier and economically attractive incentives for electric power generation from geothermal. The current "Feed in Tariff" scheme that allows generators to collect monomic fixed prices for energy supplied to the grid, could be complemented with alternative approaches such as government participation in the early, highly risky geothermal exploration phases.

These are challenges that the geothermal industry, the Peruvian government (with its various levels and jurisdictions) and the communities from different sectors of society will have to work on. These stakeholders, together, in a coordinated fashion, must achieve mutual trust. Together they must work toward common and compatible objectives that can be translated into a positive social transformation of those who will benefit from the geothermal

resources. The stakeholders must generate the mechanisms and instruments for the continuous improvement and viability of the geothermal industry in Peru. It is the time for all the players to sit together and jointly write and implement a geothermal development plan that addresses the issues presented above.

Final Comments

High growth rates, macroeconomic stability, trade openness and financial liberalization are some of the positive characteristics of Peru's economic development and investment environment. This economic environment has translated into high energy demand that will continue posing challenges for government, authorities and the people of Peru. The energy supply will have to keep pace with the demand, especially in those critical areas of the country benefiting from important investments projects. Geothermal energy offers a socially accepted complement, and a viable alternative, to a new energy matrix that will facilitate the socio-economic development of Peru. Peru's geothermal regions are located in some of the highest unfulfilled energy demand areas, where some of the most important development and investment projects are taking place. However, the challenges outlined must be tackled. Government officials, communities and geothermal company representatives, acting together, need to act now.

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