LATIN AMERICA
AND CARIBBEAN

OVERVIEW OF THE GAS SECTOR IN PERU: A BACKGROUND NOTE

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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Overview of the gas sector in Peru: A background note for the Peru CCDR

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1. Background

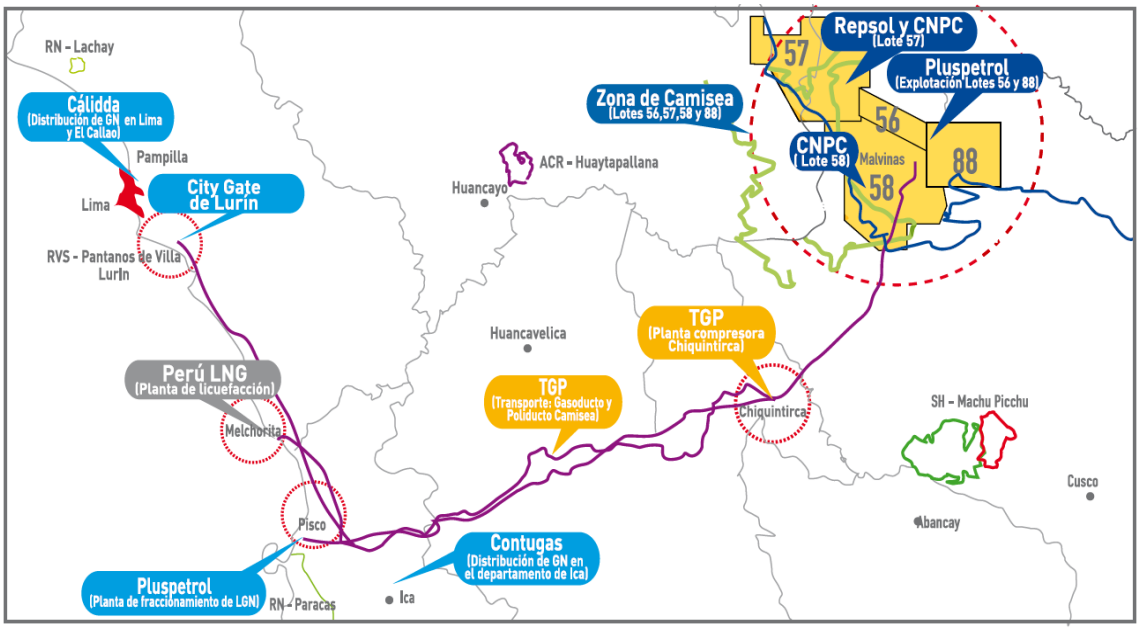
Camisea, the main natural gas field in Peru, was discovered in 1986 by Shell, in the Cusco region. Exploration revealed natural gas reserves of at least 14.6 trillion cubic feet (TCF). After failed negotiations with Shell, in 1999 the government granted a 40-year natural gas production license and a 30-year license for the liquids of natural gas (LNG) in Camisea to the Camisea Consortium, led by US-based Hunt Oil and Argentina's Pluspetrol.

The Camisea Project consists not only of the gas fields, but also of the facilities necessary to transport and process the gas. In 2000, the government granted a 33-year transportation concession contract to Transportadora de Gas del Perú (TGP), consisting of a gas pipeline from Camisea to the "city gate" in Lurín, south of Lima (of 730 km) and a liquids pipeline from Camisea to Pisco in the Ica region (of 560 km). The capacity of the Camisea gas pipelines has been increasing, from 205 million cubic feet per day (MMCFD) in 2004 to 920 MMCFD in 2016.

Initially, in December 2000, the Peruvian government entered a BOOT concession contract with TGP for the distribution of natural gas in the cities of Lima and Callao (the port city of Lima). Subsequently, in 2002, TGP and Tractebel entered a contract for the assignment of the gas distribution Concession Contract. The company was renamed Calidda and is now owned by the Bogotá Energy Group (60 percent) and Promigas (40 percent), both of Colombian origin.

The final component of the Camisea project development was the LNG (liquefied natural gas) export infrastructure. In January 2006, the government entered into a 40-year investment agreement with Peru LNG. Peru LNG's facilities include a natural gas liquefaction plant, a 408 km gas pipeline and shipping facilities. The plant is located 167 km south of Lima and has a processing capacity of 4.45 million metric tons per year (about 620 MMCFD, equal to the capacity of its gas pipeline). Figure 1 shows a schematic of the Camisea project.

Figure 1. Schematic development of Camisea Project



Source: Osinegmin

Regarding the infrastructure of natural gas transportation pipelines, there are basically three groups of pipelines. One group is owned by Transportadora de Gas del Perú (TGP), with a total length of 408 km and an accumulated capacity of 920 million cubic feet per day (MMCFD), made up of:

- The main pipeline of the Camisea project, 729 km long, which begins in Las Malvinas (in the gas field in Cusco) and ends at the "City Gate" in Lurín (about 42 km south of Lima);
- The "Loop" Costa I, 105 km long, between Pampa Melchorita (where the liquefaction plant is located) and Chilca (about 75 km south of Lima);
- The "Loop" Costa II, 31 km long, between Chilca and the "City Gate" in Lurín; and
- A derivation duct, 18 km long, between the progressive km 277 of the main gas duct and the city of Ayacucho (in the central Andean zone of the country).

Additionally, TGP has an intermediate compression station in Kámani, at progressive km 177 of the main gas duct.

The second group is made up of the Peru LNG (the LNG export company) pipeline. This gas pipeline is 408 km long and has a capacity of 620 MMCFD, between Chiquintirca and Pampa Melchorita.

The third group is made up of relatively short gas pipelines with an estimated length of 100 km, belonging to different owners. Finally, the Aguaytía Energy pipeline, 174 km long, with a capacity of 55 MMSCFD, between Curimaná and Padre Abad and Pucallpa, in the central Amazon area of Peru.

2. Current situation of natural gas

The proven reserves of natural gas as of 2019 are in the order of 10.14 TCF (Tera cubic feet), approximately 3.6% of the proven reserves in South America (Venezuela has about 70% of the NG reserves in the region). The Camisea fields (blocks 88, 56, 57 and 58), located in the eastern part of the center-south of the country, in the Amazon region of Cusco, is the largest natural gas field in the country, with proven reserves as of 2019 in the order of 9.7 TCF. Current estimates of internal consumption of natural gas indicate that the current proven reserves could last about 30 years (however, when considering the LNG exports, internal consumption reserves could last to about 20 years).

Natural gas consumption has been increasing steadily from a daily average of 368 MMCFD in 2010 to 604 MMCFD in 2019. In 2020, consumption dropped by 17.4% compared to 2019, given the COVID-19 pandemic (consumption in 2020 was just under 500 MMCFD). Electricity generation is the main natural gas consumption sector with 63.4%, followed by the industrial sector which represents 21.4%, the transport sector (vehicular natural gas, VNG) with 11.6%, and finally the residential and commercial sectors with 4.3%.

The distribution of natural gas through a pipeline network to serve the residential sector represents a small part of the total demand and is only provided in the Lima region (serving Lima and Callao), and eight other regions of the country. Calidda is the main natural gas distribution company, with approximately 12,000 km of networks (95% polyethylene) that supply 49 districts of Lima and the port city of Callao. During 2020, Calidda connected 93 thousand new residential customers, reaching a total of one million 45 thousand customers. In the case of natural gas for vehicles (NGV), at the end of 2020, Calidda has served a total of 284 stations and regarding electricity generation, it has contracts with 28 companies. The total consumption of natural gas by Calidda in 2020 has been 709 MMCFD (4% less than in 2019), of which electricity generation has represented 75%, industry 15.6%, NGV 6.3% and the rest 3% was for residential and commercial consumption.

In March 2009, Contugas, a Colombian company, was awarded a 30-year concession contract for gas distribution in Ica region, serving the cities of Chincha, Ica, Marcona, Nazca and Pisco. The commercial operation began in May 2014, serving nearly 17,500 customers. At the end of 2020, Contugas has installed a total of 1,462 km of pipelines to supply 62.6 thousand customers, with a total consumption of natural gas of 9.46 MMCFD, of which electricity generation represented 52%, industry 28%, CNG 12% and the remaining 8% was for residential and commercial consumption.

The northern concession for the distribution of natural gas, through a virtual gas pipeline (LNG tanks) and through a network of pipelines in La Libertad, Ancash, Cajamarca, and Lambayeque, was granted to Gases del Pacífico (today Quavii of the Colombian Promigas group). This 21 year concession was awarded in 2013, and put into commercial operation in December 2017. By the end of 2020, Quavii has installed a total of 2,400 km of gas pipelines and has a fleet of 32 LNG tankers. The number of customers served by 2020 has been 123 thousand and the consumption of natural gas has been 7.6 MMCFD.

The Piura concession, which includes the provinces of Talara, Sullana, Piura, Sechura and Paita, was granted to the company Gases de Norte del Perú (now Quavii) at the end of 2019, with a term of 32 years, with an initial date of operation in 2021 (postponed to 2022 due to the COVID-19 emergency). The commitment is to connect 64 thousand users in 8 years and the construction of 300 km of pipelines, with a main network capacity of 35 MMCFD.

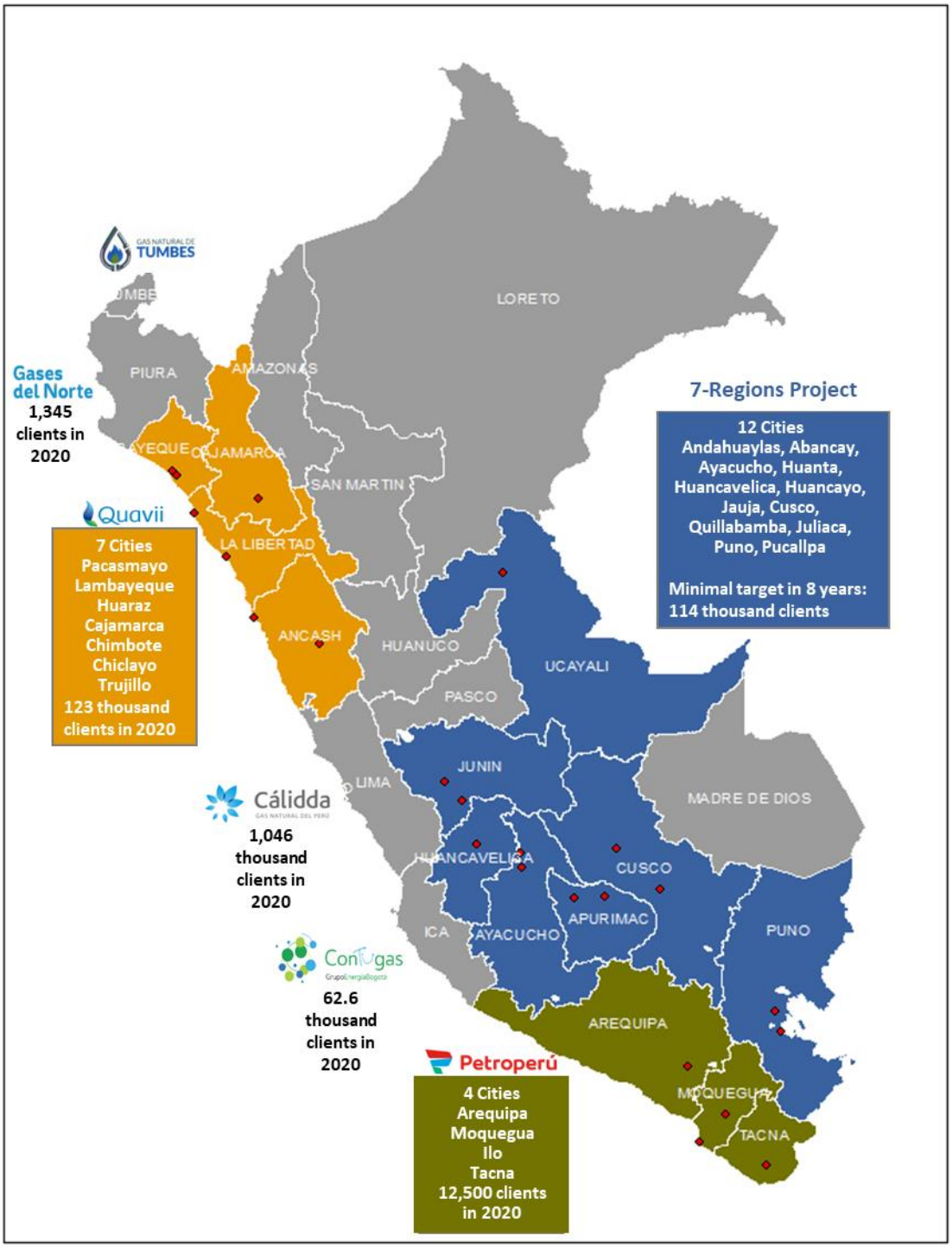
The southwest concession, which covers the regions of Arequipa, Moquegua, and Tacna, was granted to the Unión Fenosa de Perú company (Naturgy) in mid-2013, with a term of 21 years, with an initial date of operation in 2016. At the end of 2020, this concession services the cities of Arequipa, Moquegua, Ilo and Tacna, to a total of 12,500 users with a consumption of 3.1 MMCFD (the commitment was for a total of 30,500 users in 8 years, beginning in 2016). Due to difficulties in achieving the planned goals, in mid-December 2020, Naturgy reached an agreement with the government to leave the Southwest natural gas concession. The government appointed Petroperú to temporarily take over, for two years, the natural gas distribution service in the southwest.

Currently, while 10 regions have natural gas services[1], only three of them have gas distribution network, while the rest distribute through LNG trucks (or virtual gas pipelines). As of June 2021, there were about 1 million 400 thousand (398,834) residential natural gas connections throughout Peru. It is expected that by the end of 2021, 1 million 600 thousand homes will be reached. By 2025, the expansion of the

[1] These are: Lima and Callao, Ica, Áncash, La Libertad, Lambayeque, Cajamarca, Arequipa, Moquegua, Tacna, and Piura.

existing gas massification program, only to the regions that already have pipeline connections, could reach close to 2 million 600 thousand (585,000) connections. The goal of the current government is to reach 3 million homes with a connection to natural gas in 20 regions of the country by the end of the five-year government (by mid-2026) as Figure 2 shows.

Figure 2. Natural gas distribution concessions and the Seven Regions Project



Source: MINEM, ProInversion; Own elaboration

The gas massification programs in the regions of Lima and Callao, and Ica had government public support for the financing of home connections, through the so-called Bonogas[2]. The funds of Bonogas come from the Energy Social Inclusion Fund (FISE). In 2020, nearly 92 thousand residential natural gas connections were made through the Bonogas program (about 97% of the total connections made in that year).

According to the MINEM's Annual Promotions Program (PAP) 2021, FISE resources can also be used to promote the massification of natural gas in the north and south of the country, in addition to promote new natural gas distribution networks and continue with the drive for vehicle conversions to CNG. In the PAP 2021, users of multi-family buildings, micro and small businesses, and small businesses, as well as popular kitchens, shelters, and nursing homes are also being allowed to benefit.

Currently, the use of natural gas has made relatively good progress in the regions of Lima and Callao, and Ica, mainly due to direct access to natural gas supply through the pipelines associated with the Camisea project and a competitive rate (the price of natural gas is between 40% and 60% cheaper than LPG and diesel). This has led to 1.2 million households with residential natural gas service by 2020. However, the above would not have been possible without the significant natural gas demand that exists in these regions, which exceeds 700 million cubic feet per day (MMCFD), mainly driven by electricity generation. Eighty percent of this demand is concentrated in 20 customers, mainly electric power generators and large industries, which are the “anchors” that make it possible to install low pressure gas networks to serve the other 20% of the demand: consisting of medium and small industries, commercial businesses, fuel (VNG) stations and households.

3. Natural gas development prospective (and other issues)

None of the conditions that have allowed an adequate penetration of natural gas in the regions of Lima and Callao, and Ica, are present in other regions of the country. Although there are other natural gas distribution concessions outside of Lima, Callao, and Ica (as previously indicated), their scope is limited and are progressing slowly and with difficulty (one of them, in the southwest, has decided not to continue forward with the concession contract).

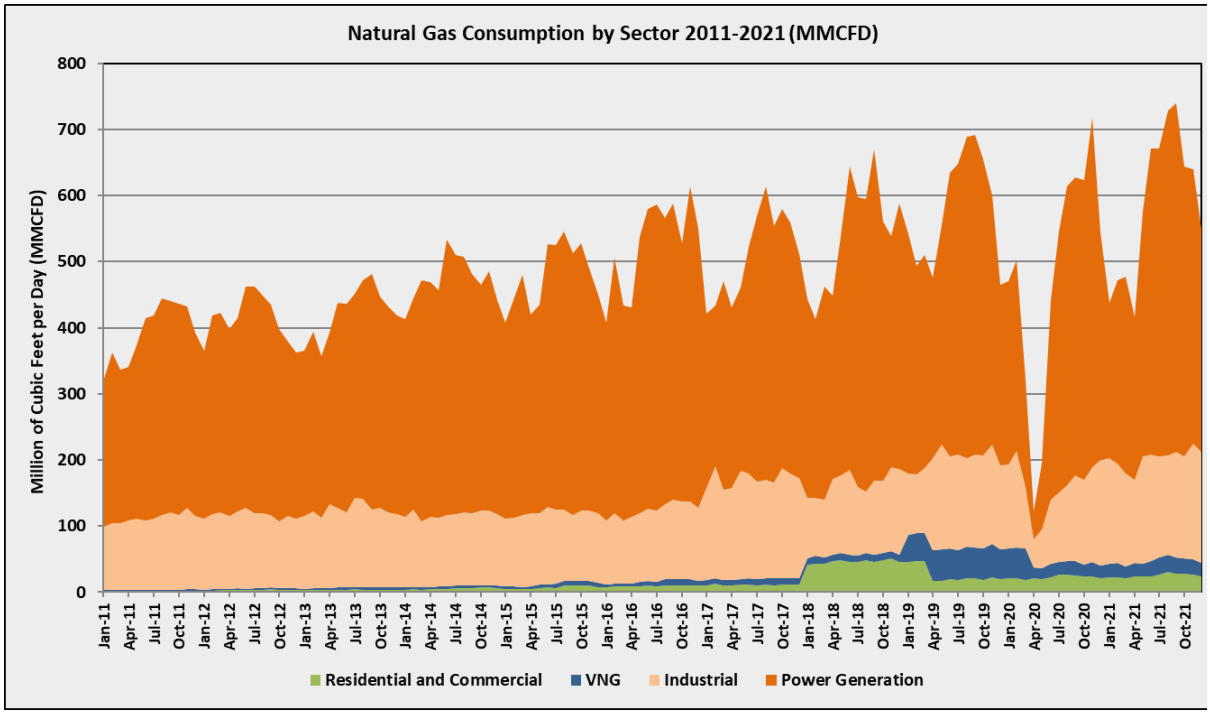
The development of natural gas going forward is likely to face difficulties both due to limited internal gas demand and the lack of gas transportation infrastructure. On the one hand, the Camisea project pipelines are reaching their design capacities. On the other, the initial policy of massification of use of natural gas, that was designed within the development of the Camisea project, has only been partially fulfilled and is showing its limitations.

Even in the case of electricity generation (63.4% of total NG consumption), NG utilization has shown significant inefficiencies, fundamentally due to the existence of a supply monopoly and inflexible 'take-or-pay' contracts. For example, in 2019, the volume of NG contracted by the generators was 560 million cubic feet per day (MMCFD) while the average consumption in the dry season (period of greatest consumption) was 420 MMCFD and in the rainy season (when there is greater hydroelectric generation) was only 300 MMCFD. As indicated, in the best of cases, only 75% of the amount of NG contracted is used and there is an important period of the year in which only 53.6% is consumed.

Furthermore, the initial plans for the use of NG in public transport have not materialized in the expected dimension either. Vehicular natural gas (VNG) represented only 9% of total consumption in 2019. Residential and commercial use of NG is very low (only 4.5% of the total demand) and progressing slowly, as indicated previously. Figure 3 shows de NG internal demand by consumption sectors from 2010 to 2020.

[2] Bonogas is a government subsidy (contribution) to new natural gas households to finance the costs of connection and basic internal installations, for users with homes in neighborhoods of medium, medium-low, and low socioeconomic levels (according to INEI classification). This bonus covers 100, 75 or 50 percent of the cost of the installation, depending on the user’s socioeconomic level. The refund of the amount of the bonus is paid in 10 years and is charged to the natural gas consumption receipts.

Figure 3. Natural gas consumption by sector 2011–2021



Source: Osinegmin; Own Development

As for the infrastructure necessary to support an increase in local and international NG demand, after the problems with the southern gas pipeline project (the Gasoducto Sur Peruano GSP), it is necessary to define a new policy. On the one hand, there is interest in continuing with this type of development to put into production the remaining natural gas reserves that exist in the area (the latest reserves evaluation of 2018 indicates 14.81 tera cubic feet of proven and probable 2P reserves, and 3.10 TCF of contingency reserves, of which 2.65 corresponds to block 58 of Camisea; see Figure 4).

Figure 4. Camisea Reserves-Block 56, 57, 58 and 88 (2P+2C)

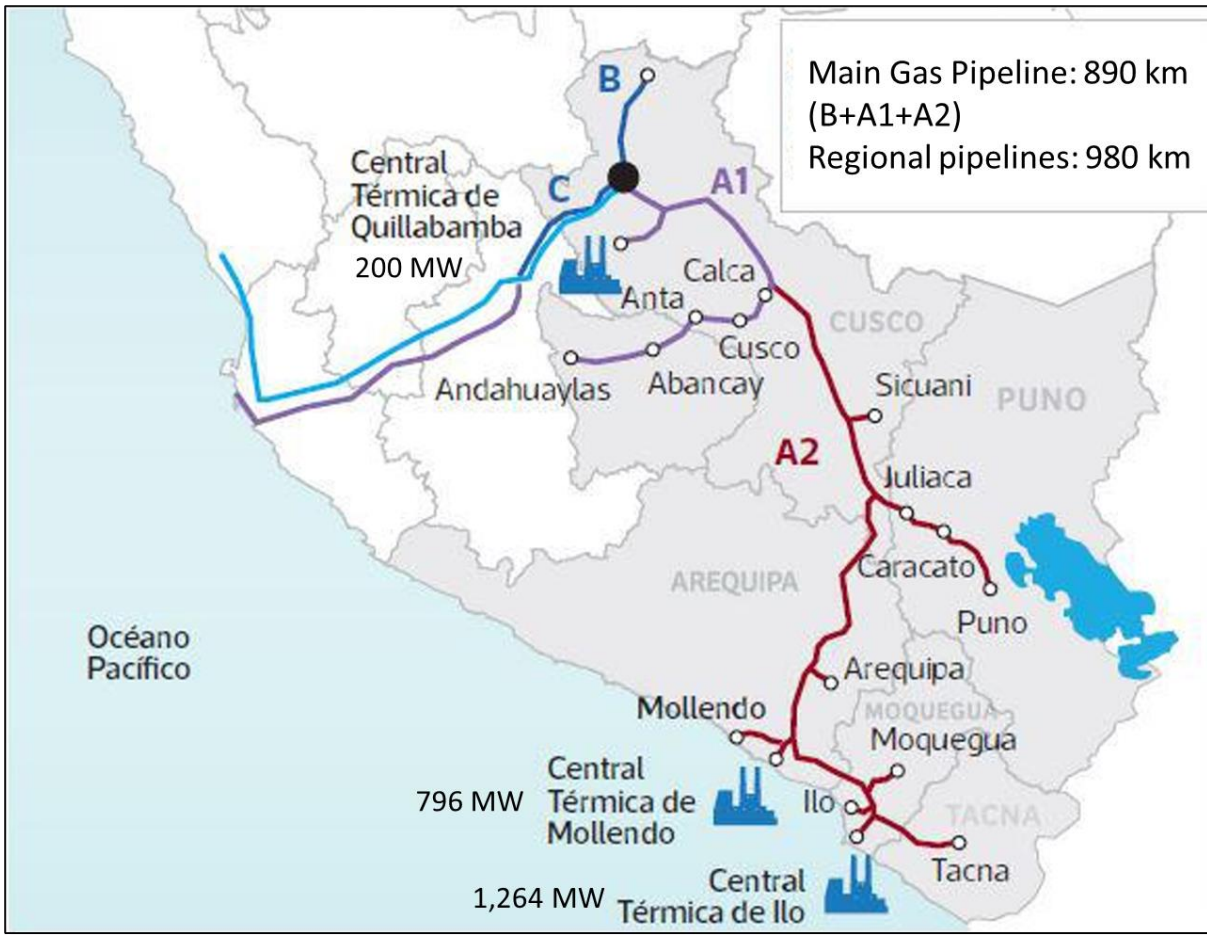
	Tera Cubic Feet (TCF = 1000 BCF)				
Camisea Blocks	Reserves Proved + Probable (2P)	Contingent Resources (2C)	Discovered Resources	Local Demand (no SIT-SUR)	Available Resources for SIT-SUR
56	1.67	0.00	1.67	1.37	0.29
57	2.17	0.45	2.61	1.19	1.43
58	0.00	2.65	2.65	0	2.65
88	7.98	0.00	7.98	6.98	1.00
Total	**11.81**	**3.10**	**14.51**	**9.54**	**5.37**

Source: MINEM and PeruPetro

On the other hand, a new gas pipeline project (SIT-SUR, proposed as a substitute of the GSP; see Figure 5) would serve to feed the southern part of the country with natural gas for: (i) local electricity

generation; (ii) use of natural gas for industries, and the commercial and residential sectors; (iii) potential installation of a petrochemical industry; and (iv) LNG export for the increasing international market. However, this potential new gas pipeline is a large-scale investment (some US$4.5 billion in capex and US$3 billion in opex) that would be economically unfeasible if used only for the expected local NG demand.

Figure 5. Sistema Integrado de Transporte del Sur (SIT-SUR) Gas Pipeline Project



Source: MINEM

Clearly, a project of the size of the SIT-SUR, with an expected economic life of 30 years and long-term commitment contracts, are not economic and financially viable without large "anchor" local NG demands, like power generation or a petrochemical industry, or/and the export of LNG for the international market. Considering the climate change and decarbonization policies, the implementation of the SIT-SUR project would mean a practical "lock-in" of NG development, and its use for power generation, beyond 2050 (the actual Camisea project already represents an unavoidable energy resource for power generation till at least 2030)

Regarding NG distribution for industry and commercial and residential sectors, MINEM has defined a new massification project for the regions of Puno, Cusco, Junín, Huancavelica, Ayacucho, Apurímac, and Ucayali (modifying and updating the previous 7-Regions NG massification project).[3] MINEM estimates that this new NG distribution project can be developed in five years, to connect some 400

[3] The Seven Regions project was launched in 2014-2015 as an initiative to provide natural gas to Andean and Amazonian households through a combination of virtual and physical gas pipelines. According to Proinversión, there were three qualified bidders: Cálidda, YPFB and the NG Holding SAC (China Gezhouba Group Company Limited) consortium. None of them submitted an offer in the tender scheduled for June 2021, which is why the MINEM took charge of the project.

thousand new families. The estimated figure for investment in pipeline infrastructure would be about US$780 million (an amount four times higher than the estimated investment for the previous 7-Regions project, which was estimated to connect 114,000 users in 8 years). The new project would be carried out under the modality of "special orders" (to state companies) and would be developed in three stages: Ayacucho and Ucayali,[4] in 2021; Cusco, in a second stage; and Huancavelica, Junín, Apurímac and Puno, in a third and final stage.

From recent tariff information for the case of NG distribution concessions, it is estimated that the unit cost (per residential customer) of the infrastructure (high-pressure steel network and low-pressure polyethylene network and other elements of the network) is around US$2,000 and the cost per home connection is US$300 (without internal installation). With these cost estimates, the new project for the 7 regions would have a total estimated cost of US$920 million (US$800 million for infrastructure and US$120 million for connections).

The implementation of this new natural gas massification program (including the southwest concession that was returned by Naturgy) would represent a significant financing and management challenge. The government must carefully examine its role, not only in defining a policy in this regard, but also how to carry out such a project successfully. It is necessary to examine: (i) the amounts of financing necessary for the infrastructure; (ii) the required contribution of subsidies if these were necessary; (iii) the financial and tariff scheme that would be applied; and (iv) the type of business management to carry out the program and its operation.

Regarding the business management of the massification program, it is necessary to examine, among others, the following alternatives:

1. Entrust Petroperu with all the new distribution (including the Southwest, which already has it assigned).
2. Entrust the regional electricity companies with all the new distribution (including the Southwest), through natural gas distribution concessions (possible greater administrative efficiency due to economies of scale).
3. Continue in some cases with new PPP-type concessions, without the need to go through ProInversion, such as special assignments to FONAFE companies or directly from FONAFE with private companies.
4. Initial public investment in the infrastructure (networks) and contracts with private companies for the operation, maintenance, and expansion of the networks.

4. Natural gas internal prices and reference netback price

The price of natural gas for thermal power generation is of great importance to the energy sector, given that it represents around 35 percent of the total electricity production (it was 36% in 2021). Natural gas from lots 88 and 56 of the Camisea fields for use in electricity generation has a regulated price (by contract) and a cap. In the Camisea lot 88 license agreement, two price caps were established, one for electricity generation, of US$1.00 per million BTU (MMBTU), and US$1.80 per MMBTU for other uses. These ceiling prices are subject to annual readjustment, applying a factor that is updated by means of a formula related to two US sectoral price indices, as indicated below:

$$\text{Price in year t, } P_t = P_0 * Fa$$

Where: P_0 is the initial price (at year zero), and Fa is the adjustment factor.

$$F_a = 0.6 * (Ind1_i/Ind1_0) + 0.4 * (Ind2_t/Ind2_0)$$

[4] The first phase of the new project would start in Ucayali and Ayacucho because both regions have gas pipelines that allow natural gas to be transported more economically compared to the alternative of virtual gas pipelines (transport in tanker trucks). In the case of Ucayali, it also has its own natural gas reserves, which Aguaytía Energy (Kallpa) exploits and markets.

Where: Ind1= Arithmetic average of the Oil Field and Gas Field Machinery index (WPS1191), published by the Department of Labor – USA; and Ind2 = Arithmetic average of the Oil Field and Gas Field Machinery index (WPU05), published by the Department of Labor – USA.

This adjustment must not exceed 5% per year during the first 5 years (until the end of 2011) and 7% per year in the subsequent years. The final NG price for electricity generation includes the transportation and distribution pipeline charges to the site of the thermal plants. The table below shows the NG price for the plants located in the Chilca, the largest thermal power generation node (south of Lima), for the period 2016-2022 (note the large increment of wellhead price between 2021 and 2022).

Table 0.1. NG Prices at Chilca Power Generation Node (US$/MMBTU)

	2016	2017	2018	2019	2020	2021	2022
Wellhead	1.518	1.443	1.503	1.579	1.550	1.453	1.808
Transport	0.909	0.935	0.977	1.000	1.010	1.025	1.023
Distribution	0.324	0.330	0.385	0.425	0.502	0.404	0.532
Total	**2.751**	**2.708**	**2.865**	**3.004**	**3.062**	**2.882**	**3.363**

There is an important gap between the actual price of Camisea natural gas, used in power generation, and the potential of economic prices of energy substitutes, or alternative uses of this gas, and with respect to hydropower generation (the other native clean energy source of the country, with important untapped resources).

To appreciate the potential impact of using local "special" prices for natural gas, it has been estimated the netback price of LNG supply from a north America Pacific coast port (like Manzanillo, in Mexico) to Chilca, considering a reference Henry Hub yearly average price of 3.3 US$/MMBTU (10-year 2010-2019 average price).[5] The maritime transport cost of LNG to Chilca has been estimated similar to shipments to the port of Mejillones in Chile (about 1.00 US$/MMBTU) and a regasification cost of 2.01 US$/MMBTU, given a total netback price of 6.31 US$/MMBTU. This price represents roughly double of the local NG price for power generation.

If it is used the 2021 average price at Henry Hub (3.91 US$/MMBTU), the netback price at Chilca would be 6.92 US$/MMBTU. This NG price translate to about 48 US$/MWh of production costs of a combine cycle thermoelectric plant. If this production cost is considered as an LCOE for a hydro power plant, its unit cost of capacity should be in the range of 2,000 to 3,000 US$/MW with a plant factor of not less than 65%. Hydro power plants out of these ranges would be uneconomical compared to NG-fired thermoelectric plants. The situation is even worse if the local "special" NG price is considered.

The "special" internal NG price for power generation also represent an economic deterrent to electricity exports and market interconnection with neighboring countries. Exporting electricity at local gas prices will be equivalent to exporting NG at the "special" price.

[5] It is considered that the years 2020, 2021 and 2022 are not representative of the long-term natural gas market conditions.