Institute for Advanced Development Studies

Hydrocarbon Prices and Subsidies in Bolivia
1986 - 2025

By:

S. Mauricio Medinaceli Monrroy
Marcelo G. Velázquez Bilbao La Vieja

Development Working Paper Series

No. 05/2023

December 2023

Hydrocarbon Prices and Subsidies in Bolivia 1986 - 2025

S. Mauricio Medinaceli Monrroy[1]
Marcelo G. Velázquez Bilbao La Vieja[2]

December, 2023

Abstract

The following study identifies five periods with different price regimes (for main hydrocarbons): 1) 1986-1996, where these prices are part of the Government's fiscal policy to finance part of the structural adjustment policies after the inflationary period; 2) 19971999, when a new methodology for price determination based on three central components is implemented, international reference prices, transport, refining and sale margins and direct, indirect and consumption-specific taxes; 3) 2000-2003, period of privatization of refineries, transport and storage, where policies of stabilization of fuel prices took on greater relevance within the regulatory framework, an aspect that allowed to keep almost unchanged the final prices of gasoline and diesel, but with a considerable fiscal cost due to adjustment of the Special Tax on Hydrocarbons and their Derivatives (IEHD); 4) 2004-2005, where in 2004 a price band was determined for international reference price behavior; in this sense, international prices above USD/barrel 27.11 are not transferred to end consumers; and 5) 2005-2022, because in 2005 the last price adjustment was made (with the 2010 temporary increase exception) for gasoline, diesel oil and liquefied petroleum gas (LPG), which remained in force until 2022.

Regarding the quantification of subsidies for production and consumption of hydrocarbons in Bolivia, five broad categories were considered in this document: an opportunity cost of selling production to the domestic market instead of its export; a direct import of petrol, diesel and LPG at higher prices for subsequent sale at lower prices; a non-updating of margins from the value chain of petroleum products; a fiscal sacrifice for non-collected VAT (Value Added Tax 13%) and; an incentive given to field operators in

[1] *International consultant, experienced in energy economics and fiscal governance:* mm@mmedinaceli.com
[2] *Partner at Energy for Sustainable Development (eSD)*: mvelazquez@energy4sd.com

Bolivia. In total, it is estimated that by 2022 these five categories will represent 11.6% of gross domestic product (GDP), with the following disaggregation: opportunity cost (5.8%), direct import (3.1%), margin update (1.2%), tax sacrifice – VAT (1.1%), and incentive (0.4%).

Key Words: Hydrocarbon prices, fiscal policy, taxes, subsidies.
JEL Codes: E62, E64, H21, L71.

Resumen

En este documento se identifican cinco períodos con regímenes (de los principales hidrocarburos) de precios distintos: 1) 1986-1996, donde dichos precios son parte de la política fiscal del Gobierno para financiar parte de las políticas de ajuste estructural luego del período inflacionario; 2) 1997-1999, cuando se implementa una nueva metodología para la determinación de precios basada en tres componentes centrales, precios de referencia internacionales, márgenes de transporte, refinación y comercialización e impuestos, directos, indirectos y al consumo específico; 3) 2000 – 2003, periodo de privatización de refinerías, transporte y almacenaje, donde políticas de estabilización de precios de combustibles tomaron una mayor relevancia dentro del marco regulatorio, aspecto que permitió mantener casi inalterados los precios finales de la gasolina y diésel, pero con un costo fiscal no trivial por ajuste de Impuesto Especial a los Hidrocarburos y sus Derivados (IEHD); 4) 2004 – 2005, cuando en el año 2004 se crea una banda de precios para el precio de referencia internacional, de esta manera, precios internacionales por encima de los USD/Barril 27.11 no se trasladan al consumidor final y; 5) 2005-2022, porque el año 2005 se realiza el último ajuste de precios (con excepción del incremento temporal del año 2010) de la gasolina, diésel oíl y GLP y ellos se mantienen vigentes hasta el año 2022.

Con relación a la cuantificación del subsidio a la producción y consumo de hidrocarburos en Bolivia, en este documento se consideraron cinco grandes categorías: el costo de oportunidad por vender la producción al mercado interno en lugar de su exportación; la importación directa de gasolinas, diésel oíl y Gas Licuado de Petróleo (GLP) a precios altos para su posterior venta a precios bajos; la no actualización de los márgenes de la cadena de valor de los derivados del petróleo; el sacrificio fiscal por el IVA no recaudado y; el incentivo entregado a los operadores de los campos en Bolivia. En total, se estima que el año 2022 estas cinco categorías representarán el 11.6% del Producto Interno Bruto (PIB), con la siguiente desagregación: costo de oportunidad (5.8%), importación directa (3.1%), actualización de márgenes (1.2%), sacrificio fiscal por IVA (1.1%) e incentivo (0.4%).

Palabras clave: Precios de los hidrocarburos, política fiscal, impuestos, subsidios.
Códigos JEL: E62, E64, H21, L71.

1. Introduction

When Butler-Bowdong (2017) reviews Adam Smith's book "The Wealth of Nations" he uses the following phrase to refer to the discretionary nature of subsidies:

> *"Today, governments inevitably grow large and bloated, moving into areas that are not really their business, and in time this inevitably makes the public poorer. Though they often believe their ability to 'pick winners' in terms of subsidizing industries to create jobs."*

The discretionary nature of a subsidy from economic policy makers, the short benefit it generates, in the short term, to the poorest segments of society and negative consequences of said subsidies on budget deficit, investment, economic growth and environmental impacts, generates major discussion on the presence, financing and impacts of subsidies on energy prices. In this sense, the main objective of this document is to study the presence of subsidies in the Bolivian hydrocarbon sector.

This means that targeting, temporality, and use of subsidies are important parameters to consider, because they tend to generate negative market distortions. Subsidies are a common practice in countries globally; for example, subsidies to encourage use and research promotion in renewable energy sources, within the agreements reached at the Conference of the Parties (COP), referring to the international convention formed by 197 nations who agreed to reach a climate pact, and mobilize resources for its fulfillment.[3] This is a specific example of this type of practice.

Considering information from 191 countries, Parry et al. (2021) estimate that fossil fuel consumption subsidies reached the figure of USD 5.9 trillion[4] or 6.8% of total GDP and, in addition, this figure is expected to increase by 2025 to 7.4%. However, it is important to note that 42% of this global amount responds to uncovered environmental costs, 29% to global warming costs, and only 8% to explicit subsidies. On the other hand, subsidies for oil, natural gas and electricity accounted for 28, 27 and 42 percent of the explicit global subsidy, while coal accounted for only 3 percent. For oil and natural gas, explicit subsidies reflect domestic pricing below international prices in energy-exporting countries, while the electricity subsidy reflects the inability to fully reflect generation costs in domestic tariffs. Globally, only 8% of the explicit subsidy reflects support for fossil fuel producers and 92% are consumer-side subsidies.

In the Bolivian case, these support measures benefit specific sectors (industrial, transport,

[3] At COP26 meeting in Glasgow, the agreement signed seeks to mobilize greater economic resources to reach the 2025 goal of at least 100 billion dollars, which according to information from the OECD that goal could be reached by 2023.

[4] $5.9\ x\ 10^{12}$.

etc.), and consequently, but in a fictitious way, it maintains the general level of prices stable to the detriment of fiscal stability due to the pressure of debt over income implied by these measures. Analyzing the evolution of regulatory measures will allow us to know and quantify the structure and values of price chains, as well as subsidies in Bolivia.

The document is organized as follows: after the introduction, a brief theoretical discussion is presented on hydrocarbons price formation, subsidies applied to them and general strategies for their elimination; in the third section, a recount on regulation applied to main petroleum derivatives in the period 1986-2022 is made; the fourth section analyzes the regulatory system applied to natural gas; the fifth reviews price provisions applied to vegetable-based additives; the sixth section exhibits the methodology for estimating hydrocarbon subsidies in Bolivia and the most important results found; the seventh section presents comparative figures at an international level in relation to prices of gasoline, diesel oil and liquefied petroleum gas (LPG). Finally, the main conclusions of this document are presented. As usual, any errors or omissions are responsibility of the authors.

2. Prices and subsidies

This section explores, from a theoretical perspective, formation of prices and subsidies associated with energy consumption, in particular, petroleum products and natural gas. It is interesting to know the characteristics associated with these concepts that make them different from others present in any economy, whether it is a producer or net importer of energy. Additionally, a section is incorporated with recommendations for subsidies elimination, either from a theoretical or empirical perspective[5].

2.1 Prices

In general, within an economy, prices should reflect the costs of production, scarcity, and consumer preferences for goods and services that are traded internally. If these signals are correct, then they become a source of information for investment and consumption decisions by producers and consumers, respectively. Energy markets operate on the same criteria as other markets; in this sense, it is desirable that energy prices incorporate the information criteria already noted.

From a theoretical perspective, economically efficient fossil fuel prices have three components:[6] 1) First, and perhaps the most important, is the cost[7] of providing consumers products that are traded at borders (such as diesel and gasoline). This concept can be approximated by the international reference price; for goods not traded at the border (electricity) this cost of supply is the cost of domestic production or "recovery

[5] Using information at the international level.
[6] Coady et al. (2019).
[7] Which includes opportunity cost.

cost" plus a reasonable rate of profit; 2) The second component incorporates the environmental costs associated with the consumption of these products; and 3) The third refers to the fact that fiscal instruments applied in an economy (VAT for example) must also be applied to the consumption of such fossil fuels.

In developing countries, the price of main petroleum products (gasoline, diesel oil and LPG[8]) is an instrument that pursues at least three central objectives: 1) energy policy, that is, the price must give the right signals for investment – supply costs[9] – and consumption[10]; 2) fiscal policy, due to the low price elasticity in petroleum products, the fiscal policy makers have all the incentive to create taxes on consumption[11] of these products; and 3) social policy: these prices have an important multiplier effect on the economy since they are linked to transport and provision of energy[12] costs; therefore, increases in prices of these derivatives raise family expenses and also company costs, generating inflationary pressures and decreasing purchasing power.

Van Beers & Strand (2013) study the relationship between gasoline and diesel pricing with political and economic variables. Some important empirical findings are: 1) when hydrocarbon export surplus is high, the prices of both products tend to be low;[13] 2) high levels of GDP are associated with low prices; 3) high level of consumption of gasoline or diesel generates pressures for high amounts of subsidies to these products; 4) high levels of health spending are associated with high prices and low subsidies; and 5) the extent of land areas are associated with low fuel prices, especially diesel oil. On the other hand, the following results are observed among the political variables: 1) more corrupt societies tend to have higher subsidies; 2) more democratic political systems present unaffordable prices; and 3) when political power is more concentrated in few people, subsidies tend to increase.

These considerations are important when finding a relationship of the regulatory context of the hydrocarbons sector on the impact of subsidies in the national economic context.

2.2 Definition and objectives of energy subsidies

Due to the increase in international oil prices observed in recent years, it was frequent practice for developing countries to apply subsidies to end consumer prices of different energy sources. An interesting international compilation is found in Clements et al. (2013). It is no coincidence that the discussion on this concept, subsidy to the price of energy, is the subject of wide discussion both in academic circles and in those less specialized. Despite this, the concept of "subsidy" is still confusing and poorly understood;

[8] Liquefied petroleum gas.
[9] In exploration, exploitation, refining, transport, and marketing.
[10] Reflecting the scarcity of these products.
[11] Either per unit consumed or as a percentage.
[12] To families and companies.
[13] This implies high subsidies.

this creates additional problems, given that the discussion of socio-economic policies is hampered by ambiguity in the definition of this concept.

As Sovacool (2017) points out, defining an energy subsidy is difficult. The author compiles from literature seventeen types of subsidies and many of them refer to lower costs of energy production, increase in prices to producers or decrease in prices for consumers. The definition of a subsidy found in literature depends on the degree of scope of the study to be done and the availability of present data; for example, Clements et. al (1998) use the definition used by the System of National Accounts of the United States of America, where a subsidy is the set of unrequired payments made by the government to companies, based on their total production or value. The EIA (Energy Information Administration) defines subsidy as a transfer of an economic resource from the government to a buyer or seller of a good or service, which has the effect of reducing the price paid, increasing the price received, or reducing the cost of producing a good or service. For Riedy (2001) subsidies include all measures that keep prices for consumers below the market level or for producers, above it; or that reduce cost to consumers or producers by giving them indirect support. For Bruce (1990) the definition of a subsidy depends on how one wants to deal with it, since it can be defined in a broad or very restricted way. In restricted form, all classifications that can be made (direct, cash, etc.) should be used; the broad form includes all forms of subsidies. Battle (2011) refers to subsidies as quantifiable payments, discounts, price premiums or favorable tax rates.

In this document, subsidies are understood as all instruments that try to lower price to final consumers. A subsidy occurs when the final sale price is below the sum of three concepts: the cost of provision[14], the usual fiscal component and a reasonable rate of profit to public or private companies that provide energy. To a lesser extent, those subsidies that increase income of producers will also be pointed out.

With regard to the objectives of creating a subsidy, in general these are used to maintain prices stable,[15] allow greater access to energy,[16] provide access to energy to the poorest families and in remote areas where the presence of such subsidies is fundamental to improve the life quality of its inhabitants,[17] and promote economic development in general;[18] however, such subsidies can (strongly) increase consumption or demand for energy and at the same time encourage inefficient use of energy, with poor investment in energy efficiency.[19] In developing countries, consumption subsidies are more common than production subsidies; therefore, their implementation or removal directly affects

[14] Which includes opportunity cost.
[15] Amin et al. (2018) were more specific and pointed out that this stability copes with global oscillations and inflationary pressures.
[16] Decreasing energy costs, see Balke et al. (2015).
[17] See Sovacool (2017).
[18] See van Beers & Strand (2013).
[19] See Aldubyan & Gasim (2021) and Amin et al. (2018).

final demand for these products; in particular, it is observed that this elimination could affect not only the well-being of poorest families, but also, they could migrate to consumption of inefficient and more polluting energies, such as firewood.[20]

Bazilian & Onyeji (2012) are more specific about the objectives pursued by fossil fuel subsidies; they include relieving energy poverty and improving equity, increasing domestic supply, redistributing national wealth, protecting domestic industry and associated employment, correcting externalities, controlling inflation, and fostering the competitiveness of those companies that are intensive in the use of energy.

In recent years, measures were implemented to eliminate subsidies due to the tax burden they represent, unequal distribution of subsidies and the promotion of inefficient consumption they cause.[21] In general, the following problems associated with subsidies in the energy sector are identified in economic literature:[22]

a) Discourage investment in the energy sector, both by public and private companies, which can lead to power outages that ultimately affect the rate of economic growth. El-Katiri & Fattouh (2015) mention that there is no incentive to invest in exploration, exploitation, refining and commercialization and, in particular, it is the gas industry that is most affected, due to the long maturity process for each project.

b) Fiscal expenditure of subsidies entails: 1) higher taxes[23] and 2) leads to reduction of expenditure for social purposes such as education, health, and infrastructure. These resources could also be used to reduce taxes in the pertinent small and medium-sized industries; see El-Katiri & Fattouh (2015).

c) Price distortions[24] lead to little effort in environmental conservation, rentier behaviors, smuggling, adulteration, and resale in the illegal market. In particular, the presence of subsidies, although it decreases the price of energy as an input, does not allow investment in plants of greater energy efficiency, reducing competitiveness of the industrial sector and additionally, decreasing quality in the provision of services[25]; see El-Katiri & Fattouh (2015).

d) The excessive consumption of fossil fuels leads to increases in CO_2 emissions and

[20] Acharya & Sadath (2017).
[21] Bazilian & Onyeji (2012).
[22] See Van Beers & Strand (2013), Breisingera et al. (2019), Clements et al. (2014), Groot & Thijs (2019), Sovacool (2017).
[23] Because of the need to finance such subsidies.
[24] For purposes of the document, a price distortion is any regulatory measure that involves the application of a subsidy or subsidies that ends up affecting producers or consumers.
[25] For example, in electricity.

has an additional economic cost due to oversized consumption.[26] Additionally, it generates problems of traffic congestion.

e) As already noted, a subsidy seeks to help the poorest families; however, in practice it is observed that it is upper-middle-income families who receive most from these subsidies.

f) They reduce energy security for importing countries and reduce export incentives for exporting countries.

g) From a macroeconomic perspective, the presence of subsidies generates pressures on fiscal and current account deficits. In the first case, the fiscal costs of subsidies may be increasing in a context of a boom in international prices and in the second case, there is the danger that imports may grow more than exports, since consumers have no incentive to save energy.

2.2.1 Measurement of subsidies

Achakulwisut et al. (2021) propose three categories of subsidies: 1) tax revenue lost by the government due to what Surrey (1973) termed "tax expenditure"[27]; these losses are due to tax rates and royalties below market or usual values; 2) cost transfers to government; and 3) public goods tariffs below actual cost and/or lax regulations for operating companies. All these categories, according to the authors, reduce the financial costs of oil producing companies (in the US) and increase the return on investment.

Sovacool (2017) points out four approaches to measuring subsidies: 1) estimation of specific programs, which includes government aid programs to specific institutions; 2) price gap, which is the difference between the domestic price and the one of products from abroad; 3) a systematic method that aggregates financial transfers plus a market support to particular industries is a more holistic approach that attempts to understand all State support to industries and consumers; and 4) externalities, which comprise all social costs including the hedonic components in price.

Clements et al. (2014) explain the usual division of subsidies to energy prices:

1. Pre-tax or explicit, which are those that benefit consumers (families and companies that use energy as an input) since the price paid for them is lower than the costs of supply, which include the costs of transport and distribution; also in this category are subsidies that benefit producers, originated when prices received by those producers are higher than the costs of supply. If products can

[26] See Davis (2013) and Davis (2017).

[27] Example: allow higher deductions (than usual) to oil and natural gas producers to settle the tax base of the income tax.

be traded internationally, the cost of supply can be measured by the international price. On the other hand, in the case of non-tradable (e.g., electricity) the relevant cost of supply includes production and distribution costs plus a reasonable rate of profit.

Aldubyan & Gasim (2021) describe this type of subsidy as a situation in which petroleum products are sold at a price that covers production costs, but, at the same time, are below international prices. In this way, when producers sell these products in the domestic market, they lose the income that they could have received in the international market. Parry et al. (2021) define an explicit subsidy (ES) as the difference between the sectoral supply cost (SC) and the price paid by the end user (FP), i.e.:

$$ES = SC - FP$$

2. Post-tax or implicit, when energy taxes, to correct externalities or increase tax revenue, are lower than efficient levels. Parry et al. (2021) defines an implicit subsidy (IS) as the difference between the efficient price (EP) and the price paid by the end user (FP), i.e.:

$$IS = EP - FP$$

Where the efficient price incorporates the supply cost (SC), the environmental cost (EC) and the general tax (T):[28]

$$EP = (SC + EC) \cdot (1 + T)$$

Batlle (2011) also incorporates institutional support instruments in this category, such as development and research funds, provision of services at prices below their cost of production or rules of positive regulatory discrimination. El-Katiri & Fattouh (2015) mention that indirect subsidies are also direct transfers (by the government) to State-owned enterprises that experience financial losses from subsidies or, if such companies do not have losses, but could have higher profits if they sold their production to more attractive markets, as exports, for example[29].

2.2.2 Notes on the elimination of subsidies

This section presents results found regarding the elimination of these subsidies, both

[28] In the case of this formula, the IMF uses as an example the value-added tax (VAT), which is one of the "ad-valorem" type.
[29] On efficient State-owned enterprises see Medinaceli (2009).

theoretically and empirically. Much of this literature finds that the elimination of a subsidy has negative impacts on the short-term GDP growth rate due to an increase in energy costs[30], affects purchasing power of families, especially in the short term[31], due to inflationary pressures in the basket of goods and services consumed, and there are no immediate improvements in the distribution of income. However, government savings are significant and, depending on the type of public policies implemented with such savings, the medium and long-term growth rate, household well-being and income distribution could improve substantially.

Groot & Thijs (2019) estimate the balance of these costs (for families) and benefits (as savings for government), through the concept of compensatory variation. Under different functional specifications[32] it is observed that in general, the government's savings are greater than the cost for families; therefore, the elimination of subsidies has a positive impact on the general well-being.[33] On the other hand, Muangjai et al. (2017) show that the price elasticity of energy demand in Thailand changes depending on whether it is a subsidized price regime or not,[34] noting that short-term gains from the elimination of a subsidy are lower in the long run.

Acharya & Sadath (2017) analyze the elimination of energy subsidies in India and suggest that, in terms of welfare, it is better to eliminate these when international oil prices are low and on the other hand, due to low short-term price elasticity of demand, an increase in energy prices leads to an increase in spending and, therefore, a decrease in the well-being of families.

An interesting compilation on good practices for elimination of subsidies can be found in Clements et al. (2014). The authors point out six elements that contribute positively to the implementation of this policy; they are: 1) a comprehensive reform plan, with clear objectives, specific mitigation policies and defined schedules; 2) a good communication policy by the government and transparency of information;[35] 3) the price increase must be gradual and differentiated by type of products.[36] It does not help if, for example, the price of those fuels consumed by the poorest families increase in a short time; 4) the efficiency of state-owned enterprises can reduce the tax burden; 5) targeted measures to mitigate costs to poorer families contribute to the success of the program. The mechanism suggested by the authors is focused money transfers.[37] On this topic

[30] Calì et al. (2019).
[31] Clements et al. (2014).
[32] From the utility function.
[33] Considering the existence of cash transfers programs to vulnerable or poor families.
[34] Demand was more inelastic with subsidies.
[35] See Vieites et al. (2022) for a study on this subject for Latin America & the Caribbean.
[36] This result also found for Ecuador, see Jara et al. (2018).
[37] Enami et al. (2019) show that the replacement of subsidies to energy and bread prices by a Programmed Subsidy Program in Iran reduced poverty and improved income distribution.

Rentschler (2016) suggest that these transfers be different according to the geographical region of each country, since socioeconomic conditions are different; 6) energy prices should be depoliticized[38]; for example, through price adjustment mechanisms with clear and transparent rules; 7) Rose & Plant (2021) suggest that fiscal savings from a subsidy can be invested in social programs visible to the population.

Belfiori (2021) points out that the mere announcement of the elimination of a subsidy could give way to a version of the "Green Paradox" where companies, anticipating such elimination and as a consequence of a possible loss of value of their assets, increase the rate of extraction of a fossil resource, thus increasing CO_2 emissions in the short term. On the other hand, a "Fiscal Paradox" arises since the government increases expenses when facing greater extraction.

Boughanmi & Khan (2019) analyze the impact on welfare and income distribution of an elimination of energy price subsidies in Oman by 50%. The authors find that the impact on GDP is small, government savings are considerable, household well-being decreases by 3% due to rising prices, and the impact on the Gini coefficient is small. Breisingera et al. (2019) conduct a numerical exercise for Egypt and find that the elimination of subsidies negatively affects GDP growth in the short term; the medium and long-term effects will depend on the type of countercyclical policy adopted by the government. On the other hand, household well-being declines in the short term, opening the way to more targeted assistance policies that could help mitigate rising energy prices.

Regarding the impact on the manufacturing sector, Calì et al. (2019) conduct a study for Mexico and Indonesia. The novelty of the simulation analysis conducted by the authors is the separation between machines that use electricity and those that operate with petroleum derivatives. When subsidies are eliminated, companies tend to replace equipment that uses fossil fuels with new (more efficient) electricity, so the impact is positive. However, when companies use electrical equipment, the impact of such disposal is negative.

When the benefits on the elimination of energy subsidies are not known to the population or are uncertain[39], there is a marked tendency towards the status quo or, even more, to oppose this measure. Calvo-Gonzalez et al. (2015) analyze this type of situation with information on the reform conducted in El Salvador in 2011.[40] In that year the government decided to replace the subsidy through the price of LPG with a direct transfer to families through the electricity bill. When the reform was implemented only 30% of people were satisfied, but a year and a half later satisfaction rate increased to 68%. The

[38] Rose & Plant (2021).

[39] See Clements et al. (2014).

[40] The reform involved the increase in prices of a bottle (of 25 Kg) of LPG from $5.10 to $13.60 and in return a system of direct transfers was introduced ($8.50 per month) to families who consumed less than 200 kWh per month. This transfer was made through electricity bills. For those families without access to electricity, a card payment system was implemented.

authors find that two variables helped the satisfaction rate increase: 1) the government's ability to deliver a direct subsidy once the reform was made, and 2) the information that families received before and after it. McCulloch et al. (2021) found that in Nigeria people who pay more for energy or do not have access to it, tend to favor a reform that eliminate subsidies; on the other hand, when people think that the government is corrupt or does not have the capacity to implement mitigation policies, then they oppose the reform.

Interesting research is proposed by Coaxhead & Grainger (2018) who suggest that the decrease in subsidies to energy prices, negatively and strongly affect the poorest families on the income side.[41] The authors show that economies that export goods and services (e.g., manufactures) cannot reallocate a price increase to final consumers[42] and, on the other hand, see their costs increase. For this reason, returns to factors decrease and this, in turn, decreases wages or employment in the export sector, thus affecting the poorest families.

From previous review, it can be concluded that, like any other price in the economy, energy prices must provide correct information on opportunity costs, production costs, the scarcity of a product, and consumer preferences. When these prices are distorted, for example, with the presence of subsidies, imbalances arise between (lower) supply and (higher) demand that also have severe environmental consequences. Although the presence of these subsidies allows low-income families to access energy and reduces inflationary pressures, negative consequences in the medium and long term on fiscal stability and economic growth are not minor. Finally, the strategies analyzed for eliminating these subsidies stand out: their gradual removal, either directly or through vegetable-based additives (VBA) with competitive prices, adequate communication between economic policy makers and civil society, support programs – direct money transfers – serve to mitigate price increases and transparency in use of fiscal resources released thanks to the elimination of said subsidies.

3. Price formation of main oil derivatives in Bolivia

To obtain a complete view of price formation in value chains of regulated products in Bolivia, this section presents the regulatory price history of the main oil derivatives since 1986 and its evolution until 2021.

3.1 1986-1996 period[43]

In 1985 Bolivia experienced a severe economic adjustment plan that sought to curb the

[41] The usual thing to do is evaluate this measure from the energy expenditure side by families.
[42] Due to elimination of subsidies.
[43] See Medinaceli (2017).

hyperinflation of the early eighties. In this plan, control of the fiscal deficit became one of the main objectives of economic policy. On the other hand, one of the few State-owned enterprises that generated positive tax revenues for the government was Yacimientos Petrolíferos Fiscales Bolivianos (YPFB),[44] the State-owned company that controlled all activities in the hydrocarbon sector. As a result of these two factors, energy policy instruments are rapidly transformed into fiscal policy instruments.

One of these instruments was the price of Special Gasoline, with the reason being clear, the higher the price of gasoline, the greater the income for YPFB and therefore, the greater the transfers of this company to the central government. Thus, during the 1986-1996 period, it is observed that the price of gasoline (and to a lesser extent of diesel) was adjusted annually (generally), according to the requirement of tax revenues for the coming year.[45] As can be seen in Table 1 and Figure 1 , the tax income from the hydrocarbons sector (domestic market) and the price fluctuation of Special Gasoline present similar behavior. A correlation coefficient of 0.98 confirms, in a way, the initial appreciation of the role played by oil prices during this period.

Table 1: Income from hydrocarbons and prices of gasoline and diesel

Year	Hydrocarbons Income - TGN (MM Bs.)	Special Gasoline Price (Bs/liter)	Diesel Oil Price (Bs/liter)
1986	412	0.50	0.50
1987	370	0.50	0.50
1988	428	0.70	0.60
1989	577	0.89	0.76
1990	748	1.10	0.90
1991	1,085	1.49	1.19
1992	1,155	1.70	1.41
1993	1,228	1.85	1.54
1994	1,274	1.85	1.54
1995	1,326	1.85	1.54
1996	1,638	2.00	2.00

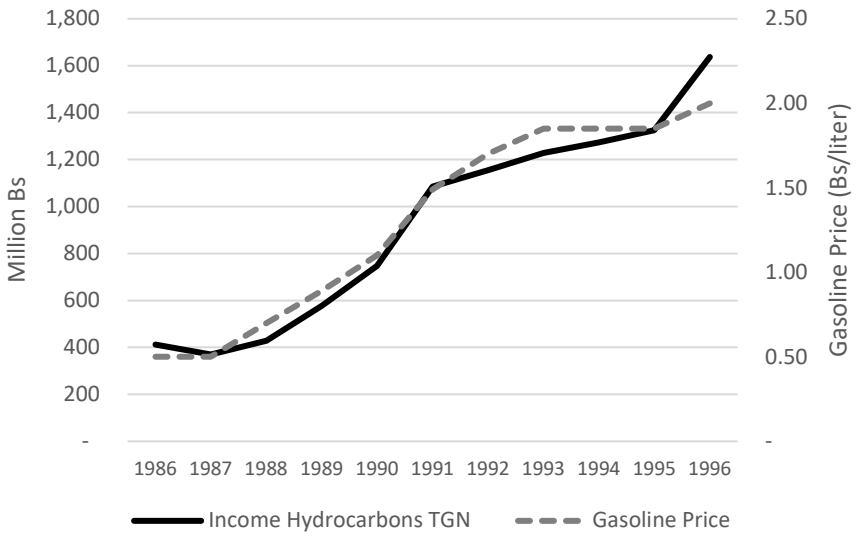
Source: Economic and Social Policy Analysis Unit

Compiled by: Authors

[44] Debate persists if whether YPFB was indeed a company that generated budget surpluses due to its business performance or by its monopolistic nature. The truth, in any case, is that it was one of the few companies that could generate economic and considerable financial surpluses.

[45] See Medinaceli et al. (2003).

Figure 1: Hydrocarbons collection and gasoline prices



In this period, prices did not fulfil their reporting job regarding the conditions of supply and demand of the market; in general they were limited to financing government expenditures, the (usually current) costs of YPFB and policies to encourage the consumption of alternative energy, such is the case of the substitution of kerosene by LPG that took place during the last 20 years.

3.2 1997-1999 period

With the approval of Hydrocarbons Law No. 1689 of 1997, a new period begins in the Bolivian hydrocarbon sector. The fundamental change proposed is the changeover of oil partnership contracts to joint-venture contracts. Under the old regime, private companies could exploit a reservoir under the condition that 50% of the total produced be handed over to the Bolivian State, it being the responsibility of the private company to finance the investment.[46] With this new Hydrocarbons Law, this mode was eliminated, and joint-venture contracts were established, whose main characteristics are the following:

a. The exploration and exploitation phases are recognized. In the first, the company acquires the right to explore a certain geographical area and has the option of moving or not to the exploitation phase if it makes a commercial discovery.

b. Companies only had to pay taxes and royalties established by the Hydrocarbons Law and Law 843, which includes all other taxes applied to commercial activities in Bolivia.

[46] Medinaceli (2007a).

Applying royalties, the Hydrocarbons Law creates the figure of existing hydrocarbons and new hydrocarbons, with rates of 18% and 50% respectively.[47]

c. It was also established that activities of refining, sale and transport of hydrocarbons are free to be conducted by the private sector, if the provisions of quality of service and product are met.

The main objective of this new law was to attract private investment, especially foreign investment, to a sector that, due to past fiscal pressures, could not implement an aggressive exploration and exploitation plan. It can be said that the initial objective of this Hydrocarbons Law, associated with the fact that the export of gas to Brazil had already been concretized, was fulfilled, given that the sectorial investment rate increased significantly.

On this overall strategy it was reasonable to assume that refining, transport and marketing activities would be regulated. In this context, it was necessary for the price of petroleum products to reflect to the degree possible the cost of production, ensuring the transfer of a State monopoly to a situation of greater competition. Thus, on August 4, 1997, Supreme Decree 24804 was passed, approving the Regulation on Price Regime of Petroleum Products, a legal framework that authorized the Superintendency of Hydrocarbons (institution in charge of downstream regulation) to calculate and publish end consumer prices.

This decree was ratified and partially modified on December 5, 1997, through Supreme Decree 24914, establishing a new methodology for calculating the domestic price of regulated petroleum products.[48]

This methodology aimed to approximate the domestic price to its cost of production and marketing plus the associated fiscal component. Through this methodology the government decided to regulate two prices: 1) the Pre-terminal Price (PPT), which was the sale price of the refineries, and (2) the selling price to the final consumer. It is important to note that the purchase price (not so the PPT) was a maximum price, and the distribution companies to the final consumer could reduce this price and thus gain greater market share. It was also established that the price of compressed natural gas (CNG) used by cars should be equal to 50% of the purchase price of Special Gasoline.

Somehow, it sought to incorporate a regulatory scheme on a temporary basis, which had to be reviewed by sectorial authorities to evaluate the liberalization of market for energy from hydrocarbons or maintain a regulated scheme according to economic evaluation.

[47] See Medinaceli (2002), Medinaceli (2003) and Medinaceli (2004).
[48] Medinaceli (2010c).

3.2.1 Pre-terminal Price

The Pre-terminal Price (PPT) was defined as that used by refineries to sell their production to wholesale distributors after entering the storage plant. The components of this price are observed in the following equation:

$$PPT_t = RP_t + RM_t + Td_t + Tp_t + IEHD_t + FM_t$$

The reference price (RP_t) shows one of the main changes that occurred with this new methodology. Each of the regulated products had an international reference base price that had two characteristics, namely: 1) it was the average, 90 days for gasoline, of the daily prices recorded by the Superintendency of Hydrocarbons, and 2) domestic prices were only modified when the reference price was 5% higher/lower than the current price. The reference prices used were[49]:

i. Unleaded gasoline 87 (RON), recorded in Gulf Coast effective prices, taken as the reference product for Special Gasoline, premium gasoline, and grade 100 aviation gasoline.
ii. Jet/kero 54, recorded in the Gulf Coast effective prices, was the reference product for A-1 jet fuel and kerosene.
iii. LS N2, for diesel oil, later replaced by the Oil 2 Waterborne Gas.
iv. Fuel N 6 with 0.7% sulfur for fuel oil.
v. LPG defined as fifty percent propane and fifty percent butane took the reference of the Mont Belvieu Spot Price Assessments.

The refinery margin (RM_t) was part of the PPT_t that ensures resources for the proper functioning of refineries. It being a fixed amount expressed in dollars per barrel, it implicitly regulates the refining activity via limit prices.

There are two types of transport in Bolivia from refineries to storage plants, transport by pipelines (Tp) and different transports (Td) that correspond to barges, tanker trucks, etc. In this sense, since these two margins are within the PPT, the refinery is implicitly obliged to incur transport costs, conducting the corresponding cross subsidy within its operation, in such a way that it has the same PPT throughout Bolivian territory.

Specific tax and transfers – the last two components of the PPT were the Special Tax on Hydrocarbons and their Derivatives ($IEHD_t$) and a direct transfer to government called the Fixed Margin (FM_t). Regarding the first component, this tax was levied at a fixed rate in Bolivianos (Bs.) per liter to the volumes sold in the domestic market, from either domestic or imported production. On the other hand, the fixed margin was a direct transfer from the refineries to the central government, consisting of the application of a band in US dollars per barrel (USD/barrel) on the production sold in the domestic market.

[49] Published in S&P Global Platts.

3.2.2 Final price

The final price[50] (FP_t) results from adding to pre-terminal price (PPT_t) the wholesale margins ($Mwsale_t$), storage ($Msto_t$), retail or gas stations ($Mretail_t$), the Value-added Tax (VAT_t), the Transaction Tax (TT_t) and the margin allocated to the regulatory entity (S_t) times the exchange rate (e_t) of Bs. to USD and the equivalence from barrels to liters, as shown in the following equation:[51]

$$PF_t = (PPT_t + Mwsale_t + Msto_t + Mretail_t + VAT_t + TT_t + S_t) \cdot \frac{e_t}{158.98}$$

The storage, wholesale and retail margins were in line with the formation of the PPT; the storage margin ($Msto_t$) allocated a part of the purchase price to cover the storage costs borne by the wholesale distributor. The proposed dynamic (which was later implemented) is as follows: the refining company would sell its production to the wholesale distributor at the PPT; the wholesale distributor was responsible for financing the storage costs after sale to retail distributors or service stations. Finally, sales margins ($Mwsale_t + Mretail_t$) ensured a reasonable profit for the agents in charge of these activities.

The Value-added Tax (VAT_t) was levied on all transactions made in the Bolivian geographical territory and consisted of a rate of 13% on the added-value of the transaction. As can be seen in the following equation, for petroleum products the tax is not levied on the IEHD. It should also be noted that the associated margin is calculated "at the end" of the formula; therefore, a first problem arose (which was solved later) since the PPT did not incorporate the corresponding VAT.

$$VAT_t = (RP_t + RM_t + Td_t + Tp_t + FM_t + Mwsale_t + Msto_t + Mretail_t) \cdot \left(\frac{13}{87}\right)$$

The Transaction Tax (TT_t) is one of the general rates levied at 3% on the gross value of transactions conducted in the Bolivian geographical territory. It is noted that its tax base did not incorporate the IEHD, but the VAT and the regulation rate paid did.

$$TT_t = (RP_t + RM_t + Td_t + Tp_t + FM_t + Mwsale_t + Msto_t + Mretail_t + VAT_t + S_t) \cdot \left(\frac{13}{87}\right)$$

The Regulation Fee (S_t) was created under Law 1600, which also created the Sectoral Regulation System (SIRESE) with the purpose of regulating, controlling, and supervising

[50] Paid by the end consumer.

[51] The exchange rate (tc_t) converted the result in USD to Bs. and the factor of 158.98 allowed its expression in liters. All margins and prices were expressed in US dollars per barrel.

the activities of telecommunications, electricity, hydrocarbons[52], transport, and basic sanitation sectors. The SIRESE consisted of the General Superintendency and five Sectoral Superintendencies. According to this Law, regulated activities must pay up to 1% of their gross income to the Sectoral Superintendencies to ensure their operation. For this reason, margin S_t represents the part of the purchase price destined to the payment of the regulation fee, which was calculated ad hoc according to the following equation:

$$S_t = (RP_t + RM_t + FM_t) \cdot 0.01$$

3.2.3 Price behavior

In this period, although the new pricing methodology was already in force, refining, derivatives transport, and sales activities were still under the administration of YPFB. In this sense, the three refineries located in Santa Cruz, Cochabamba and Chuquisaca supplied 95% of demand for Special Gasoline and 50% for diesel oil, thus forming a monopoly in refining. YPFB also owned 24 storage plants, a multi-product pipeline for derivatives transport from refineries to storage plants, wholesale commercialization, 33% of retail sales, natural gas distribution networks, bottling plants, and airport service stations.

The activities in which YPFB had a monopoly were: refining, transportation, and wholesale commercialization (particularly in Special Gasoline) in several of the 24 commercial areas and airports, and distribution of natural gas by networks. With the approval of the new Hydrocarbons Law and operation of the Superintendency of Hydrocarbons, YPFB faced competition in wholesale distribution (regarding import of hydrocarbons) and in the handling and distribution of LPG, since private companies began to operate in La Paz, Cochabamba and Santa Cruz.

In 1998, a fall in international reference prices caused prices in the domestic market to fall; for example, the price of Special Gasoline fell six times. The asymmetry in decreases is explained by the effect of the exchange rate; when the period between two adjustments was prolonged, the adjustment (downward) tended to be smaller, since the exchange rate in Bolivia followed a process of periodic "small depreciations". In this sense, the variation in end consumer price did not directly reflect the decrease in the effective reference price but was "attenuated" by the effect of the depreciation of the Bolivian currency against the US dollar. For most of this year the pricing methodology was fully applied; however, there were two modifications to it. The first was the change in the price band and the second a positive adjustment in the IEHD rate.

In December 1998, the price band was changed from +/- 5% to +5% and -20%, so that, to make a downward adjustment of domestic price, it was necessary for the international

[52] In the oil activities of pipeline transport, refining, distribution of gas by networks, and marketing of petroleum products.

reference price to decrease by more than 20%. It is the conjunction of two facts that is the main reason for implementing this change (which turned out to be temporary), on the one hand, the constant drop in domestic prices observed that year, and on the other hand, refining and sales were still under the administration of the State. Therefore, decreases in domestic prices decreased YPFB's income (in refining and sales activities), negatively affecting the daily transfer of monetary resources that, until before the privatization process, were transferred by this State company to the central government. While this measure effectively "stabilized" the price of hydrocarbon derivatives, it was simply the corollary of a tight fiscal policy.

The law that created the IEHD established that this rate should vary according to the rate of observed devaluation[53]; for this reason, in December 1998 this adjustment was practiced by also increasing the purchase price of derivatives subject to analysis. On the other hand, the moderate growth in observed international reference prices during the last months of 1998 continued and intensified in 1999, and the Special Gasoline price increased nine times. The change in prices during these two years is asymmetrical; that is, on average the variation observed in 1998 was -1.65%; however, for 1999 the average is 2.0%. As already mentioned, the effect of the continuous "mini depreciations" on the exchange rate caused this behavior. However, it should be noted that in 1999 the absolute variation of prices was much more severe; that is, in 1998 there is was annual growth rate of -5.5%, and this indicator was 17.4% in 1999.

Due to the constant increase in domestic prices, in August 1999 the Bolivian government decided to sterilize the increase in the effective reference prices of Special Gasoline and diesel through modifications in the IEHD rate. According to methodology in force, when the effective reference price increased it was possible to keep the PPT constant by decreasing the IEHD rate. Although during this year the refinery remained under State control, maintaining daily transfers to the central government, this sterilization mechanism had an important negative fiscal impact, since contracts of said refinery with the crude suppliers (private companies), were based on international prices. In this sense the level of transfer was lower. On the other hand, to keep the purchase price unchanged, the IEHD rate had to sterilize not only the effective reference price but also observed exchange rate differences in all margins (expressed in USD/barrel) that made up the price.

In summary, during this period no explicit and planned stabilization policy was presented. In general, temporary mechanisms are observed due to the decreasing and increasing nature of international reference prices. In this sense, changes in the band and changes in the IEHD rates were the main instruments of adjustment.

3.3 2000-2003 period

On September 30, 1999, Supreme Decree 25530 amended the way in which prices of

[53] Of the national currency with respect to the US dollar.

regulated products were calculated, establishing: (a) elimination of the regulatory margin and Transaction Tax; (b) incorporation of VAT in the calculation of PPT; and (c) the merger of Fixed Margin with IEHD. Undoubtedly, the modifications to the methodology sought to adapt the calculation of regulated prices to the privatization process of refineries belonging, until then, to YPFB.

One of the main problems with calculation of PPT was that it did not incorporate the margin allocated to the payment of VAT and IT taxes, nor did it incorporate the S regulation rate. This situation could be present in the previous period because YPFB owned the entire refining-sales chain; however, once the refineries were privatized, some adjustments needed to be made to the formation of this price. In particular, three modifications were made: (a) the VAT margin calculated at the end of the price chain (up to that point) was decomposed, allocating an amount corresponding to each stage of refining and sales; b) explicit TT margins and the S regulation rate were eliminated, because this tax and fee had to be inserted in the margins of the operators, which is why these were increased; and c) the fixed margin (FM) was eliminated, since this transfer was not established by Law. In this way, the rate of the IEHD was increased by a sufficient proportion to compensate for the elimination of this margin. With all these changes the formation of the PPT was as follows:

$$PPT_t = RP_t + RM'_t + Td'_t + Tp'_t + IEHD'_t + VAT_t$$

$$VAT_t = (RP_t + RM'_t + Td'_t + Tp'_t) \cdot \left(\frac{13}{87}\right)$$

It should be noted that RM', Td' and Tp' were the new refining and transports margins that already incorporated the margin associated with IEHD and the S regulation rate payment. This modification caused the refinery to experience situations of profit and loss.

As in the PPT, the components of the purchase price were altered to introduce the margins of TT and S, with the relevant formulas for the calculation of final price being the following:

$$FP_t = (PPT_t + Mwsale'_t + Msto'_t + Mretail'_t + VAT'_t) \cdot \left(\frac{e_t}{158.98}\right)$$

$$VAT'_t = (Mwsale'_t + Msto'_t + Mretail'_t) \cdot \left(\frac{13}{87}\right)$$

Subsequently, Supreme Decree 25535 of October 6, 1999 established new modifications: (a) tariffs were called margins; b) the use of the official exchange rate for ex-refinery and pre-terminal prices was regulated; (c) new margins were established for transport by pipelines, as well as different transports (tankers and others); and d) an annual validity of the updated margins was established.

In this period, two refineries, storage plants, multi-pipelines, airport service stations, and wholesale operations were privatized. The pumping plants, natural gas distribution networks and some liquid fuel stations were still under the control of the State (through YPFB). Two YPFB refineries located in Santa Cruz and Cochabamba were sold to EBR S.A., a company that trades 90% of the Special Gasoline demanded and 50% of the diesel demanded. The multi-product pipeline and storage plants were transferred to the private sector, and storage was transferred to wholesale distributors. On the other hand, in wholesale distribution, concessions were granted to six companies (through a bidding system in a "closed envelope") to trade production of EBR S.A. during the next five years. Finally, there are gas stations that buy the product from wholesalers and sell it to the final consumer. Already before 1997 there were private gas stations (granted through YPFB) and in significant numbers; for this reason, the composition of the market in this part of the chain was not significantly altered.

Regarding price behavior, during the first half of 2000 the same trend as in the previous year was observed. Even though price stabilization policies were already in place during the first half of 2000, they were not effective enough to prevent domestic prices from maintaining an upward trend. For this reason, in July 2000 the government signed an agreement with the oil companies (suppliers of crude oil to the refinery) and EBR S.A. to stabilize final and pre-terminal prices of Special Gasoline and diesel for a period of 360 days, which was finally extended until August 7, 2001. This mechanism established that the effective reference price (in force at the date of signature of the agreement) should remain unchanged for the contract term, as long as the accumulated increase in the "real reference prices" between the two products did not exceed 30%. In this way, companies had a level of coverage or upper limit insured.

If the actual effective reference price; that is, the price that resulted from the normal application of the new pricing methodology, was higher than the stabilized price, then a debt was generated of the Bolivian consumer (represented by the government) to the oil companies; otherwise, this account generated a positive balance. The interest rate resulting from this agreement was one of the simplest rates, equivalent to 9% per year. Following the completion of the agreement with private companies, the government decided to resume the old price stabilization mechanism via adjustments to the IEHD rate and to keep prices stabilized at the level of July 2000. In this period there were no considerable changes; in fact, in June 2000 the price of gasoline reached 3.31 Bs./liter and this was still the price in December 2003. The same happened with the price of diesel oil, at 3,12 Bs./liter.

From this analysis it can be concluded that prices of the main petroleum products were the result of several decisions taken by the government, either to change the methodology of fixing these, or to stabilize them at certain levels. The instruments used were various and of different natures; however, the associated fiscal cost was not insignificant.

3.4 2004-2005 period

The 2002-2003 period was one of high political turbulence in Bolivia and much of the discussion at the time had, as a central element of debate, the hydrocarbons sector. In this context, the entire pricing methodology constructed since 1997 was put on hold under Supreme Decree 27691 of August 19, 2004, which "froze" the amount of crude oil deposited in refineries. This rule, in force until now, determined upper and lower limits for the reference price of regulated products; that is, the following price band:[54]

$$P_f = \begin{cases} 27.11 & if \quad P_f > 27.11 \\ P_f & if \quad 27.11 > P_f > 24.53 \\ 24.53 & if \quad P_f < 24.53 \end{cases}$$

Where:

P_f= reference price is the 365-day average of WTI (West Texas Intermediate international oil price reference) discounting 6.29 USD/barrel.

On December 30, 2004, Supreme Decree 27959 was approved, which states as follows:

a) Reference price. Ratifies the provisions of Supreme Decree 27691 for regulated products and for LPG determined at 16.91 USD/barrel.
b) Modifies the refinery margin.
c) Modifies IEHD rates.

In this period, the approval of Supreme Decree 27992 of January 28, 2005, which derogates Decrees 27343, 27344, 27442, and 27601 (referring to methodologies for calculating IEHD and prices for gasoline and LPG) to avoid the adjustment of petroleum products for international prices or exchange rates. In addition, Decree 28117 of May 16, 2005, instructs the regulatory agency to conduct a review of transport margins, both by pipeline and by tanker trucks, and Supreme Decree 28121 (of same date) approves the price chain of LPG produced in plants. The legislation incorporates a margin of compensation for bottling, where this activity is observed to be unprofitable and tends to be protected by the Bolivian regulation scheme, under a mode of cross-subsidy. In other words, price chains from other fuels have a specific margin to finance the cost of LPG bottling. Hence, for each liter of gasoline or diesel oil that is consumed, the bottling of a 10 Kg LPG cylinder is compensated.

In this period prices of regulated products have small variations. In fact, the price of gasoline varies goes 3.31 Bs./liter to 3.34 in April 2004 and after five variations reaches 3.74 Bs./liter in December 2004, which is the price in force until now. Regarding diesel oil,

[54] Variables and constants unit is USD/barrel.

year 2002 has a price of 3.12 Bs./liter. At December 2004 it reached 3.72 Bs./liter, which is the price until now. Slowly, the regulated price scheme tended to disadvantage the productive activity of the hydrocarbons sector and make up the economic reality of the final consumer through artificial pricing mechanisms.

3.5 2005-2022 period

In May 2005, Hydrocarbons Law 3058 (in force until now) was approved, which established, among others[55], the following provisions in the Bolivian oil and gas sector:

- Created the Direct Tax on Hydrocarbons (IDH), equivalent to 32% of the gross production of hydrocarbons at the wellhead. This tax, associated with existing royalties and shares of 18%, caused the State, regardless of operating and capital costs, to retain 50% of gross sales at the wellhead.

- Exploration and exploitation activities must be conducted through Production Sharing Contracts, Operation or Partnership Contracts (Article 65). However, the Law is not clear, given that in another article it mentions Exploration and Exploitation (Article 38) and Shared Development (Article 133) contracts.

- In gas export contracts, YPFB will negotiates a percentage of the export to finance an Internal Support Fund aimed to massify the use of natural gas in the domestic market (Article 143).

- With respect to the price of hydrocarbons, it establishes that:

  "*The Regulator will set for the domestic market, the maximum prices, in national currency, and the respective updating parameters, according to the Regulation, for the following products:*

  a) Crude Oil and LPG, taking as reference the Export Parity of the reference product.

  b) Regulated Products, taking as reference the prices of raw material indicated in paragraph a) above.

  (c) For imported regulated products, they shall be fixed by reference to import parity.

  d) Natural gas, considering the prices of existing contracts and market

[55] This Law approves a set of measures of greater scope. In this section only those relevant to the objectives of this document are mentioned. More details on this Law can be found in Medinaceli (2006), Medinaceli (2007b) and Medinaceli (2008); some impacts of this are found in Medinaceli (2012a), Medinaceli (2012b) and Medinaceli (2014).

opportunity."

- Article 64 establishes that the production of hydrocarbons from marginal and small fields will have a premium according to level of production and quality of hydrocarbon.

A year after the approval of the current hydrocarbons law, the Bolivian government approved Supreme Decree 28701, also known as "Héroes del Chaco"[56] that raises the tax burden for producing fields in Bolivia and initiates the renegotiation of hydrocarbon exploration and exploitation contracts. The approval of this legislation has a more symbolic than instrumental character since it opens the space for the Bolivian State to expand its functions from regulator to operator. Once this measure was approved, YPFB acquired shares and participation in other segments of the hydrocarbon value chain, and today it is the main operator of transport, refining and sales of gas, oil, and petroleum derivatives in Bolivia.

Concerning the regulatory scheme, Supreme Decree 29768, of October 29, 2008, updated the calculation of different transport margins for regulated products. Supreme Decree 29777, of November 5, 2008, updated the refinery margin, as well as the IEHD rates. These measures – together with other regulations described in the annex to this document – slightly modify the regulation and pricing in Bolivia. During this period, the only price change recorded was in December 2010, when the prices of the main oil derivatives increased; however, social pressures forced a reversal and that is how, five days after the approval, these regulated prices returned to their original level.[57]

3.6 Prices in force as of 2022

This section presents the values of regulated prices of hydrocarbons and associated products observed in 2022. The central objective is to conduct a comparative analysis (of relative prices) between these prices. Table 2 presents the final prices of petroleum derivatives, Special Gasoline+, Super Ethanol 92, and Agro Fuel. As analyzed in previous sections, the prices of the most important products, Special Gasoline, diesel oil and LPG[58], are at the same levels as in 2005. It is also useful to note that the National Hydrocarbons Agency[59] (ANH) regulates and publishes the prices of "Special+ Gasoline", "Super Ethanol 92" and "Agro Fuel", which are products that have an agro-industrial component, either by content (vegetable-based additive) or by consumption sector (agro fuel).

[56] Also called the "nationalization of hydrocarbons".
[57] Find in annex to this document the values of this increase, for gasoline and diesel oil.
[58] For LPG it is a unitary price (per kilogram), independent of the cylinder capacities available for sale in the market (10 Kg or 45 Kg).
[59] Former Superintendency of Hydrocarbons.

Table 2: Final prices of regulated products – May 2022

Concept	Unit	End Consumer Prices
Special+ Gasoline	Bs/liter	3.74
Super Ethanol 92	Bs/liter	4.50
Special Gasoline	Bs/liter	3.74
Premium	Bs/liter	4.79
Diesel Oil	Bs/liter	3.72
Aviation Gas	Bs/liter	4.57
Kerosene	Bs/liter	2.72
Jef Fuel (National)	Bs/liter	2.77
Agro Fuel	Bs/liter	2.55
Gas Oil	Bs/liter	1.10
Fuel Oil	Bs/liter	2.78
LPG	Bs/kilo	2.25

Source: ANH
Compiled by: Authors

According to regulations,[60] vehicles entering the country with a foreign license plate must pay prices without subsidy. For this reason, the ANH calculates and publishes the so-called "international prices"; see Table 3. This criterion also applies to aircraft that do not have a national license plate for international jet fuel consumption.

Table 3: International prices of regulated products – May 2022

Concept	Unit	International Price
Special+ Gasoline	Bs/liter	8.68
Special Gasoline	Bs/liter	8.68
Diesel Oil	Bs/liter	8.88
Jef Fuel (International)	Bs/liter	7.32
VNG	Bs/CM	3.10

Source: ANH
Compiled by: Authors

Following the structure of price chain formation of petroleum products, in accordance with Bolivian regulations, Table 4 presents ex-refinery price formation of regulated products and Table 5 shows information for LPG obtained from refineries and obtained from separation plants. The ex-refining price adds to the reference prices, the refining margin, the compensation margins, and the VAT. In the case of Special+ Gasoline and Super Ethanol 92, the proportion of costs of anhydrous ethanol and fossil fuel (base gasoline A according to regulation) is distributed according to the percentage of mixture.

[60] Supreme Decree 29814 of November 27, 2008.

Although the current legislation at year 2022[61] indicates that the Special+ Gasoline must contain 12% of anhydrous ethanol, YPFB does not yet make the corresponding mixture, and continues the previous norm of 8% of mixture. This is how the first row presents the first phase of the Special+ Gasoline price chain with 8% ethanol. The second row corresponds to Super Ethanol 92 with 12% anhydrous ethanol in the mixture.

Table 4: Composition of Ex-Refining Price (USD/barrel)

Concept	Anhydrous Ethanol (*)	Ethanol Transportation	Reference Price	Refinary margin	Gas Oil Differential Price Compensation	Compensation margin	VAT EX-REFINERY	EX- REFINERY PRICE
Special+ Gasoline	7.59	0.71	24.94	5.54	n.a.	1.44	6.01	46.23
Super Ethanol 92	11.38	1.07	23.86	5.30	n.a.	1.38	6.42	49.41
Special Gasoline	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Premium	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Diesel Oil	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Aviation Gas	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Kerosene	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Jef Fuel (National)	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Jef Fuel (International)	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89
Agro Fuel	n.a.	n.a.	27.11	6.02	n.a.	0.00	4.95	38.08
Gas Oil	n.a.	n.a.	27.11	4.81	-14.33	0.00	2.63	20.22
Fuel Oil	n.a.	n.a.	27.11	6.02	n.a.	1.57	5.19	39.89

(*) For the first 5 years established by law 1098 [2018-2023]

Source: ANH

Compiled by: Authors

Table 5: LPG prices (USD/barrel)

Concept	Reference Price	Refinery margin	VAT Ex-Refinery	VAT Reference Price	Ex-Refinery Price	Ex-Plant Price
LPG - Refinery	16.9	4.8	3.2	n.a.	25.0	n.a.
LPG - Plants	16.9	n.a.	n.a.	2.5	n.a.	19.4

Source: Compilation based on legal information

The highest tax burden (by VAT) of gasoline suitable for cycle-otto vehicles,[62] corresponds to Super Ethanol 92 and Special+ Gasoline. The refinery margin is lower, given that it is being evaluated per barrel of product produced; therefore, the necessary volume of "base gasoline A" is lower in proportion to the mixture used to produce a barrel of gasoline with ethanol. Additionally, it is observed that for regulated products except for agro fuel and gas oil, the ex-refinery price follows the same price structure. That is, in financial terms, the refinery perceives indistinctly the same margin of producing a barrel of oil, kerosene or international jet fuel. Moreover, the cross-subsidy reflected in the compensation margin,[63] is the same for all products, even if it is considered that the use of a barrel of base gasoline A would have the same compensation as the other products.

[61] RAR-ANH/240-2020.

[62] Fuel used in vehicles with internal combustion gasoline engines.

[63] Margin recognized for refineries for indistinct production of a product; it is a cross-subsidy, since it arises from the recognition to produce LPG in refineries and plants, and recognizes the amount not covered by the subsidy with respect to the LPG price differential.

The regulatory treatment for LPG is different, part of the differentiation between LPG from refineries and plants. Both with a lower reference price than other regulated products and different because one incorporates a margin to refining and another incorporates a discount or negative refinery margin. The latter is used to define a price after the ex-plant. The refinery margin of LPG production from refineries is a positive value of 4.81 USD/barrel.

Table 6 presents the price formation of petroleum derivatives from refinery output to the pre-terminal phase. Since anhydrous ethanol is a vegetable-based additive (VBA), i.e., not fossil, it is not subject to payment of the IEHD tax, but gasoline base A is in a proportion of up to 26% of the price of Special Gasoline (fossil fuel). The rest of the chain to PPT corresponds to transport of fossil gasoline. The IEHD rate is a mechanism of adjustment to the purchase price. It is a sensitive component since any variation is transferred to the final consumer. For example, the IEHD rate for International Jet Fuel is almost four times higher than other rates. The State captures the variation of international market prices through the adjustment of the IEHD rate. As established by law, IEHD rates can be modified by Supreme Decree.

Table 6: Pre-Terminal Price Formation (USD/barrel) – May 2022

Concept	Ex-Refinery Price	IEHD (*)	Multiproduct pipelines	Different Transportation	Cumulative VAT or Post Ex-Refinery	Pre-Terminal Price
Special+ Gasoline	46.23	17.66	0.74	1.33	0.31	66.27
Super Ethanol 92	49.41	16.89	0.70	1.28	0.30	68.58
Special Gasoline	39.89	24.32	0.80	1.45	0.34	66.79
Premium	39.89	43.13	0.80	1.45	0.34	85.60
Diesel Oil	39.89	24.64	0.80	1.45	0.34	67.11
Aviation Gas	39.89	36.60	-	1.45	0.22	78.15
Kerosene	39.89	5.75	0.80	1.45	0.34	48.22
Jef Fuel (National)	39.89	6.36	0.80	1.45	0.34	48.83
Jef Fuel (International)	39.89	96.85	0.80	1.45	0.34	139.32
Agro Fuel	38.08	12.23	-	-	-	50.32
Gas Oil	20.22	-	0.80	0.49	0.19	21.70
Fuel Oil	39.89	7.79	0.80	1.45	0.34	50.26

(*) Corresponds to the law enforced rate (Bs/liter) converted to USD/Barrel

Source: Compilation based on legal information

Table 7 presents the price formation from PPT to end consumer price. As already noted, the margins of storage and wholesale allocate a part of the price to storage and transport of products to gas stations; retail margin covers (in theory) the operating costs of such stations and a reasonable rate of profit. It also highlights the remuneration to wholesalers (YPFB) and retailers with ethanol products compared to other products, which reflect incentives to expand the coverage of green fuels in the nation's territory.

Table 7: Final Price Formation (USD/barrel) – May 2022

Concept	Pre-Terminal Price	Storage	Wholesaler	Retail	Cumulative VAT	Final Price
Special+ Gasoline	66.27	0.71	1.75	4.12	0.98	73.83
Super Ethanol 92	68.58	0.68	12.16	4.82	2.64	88.87
Special Gasoline	66.79	0.77	1.58	3.78	0.92	73.83
Premium	85.60	2.38	1.64	3.78	1.17	94.57
Diesel Oil	67.11	0.77	1.58	3.15	0.82	73.43
Aviation Gas	78.15	2.38	4.37	3.78	1.57	90.25
Kerosene	48.22	2.38	1.64	0.74	0.71	53.69
Jef Fuel (National)	48.83	0.77	4.32	-	0.76	54.68
Jef Fuel (International)	139.32	0.77	3.73	-	0.67	144.49
Agro Fuel	50.32	-	-	-	-	50.32
Gas Oil	21.70	-	-	-	-	21.70
Fuel Oil	50.26	2.38	1.64	-	0.60	54.88

Source: Compilation based on legal information and from ANH 2022

The LPG regulatory price contains an essential element of cross-subsidy. This is explained below, both for LPG from refineries and plants:

1. LPG from refineries: To the ex-refinery price is added a differential price, which is compensated with Fiscal Credit Notes (NOCREs). The regulation indicates that if this differential does not compensate for the costs of bottling, a cross-subsidy called compensation margin is added, which is a concept that is part of the price chain of regulated products, with the exception of LPG.

2. LPG from plants: The subsidy is transferred to the end consumer as indicated by Supreme Decree 28121, reflected in the price differential, which is the difference between the reference price and the refinery margin.

Table 8: LPG from Refineries, end consumer Price (USD/barrel) – May 2022

Concept	Obs Value
Ex-Refinery Price	25.00
Price Differential	9.10
NOCREs	-5.10
Multiproduct pipelines	0.80
Different Transportation	0.50
Storage	3.50
Wholesaler	3.40
Retail	4.80
Cumulative VAT	2.50
Final Price	**44.40**

Source: Compilation based on legal information

Table 9: LPG from Plants, end consumer Price (USD/barrel) – May 2022

Concept	Obs Value
Ex-Plant Price	19.40
Refinery margin or discount	-3.10
VAT Refinery magin	-0.50
Ex-Refinery Price	15.90
Subsidy	11.90
Multiproduct pipelines	0.80
Different Transportation	0.50
Storage	3.50
Wholesaler	3.40
Retail	4.80
Cumulative VAT	3.70
Final Price	**44.40**

Source: Compilation based on legal information

It is important to note that prices approved by the ANH use the official exchange rate of 2004, i.e., 8.05 Bs./USD. However, regulations indicate that variations in prices must be updated to the exchange rate at which the variation was observed. The fact that there is a ceiling on the calculated differential price or other margins does not imply that there is no change to the calculated value which will adjust to the price band defined in regulation.

It is a sensitive component, in social terms, to generate fluctuations to the end consumer price of Special Gasoline and Special+ Gasoline. From the revision of Law 1098, it is evident that anhydrous ethanol is not an input that has the issuance of NOCREs (due to its objective of eliminating subsidies). Therefore, if economies of scale for this VBA are promoted, accompanied by a policy that increases final consumption (higher percentage of mixture), it would allow a reduction in production costs of this additive, and therefore, the domestic price could be aligned with a competitive price of export parity. This leads to a reduction of costs and subsidy to the gasoline, without the need to increase the price to end consumers.

4. Natural gas prices and incentives

4.1 Natural gas prices

After decades of negotiation, a comprehensive policy of natural gas sales by Bolivia to Brazil was consolidated, which, according to Medinaceli (2021) began in the seventies and culminated 20 years later with the signing of YPFB-PETROBRAS natural gas sales contract. On August 16, 1996, the contract that extended the aforementioned agreement was signed and the advance payment contract for the construction of a 3,100 km gas pipeline was signed. Once the works were completed, in 1999 the supply of natural gas to Brazil

began for a period of 20 years and an initial contractual volume of 30.08 MM CMD (cubic meters per day) was established, with export prices indexed to a basket of fuel oil and with a withdrawal and delivery mode of "Take or Pay" and "Deliver or Pay".

The signing of the Gas Supply Agreement opened the door to the country's energy development with natural gas as a fundamental pillar. Thus, on October 31, 1996, Supreme Decree 24399 approved the Gas Sales Regulation, which was subsequently amended by Decrees 25144 and 25473 of August 31, 1998, and July 30, 1999, respectively. The main content of this legislation is as follows:

a) The Aggregation Committee (formed by loader and representative producers) created to allocate volumes for natural gas export to foreign markets and their conditions.
b) Establishes the functions of SIRESE, such as determining volumes of natural gas to satisfy the domestic market and granting export permits.
c) Determination of proven reserves and non-contracted proven reserves, and their free disposal.
d) Categories of consumption in domestic market: own consumption, volume burned or vented, reinjection, process gas in plants and treatment, consumption in refineries and sales operations, fuel and losses in pipelines, electricity generation plants, natural gas by networks; consumption of industry, commerce, transport and petrochemicals, losses, and other adjustments.
e) Timeframes to determine volumes and deficits of reserves for the protection of domestic consumption.
f) Rights and obligations for the supply of natural gas to Brazil and Argentina.
g) Assignment procedure and "Back-to-Back" clauses.
h) Sales prices for the domestic market, which considered contractual arrangements in force at the time. If there are no contracts, the weighted sale price between Argentina and Brazil at the wellhead is considered, added to domestic market transport rate and a constant factor of 1.1494. The result is the selling price at delivery point for producers and shippers.

Subsequently, Supreme Decree 26037 of December 22, 2000, excludes thermoelectric generation from the methodology, arguing that the opportunity cost is higher and temporarily, until a specific methodology is approved, a maximum price of USD 1.30/MCF (thousand cubic feet) is applied. This standard was abolished by Supreme Decree 27354 on February 4, 2004; the latter established a calculation methodology for thermoelectric generation and distribution of natural gas by networks. However, its application remained in force, but in suspension, as established by Supreme Decree 27368 of February 17, 2004, given that a new Hydrocarbons Law draft was being dealt with.

Supreme Decree 27297 of December 20, 2003, approved the Vehicular Natural Gas (VNG) Conversion Regulation, determining the price chain for VNG. Afterwards, Supreme Decree 29629 of July 2, 2008, approved the methodology for the VNG price regime, modified by Supreme Decree 2782 of June 1, 2016, and the ANH, through Administrative Resolution

0274/2016, approved the price chain for VNG, both for Tarija and for the rest of nation's territory.

In this context, price regulation was necessary for distribution of natural gas by networks in the other categories. Thus, on January 7, 2005, through Supreme Decree 27967, the price at "city gate" was established, and it was not to exceed the weighted average of 3 months of the contracts in force in the domestic market. This rule was amended by Decree 28106 of April 29, 2005, which states that the determinant price methodology at "city gate" must not exceed 90% of the arithmetic average price of hydrocarbon shares prices[64] for the domestic market.

Afterwards, on May 17, 2005, Hydrocarbons Law 3058 was approved, and two days after its promulgation, the transitional regime for hydrocarbon activities in the country (Supreme Decree 28173) was approved. In this sense, the price regime in force so far (Supreme Decree 27354) was outside the provisions of the new transitional regime. Therefore, decree 28275 of August 8, 2005 abolished Decree 27354 on the methodology for calculating natural gas prices for thermoelectric generation and renewable energy generation.

After the approval of Supreme Decree 28701 ("Héroes del Chaco"),[65] it was necessary to establish guidelines for the determination of prices in the domestic market, and that YPFB apply them in its sales contracts. Therefore, Supreme Decree 29510 of April 9, 2008, laid down these guidelines for thermoelectric generation, natural gas distribution by renewable energy, electricity and VNG:[66]

a) Thermoelectric generation[67]: it is the maximum value of all prices declared by generating agents to the National Cargo Dispatch Committee (CNDC) for node costs fixation in the period November 2007 - April 2008.
b) Thermoelectric generation[68]: same conditions of contracts in force until that date.
c) Natural gas by networks: price not higher than that established in Administrative Resolution SSDH 0605/2005 equivalent to 0.98 USD/MCF.
d) Direct Consumers: no more than the contracts in force until that date.
e) VNG: no higher than contracts in force until that date; that is, it complies with provisions of Supreme Decree 27297.

In 2013, Supreme Decree 1719 established guidelines to determine the price of natural gas for Liquid Separation Plants (PSLs), and in this context Ministerial Resolution 255, of

[64] It is a category of production tax; for more details see Medinaceli (2007a).
[65] Also called "Nationalization of Hydrocarbons."
[66] Be it noted that the price of VNG is in accordance with Supreme Decree 2782 and Administrative Resolution 0274/2016 of the ANH.
[67] Of the National Interconnected System.
[68] Of isolated systems.

October 28, 2013, approved the methodology of natural gas prices for PSLs defined by the ANH. This, by Administrative Resolution, 0073/2020 and ratified by 0136/2021, determined the price of natural gas for PSLs at 1.31 USD/MCF. Then, Supreme Decree 1996 of May 15, 2014, approved the Regulation of Distribution of Natural Gas by Networks, and therefore the ANH approved the maximum prices for various categories: domestic, commercial, and industrial, for nation's territory and Tarija[69].

Through Administrative Resolutions RAR 0034/2005, RAR 0035/2005, RAR 0036/2005, RAR 0037/2005, RAR 0038/2005, RAR 0039/2005, RAR 0040/2005, RAR 0041/2005, the price of natural gas by networks for domestic and commercial categories was approved; and through RAR 0331/2017 for the industrial category throughout the nation's territory, except Tarija. For the specific case of EMTAGAS (Tarija's gas company for Bolivia), the domestic and industrial categories have gas prices approved by RAR 0122/2005 and the commercial category by SSDH 0598/2001.

Supreme Decree 2863 of August 3, 2016, modified Supreme Decree 29510, and incorporated the price of natural gas for reinjection (extraction of liquids), also known as gas lift, with a value of 0.97 USD/MCF[70]. This Supreme Decree also established the methodology for the price of natural gas used in liquefied extraction plants[71] and the ANH determined it at 1.33 USD/MCF.

Ministerial Resolution 147-17 approved the methodology for calculating the price of natural gas as fuel and as raw material for the Ammonia and Urea Plant (PAU). Then, the ANH, through Administrative Resolution RAR 0173/2018 of January 20, 2018, approved a price of 0.90 USD/MCF for both.

As a result of the above-mentioned regulatory set, Table 10 shows end consumer prices of different consumption categories and Table 11 shows the price structure in distribution networks. These values correspond to 1) criteria for optimizing investments made in liquid separation plants; 2) extracting more fluids; 3) generating competitiveness in urea export markets; 4) incentivizing VNG coverage expansion; and 5) achieving low electricity rates that benefit Bolivian consumers.

[69] Current operation of the Tarija gas company – EMTAGAS.
[70] Approved by Administrative Resolution RAR 0391-2016 of the ANH.
[71] Located within the areas of exploration and exploitation contracts.

Table 10: End consumer prices of natural gas

Concept	Unit	End Consumer Price
PSLs	USD/MCF	1.31
Gas Lift	USD/MCF	0.97
Liquefiable Extraction	USD/MCF	1.33
PAU	USD/MCF	0.90
VNG	Bs/CM	1.66
Thermoelectric Generation	USD/MCF	1.30

Source: ANH
Compiled by: Authors

Table 11: Natural gas prices by network

Category	Unit	YPFB	EMTAGAS
Domestic	USD/MCF	5.17 - 6.13	2.45 - 3.19
Commercial	USD/MCF	4.32 - 6.13	1.50 - 1.70
Industrial	USD/MCF	1.87 - 2.52	0.9

Note: Values vary by Department, and these are detemined by ANH
Source: ANH
Compiled by: Authors

Detailed below is the price structure of VNG for the areas supplied by YPFB (Table 12) and EMTAGAS in Tarija (Table 13). The main difference between the two is the resources allocated to the Vehicle Conversion Fund (FCV), and the Cylinder Requalification and Replacement Fund (FRC), which must depend on the quality inspection of the cylinders with respect to the number of conversions. Since conversion program approval in 2016, more than five years have passed during which converted vehicles require inspections in terms of cylinder capacity and quality to continue operating in optimal conditions.

In Tarija, the investment program approved by Law 3802 of December 24, 2007, allows the use of this fund with own resources through a Revolving Fund, however, contributions to the Conversion Fund (TFA) are mandatory amounts throughout the nation's territory in order to generate resources for conversion purposes, where gas stations act as retention agents.

Table 12: VNG Price Chain - YPFB Area [USD/MCF]

Concept	Price
Price of gas at wellhead	**0.57**
Transport Tariff	0.41
City Gate Price	**0.98**
Retail Tariff	0.24
Operations Fund	0.16
Discount at City Gate	0.32
Distribution Price	**1.70**
FRC	0.20
FCV	0.61
IEHD	-
Natural Gas - Retail Price	**2.52**
Retail Margin	4.20
AFC	0.08
VNG End Consumer Price	**6.80**

Source: RAR-ANH-ULGR-0274-2016, Administrative Resolution by ANH

Table 13: VNG Price Chain - EMTAGAS Area [USD/MCF]

Concept	Price
Price of gas at wellhead	**0.57**
Transport Tariff	0.41
City Gate Price	**0.98**
Retail Tariff	0.24
Operations Fund	0.16
Discount at City Gate	0.32
Distribution Price	**1.70**
FRC	0.08
FCV	0.74
IEHD	-
Natural Gas - Retail Price	**2.52**
Retail Margin	4.20
AFC	0.08
VNG End Consumer Price	**6.80**

Source: RAR-ANH-ULGR-0274-2016, Administrative Resolution by ANH

A method to evaluate prices received by natural gas producers is to apply the information in Medinaceli (2021) and evaluate the "netback" of sales prices with respect to operating expenses, capital, as well as pipeline transport, amortizations, and State shares. The information in Table 14 shows that, with regulatory measures regarding sales price, it is possible to encourage an accelerated consumption of natural gas in different categories of consumption; however, sustainability, discriminating only price, shows that by MCF of

sale a negative flow is generated in the exploration and exploitation activity.

Table 14: Natural gas and oil prices (May 2022)

Concept	Natural Gas Price (USD/MCF)							Petroleum Internal Market (USD/Barrel)
	PSLs	Gas Lift	Liquafiable Extraction	PAU	VNG	Thermoelectric Generation	Gas Network	
Selling Price (*)	**1.31**	**0.97**	**1.33**	**0.90**	**0.98**	**1.30**	**2.56**	**27.11**
Transport Tariff	-0.41	-0.41	-0.41	-0.41	-0.41	-0.41	-0.41	-2.48
Price at wellhead	**0.90**	**0.56**	**0.92**	**0.49**	**0.57**	**0.89**	**2.15**	**24.63**
Royalties and participation (18%)	-0.16	-0.10	-0.17	-0.09	-0.10	-0.16	-0.39	-4.43
IDH (32%)	-0.29	-0.18	-0.29	-0.16	-0.18	-0.28	-0.69	-7.88
Gross Margin	**0.45**	**0.28**	**0.46**	**0.25**	**0.29**	**0.45**	**1.07**	**12.32**
OPEX	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	-0.66	n.a.
Investment Depreciation	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	-1.10	n.a.
Available Margin	-1.31	-1.48	-1.30	-1.52	-1.48	-1.32	-0.69	n.a.

(*) VNG selling price at City Gate

Source: Compiled using information from Medinaceli (2021)

4.2 Incentives

The use expansion of natural gas in the domestic market and potential export markets required the promotion of upstream activities. The consequent effect from subsidies on disincentive of investment in productive activities (El-Katiri & Fattouh, 2015), led to the need for the State to seek an incentive mechanism (which resulted in a new subsidy) to promote new investments for the production of crude oil, condensate and natural gas, as shown in Table 15:

Table 15: Investments in E&E [Millions of USD]

Year	Exploration	Exploitation	Sum Total
2010	109.4	433.5	542.8
2011	204.0	652.9	856.9
2012	108.6	791.8	900.5
2013	190.2	756.2	946.4
2014	208.5	1,020.9	1,229.4
2015	297.8	840.2	1,138.0
2016	327.4	518.7	846.1
2017	305.7	276.1	581.8
2018	275.7	241.5	517.2
2019	312.1	299.6	611.7

Source: MHE/YPFB

Compiled by: Authors

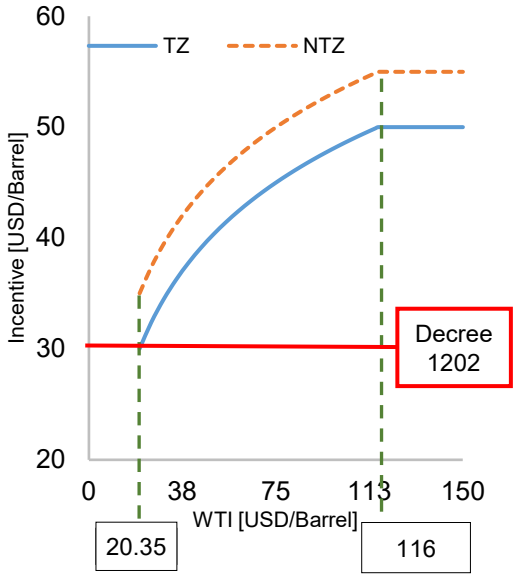
In 2006, the first regulation of the Incentive Regime was established, to produce oil and natural gas in marginal and small fields. At that time, a 13 USD/barrel value in oil production was determined, and priority allocation in export markets in the case of natural gas production, in accordance with regulations which were not conducted. Subsequently, in 2012, through Supreme Decree 1202, of April 18, the incentive value was

increased to 30 USD/barrel on oil production, the incentive orientation in natural gas was maintained, and the above-mentioned Supreme Decree was regulated by Ministerial Resolutions 103 and 128, of years 2014 and 2016, respectively.

The expansion and detailed mechanisms for subsidies to producers (incentives) both on the Service Contracts already signed between YPFB and the companies, as well as new investments for the indicated products, required a legal instrument of greater hierarchy; that is, a Law. Therefore, on December 11, 2015, the Bolivian State promulgated Law 767 on the Promotion of Investment in Hydrocarbon Exploration and Exploitation, modified by Law 840, the regulations of which were approved by Supreme Decree 2830, of July 6, 2016, establishing the mechanisms for applying incentives to crude oil production, condensate associated with natural gas production, additional condensate associated with natural gas production, and incentive to gas fields with dry gas reservoirs, and marginal and/or small fields.[72] This rule was modified and complemented by Supreme Decree 4616, of November 10, 2021, in order to establish conditions for the application of incentives to investments in hydrocarbon exploration and exploitation when YPFB is an operator, prioritizing areas with oil potential. The incentives indicated in the legislation are the following:

a) Oil production – Figure 2 shows the incentive value growth in logarithmic function with respect to WTI:

Figure 2: Oil production incentive



Source: Own preparation based on regulations

As shown in Figure 2, there is a positive logarithmic relationship between the value of

[72] Ministerial Resolution 289-16, of December 16, 2016, determines deadlines, mechanisms, and procedures for the application of incentives.

the incentive and WTI up to 116 USD/barrel for the total production in a given period, and greater than the constant established in Supreme Decree 1202 with respect to WTI. The calculation of the incentive is determined for Traditional Zones and Non-traditional Zones according to the following equations presented in Supreme Decree 2830 and its amendments:

$$I_{TZ,t} = [-4.623 + 11.491 \times ln(WTI_t)] \times Q_t$$

$$I_{NTZ,t} = [0.377 + 11.491 \times ln(WTI_t)] \times Q_t$$

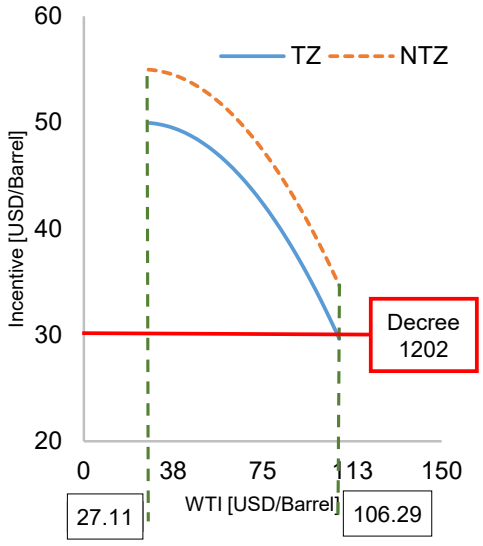
Subject to the following range: $20.35 < WTI < 116$

Where:
$I_{TZ,t}$ = monthly incentive for Traditional Zones in period t, expressed in US dollars.
$I_{NTZ,t}$ = monthly incentive for Non-traditional Zones in period t, expressed in US dollars.
Q_t = volume of crude oil production measured at the control point, expressed in barrels.

For values above 116 USD/barrel, WTI is considered the determined value of the incentive at the upper limit. Therefore, in Traditional Zones the incentive goes from 30 to 50 USD/barrel, and in Non-traditional Zones from 35 to 55 USD/barrel.

b) Production of condensate from Natural Gas – The legislation authorizes two types of incentive, one that directly increases the value of this according to the WTI and another with respect to the duration of the incentive depending on the prospective resources. The first is shown in Figure 3 and deadlines in Table 16:

Figure 3: Incentive to condensate production



Source: Own preparation based on regulations

Table 16: Deadline for condensed production incentive

Prospective Resources [TCF]	Deadline [years]	
	Traditional Zone	Non-Traditional Zone
<1	20	25
From 1 to 2	13	18
>2	7	12

Source: Compiled by authors based on legislation

For this incentive, an inverse linear quadratic relationship is observed between the value of the incentive and WTI up to 106.29 USD/barrel for total production in each period. The calculation of the incentive, in terms of value, is differentiated for Traditional Zones and Non-traditional Zones according to the following equations:

$$I_{TZ,t} = [-0.003 \times WTI_t^2 + 0.1479 \times WTI + 48.173] \times Q_t$$

$$I_{NTZ,t} = [-0.003 \times WTI_t^2 + 0.1479 \times WTI + 53.173] \times Q_t$$

Where:

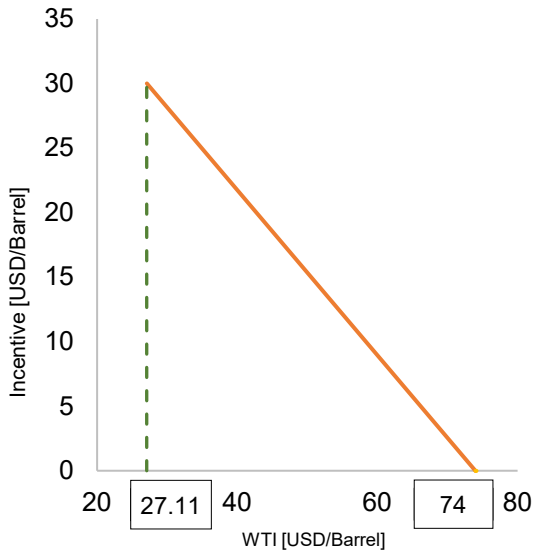
Q_t= volume of condensate production measured at the control point, expressed in barrels.

Both zones with a range of WTI between 27.11 and 106.29 USD/barrel. For values below or above the minimum or maximum value, respectively, the payment of incentives does not apply.

It is worth noting that the values established in Table 16 are subject to review and adjustment by YPFB, considering the net economic/commercial present value of the contract holder, in order to adjust the determined deadlines if necessary.

c) Additional production of condensate from natural gas. It applies to fields in exploitation period of producing reservoirs, with an inverse and linear behavior with respect to WTI, as shown in Figure 4.

Figure 4: Incentive for additional condensate production



Source: Own preparation based on regulations

The total calculation of the incentive follows the function of the following equation:

$$I_t = [-0.6398 \times WTI + 47.345] \times Q_t$$

The calculated value is subject to a WTI range of 27.11 and 74 USD/barrel, where there is no incentive payment for values below the limit of 27.11 and above 74 USD/barrel. Volume Q_t is the production of condensate associated with natural gas above a baseline. The term of the incentive is ten years.

d) Natural gas production

Legislation indicates that a prioritization of markets will be conducted in accordance with regulations as part of the incentive, with an allocation of gas sales up to 99.5% to the foreign market, for small and/or marginal fields and dry gas reservoirs. The following equation shows the allocation criteria:

$$IM_t = IM_{t-1} - \left[\frac{0.002 \times I_c \times (Y_{max} - Y_{res})}{PEM_{t-1} - PIM_{t-1}}\right] \times 100$$

Where:

IM_t= percentage of allocation to the internal market in annual period t.
IM_{t-1} = percentage of allocation to the internal market in annual period t-1.
I_c = annual average incentive determined for condensate production in Traditional or Non-Traditional Zones, as appropriate, subject to the conditions provided in legislation.
Y_{max} = ratio of natural gas condensate expressed in 10 barrels/MMCF.

Y_{res} = ratio of natural gas condensate from Dry Gas Reservoir expressed in barrels/MMCF.
PEM_{t-1} = weighted average selling price of natural gas to external market at control point, in period t-1, expressed in USD/MCF.
PIM_{t-1} = weighted average selling price of natural gas to internal market at control point, in period t-1, expressed in USD/MCF.

Subject to a minimum percentage of internal market share of 0.5%; that is, the incentive is up to a share of 99.5% of production for the external market.

The financing of this incentive is through the Fund for the Promotion of Investment in Exploration and Exploitation of Hydrocarbons (FPIEEH), the resources of which come from 12% of IDH before distribution to autonomous territorial entities, public universities and all beneficiaries provided for in current legislation.

5. Prices for vegetable-based additives

In previous sections, policy and regulations corresponding to pricing of hydrocarbons and their derivatives, as well as natural gas, were analyzed. An alternative that seeks to respond to the challenges of changing the energy matrix and gradually reducing subsidies by the State is the policy adopted by the Bolivian government regarding VBA. Given this, Law 1098 of September 15, 2018, approved the production and sale of VBA, to eliminate in the midterm, subsidies to liquid fuels, both gasoline and diesel oil.

This law typifies two types of VBA, anhydrous ethanol, and biodiesel. Anhydrous ethanol is identified as an ethyl alcohol with a minimum degree of dehydration of 99.5% through processes that do not generate chemical residues, to avoid corrosion in vehicles.

The methodology for price fixation of anhydrous ethanol was approved by MR (Ministerial Resolution) 127 of October 18, 2018, which determines a fixed price duration period of five years, establishing the following:

a) Price of indifference or equilibrium between producing a main product (in the case of cane is sugar) and anhydrous ethanol, to avoid distortions in production between both goods, and,

b) Unit price that allows the recovery of investments in dehydration plants and treatment of vinasse by the agro-industrial sector.

This price is in force for five years and is expected to subsequently depend only on the price of indifference between producing sugar and anhydrous ethanol. Administrative Resolution of the ANH 002/2019 approved the price – for total annual withdrawal

volumes exceeding 30 million liters – at 4.80 Bs/liter and 4.94 Bs/liter for lower volumes, to encourage the withdrawal and production of higher levels of anhydrous ethanol.

The proportion of anhydrous ethanol blend established in the regulation began with the launching of the product called Super Ethanol 92, with a volumetric mixture of 12% (e12), and with octane RON 92, with an end consumer price of 4.50 Bs./liter. On January 28, 2019, MR 15-2019 was approved, to establish a calculation methodology for end consumer prices of liquid fuels containing anhydrous ethanol. The purpose of this measure was to reduce the subsidy in two ways:

1) Moving volumes, depending on the ratio of mixture, the anhydrous ethanol replaces the demand for gasoline and Inputs and Additives (I&A). That is, per additional liter consumed of anhydrous ethanol, a reduction in the need for fuel imports is expected in the same proportion.

2) Reducing the price of gasoline produced and imported, the anhydrous ethanol, due to its high-octane level RON (approximately 113), requires for the final mixture, low-octane fossil fuel,[73] that is, an I&A of lower price.

In this context, by MR 42-2019 of April 1, 2019, the quality of low-octane fossil fuel (produced or imported) (base gasoline) is approved to be mixed with anhydrous ethanol (e8) and replaces Special Gasoline under a new name: Special+ Gasoline. Through MR 45-2019, of April 1, 2019, the methodology to determine new values of the PPT and Ex-Refinery Price for Special+ Gasoline price chain formation was approved.

To displace a greater proportion of I&A, Supreme Decree 3992 recognizes the same tax treatment and recognition of NOCREs for imported fossil fuel volumes to be blended with anhydrous ethanol. Therefore, anhydrous ethanol would not only be blended with domestic production, but also with I&A. Hence, the quality standard leads to a lower quality need of I&A as base gasoline, and therefore, to a lower price. This procedure is regulated through Bi-Ministerial Resolution No. 1-2019.

The VBA policy determines that production of raw material for anhydrous ethanol production must be gradually guaranteed; therefore, YPFB withdrawals must be increased annually to respond to this mandate. On August 18, 2020, MR 060-2020 was approved, which determined a generic “base gasoline A” that fits the quality needs that accompany a gradual growth of anhydrous ethanol blending with gasoline, within the framework of Law 1098. In this resolution, it was established that the percentage of

[73] Pricing of gasolines is determined by their octane number (RON).

mixture is the maximum defined by Supreme Decree 3672 of September 25, 2018[74]. Therefore, the proportion that Special+ Gasoline must contain is 12%.[75]

Biomass will be analyzed for transformation and use as an additive to liquid fuel for cycle-otto vehicles. Law 1098 of September 15, 2018, established the framework for the production, storage, transport, sales, and mixing of VBA.[76]

With respect to prices, a specific chapter determines that a) for a first period, the price calculation of anhydrous ethanol must take into account (among relevant factors) the indifference price of processing sugarcane (or raw material) into sugar (or another main product) and the investments made for the dehydration of ethanol; b) after this first period, a new price shall be established covering only the price of indifference, with a new updated price.

As mentioned above, 2019 regulations contemplate two prices approved by the ANH, for sales volumes of anhydrous ethanol greater than 30 million liters and others for smaller quantities, equal to 4.80 Bs./liter and 4.94 Bs./liter (excluding VAT), respectively. Hence, price reduction of VBA comes through encouraging production at scale by means of an increase of the blend percentage. In this sense, the ANH regulation determined the quality specifications of gasoline blended with VBA according to guidelines, within the limit established in Supreme Decree 3672. That is how in Bolivia the progressive implementation of anhydrous ethanol began, with Tarija, Santa Cruz, Cochabamba, and La Paz being the first regions to incorporate VBA through Super Ethanol 92 and Special+ Gasoline.

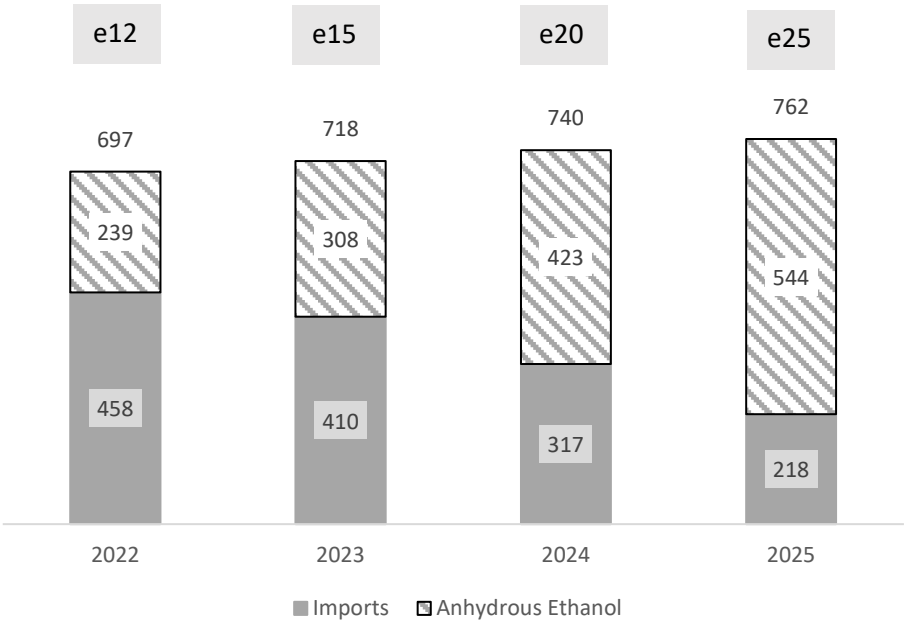
In 2020, to meet the green fuels policy objective, and gradually reduce the subsidy, it was observed that regulation establish that the productive sector must guarantee the necessary volumes to reduce subsidies. In this sense, regulations established a fixed percentage of anhydrous ethanol blending for Special+ Gasoline, which corresponds to the upper limit of Supreme Decree 3672, equivalent to 12%, to displace greater volumes of I&A and comply with the objective of reducing the subsidy. Figure 5 shows an exponential shift in the I&A requirement as the percentage of anhydrous ethanol blending increases.

[74] Which determines that the mixture will be up to 12% VBA.

[75] In forced in Administrative Resolution of ANH RAR 240-2020, of September 7, 2019, which instructs YPFB to blend 12% of anhydrous ethanol in the composition of Special+ Gasoline.

[76] The standard indicates that they are intermediate products extracted or derived from products, by-products, residues, and vegetable wastes that are used to be mixed with gasolines, diesel or other fuels of fossil origin. The Law only defines two: anhydrous ethanol and biodiesel.

Figure 5: Displacement of I&A by Anhydrous Ethanol



Price chains of Special+ Gasoline and Super Ethanol 92 with a blend of 12% in force are shown below in the Tables that follow. Depending on the blending percentage, different prices of anhydrous ethanol apply for a specific demand profile. It should be noted that the State has been applying the mixture of anhydrous ethanol less than 12% in the Special+ Gasoline.

Table 17: Special+ Gasoline Price Chain (Bs/liter)

Concept	Base Gasoline	Anhydrous Ethanol	Special+ Gasoline
Anhydrous Ethanol		**4.80**	**0.38**
VAT Anhydrous Ethanol		0.72	0.06
Transport VBA		0.45	0.04
VAT Transport VBA		0.07	0.01
Reference Price	**1.37**		**1.26**
VAT Reference	0.21		0.19
Refinery margin	0.28		0.26
VAT Refinery margin	0.04		0.04
Compensation margin	0.08		0.07
VAT Comp. margin	0.01		0.01
Multiproduct pipeline	0.04		0.04
VAT Multiproduct pipeline	0.01		0.01
Different Transportation	0.07		0.07
VAT Different Transportation	0.01		0.01
IEHD	0.97		0.89
Storage margin			0.04
VAT Storage			0.01
Wholesaler margin			0.10
VAT Wholesaler			0.02
Retail margin			0.22
VAT Retail			0.03
End consumer price			**3.74**

Source: Compiled by authors based on final prices and legislation.

Table 18: Price Chain Super Ethanol 92 (Bs/liter)

Concept	Base Gasoline	Anhydrous Ethanol	SE92
Anhydrous Ethanol		4.80	0.58
VAT Anhydrous Ethanol		0.72	0.09
Transport VBA		0.45	0.05
VAT Transport VBA		0.07	0.01
Reference Price	**1.37**		**1.21**
VAT Reference	0.21		0.18
Refinery margin	0.28		0.25
VAT Refinery margin	0.04		0.04
Compensation margin	0.08		0.07
VAT Comp. margin	0.01		0.01
Multiproduct pipeline	0.04		0.04
VAT Multiproduct pipeline	0.01		0.01
Different Transportation	0.07		0.06
VAT Different Transportation	0.01		0.01
IEHD	0.97		0.86
Storage margin			0.04
VAT Storage			0.01
Wholesaler margin			0.64
VAT Wholesaler			0.10
Retail margin			0.24
VAT Retail			0.04
End consumer price			**4.50**

Source: Compiled by authors based on final prices and legislation.

Finally, a straightforward implementation of VBA policy, considering prices of regulatory mandates, could generate economies of scale and external price parity for anhydrous ethanol. Producing larger quantities of anhydrous ethanol could allow the industry to generate returns from higher sales volumes with a competitive price, from the fifth year (2023) after the fixed pricing period.

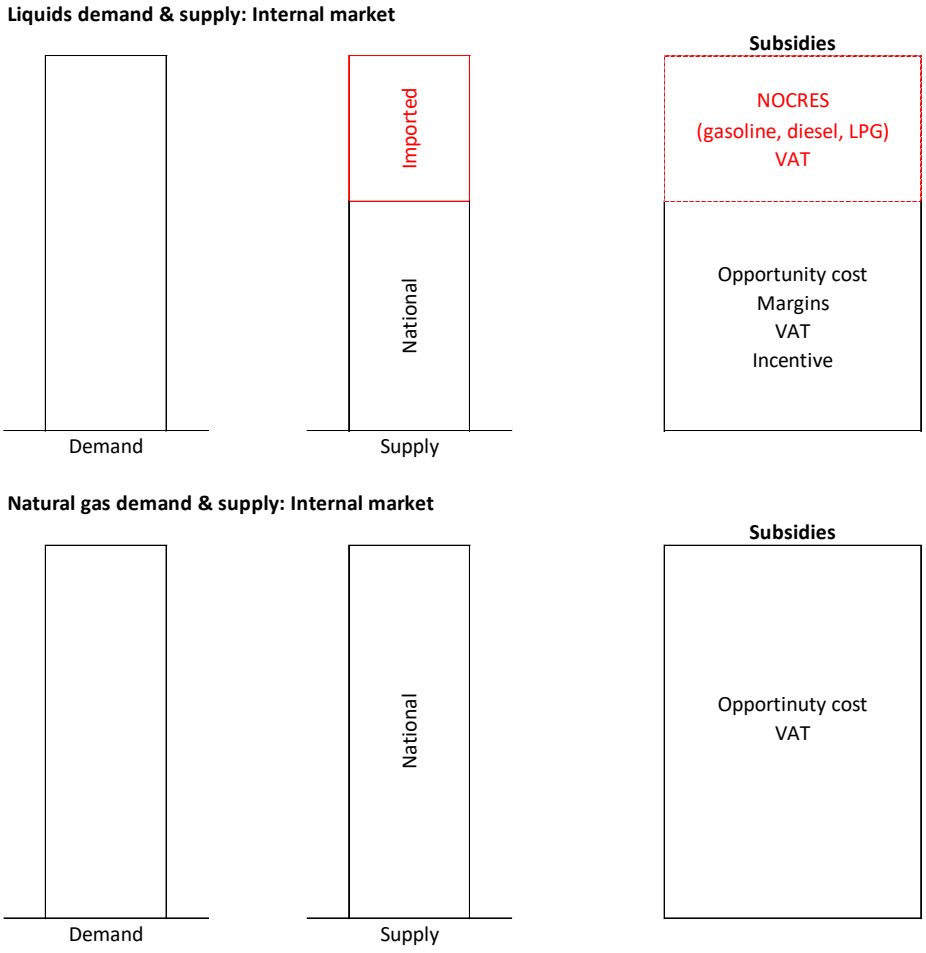
6. Subsidies in Bolivia

Figure 6 presents the proposed analytical structure to understand the allocation of energy price subsidies in Bolivia. It is observed that in the oil and derivatives market, when the supply is domestic, there are opportunity cost subsidies, from non-updating of margins, losses in non-collected VAT and a direct one (called incentive) to operators of liquid and gas fields[77]. On the other hand, when supply of liquids is imported, then a direct subsidy is presented from imported value and non-collected VAT. In relation to natural gas, all supply is domestic, so in this section only the opportunity cost subsidy and non-collected

[77] Crude, condensate, and natural gas market share.

VAT will be analyzed. It is important to note that the incentive provided by the Bolivian State also applies to natural gas fields; however, there is no discriminated information (by type of product) on this concept. For this reason, the entire incentive will be analyzed in the section on supply and demand of liquids.

Figure 6: Analytical framework for subsidies study in Bolivia



Source: Compiled by authors

6.1 Methodology applied to petroleum and derivatives

This section presents the methodology for estimating existing subsidies in production and consumption of oil and its derivatives, whether they are produced domestically or imported. When the origin of these products is domestic then there are at least four types of subsidies:

1. Opportunity cost, as already analyzed, the sale price of oil[78] in Bolivia has a cap of

[78] From producers' point of view.

27.11 USD/barrel. For this reason, when the export parity price is above this cap, an opportunity cost subsidy arises, since producers could export the production and receive a higher price than that of the domestic market[79]. The following equation shows how this subsidy is estimated:

$$S_t^{co,l} = \left(pl_{int} - xl_t - \overline{pl_0}\right) \cdot Vl_t$$

Where:

$S_t^{co,l}$ = the opportunity cost subsidy of liquid production
$pl_{int,t}$ = the international price of oil
xl_t = an adjustment factor to find the export parity price[80]
$\overline{pl_0}$ = the maximum price for the sale of liquids in Bolivia
Vl_t = the volume of liquid production in Bolivia

2. Margins – Bolivia's regulated pricing methodology for petroleum products incorporates refining, sales, and transportation margins. These margins have not been adjusted since their creation; therefore presently they do not reflect the current costs of providing the service. The approximation of this subsidy is conducted as follows:

$$S_t^{m,d} = \left(rm_t^d + tm_t^d + cm_t^d - rm_0^d - tm_0^d - cm_0^d\right) \cdot V_t^d$$

Where:

$S_t^{m,d}$ = the subsidy for non-adjustment of margins in the price chain of derivative "d"
mr_t^d = the refining margin adjusted to period "t" of derivative "d"
mt_t^d = the transport margin adjusted to period "t" of derivative "d"
mc_t^d = the trading margin adjusted to period "t" of derivative "d"
mr_0^d = the current refining margin of derivative "d"
mt_0^d = the current transport margin of derivative "d"
mc_0^d = the current trading margin of derivative "d"
V_t^d = the traded volume of derivative "d"

3. VAT is the value-added tax that results from applying the tax rate to the regulated prices, setting to the reference price of oil measured at export parity and to the adjusted margins (refining, transport and sale); that is:

[79] The entities that receive royalties and IDH on this price would also benefit, since sale prices at the wellhead would be higher.
[80] It usually incorporates the cost of transportation and sales.

$$S_t^{iva,d} = S_t^{co,l} \cdot \left(\frac{13}{87}\right) + \sum_{d=1}^{n} S_t^{m,d} \cdot \left(\frac{13}{87}\right)$$

4. NOCREs, since demand for derivatives was not fully supplied by domestic production, it was necessary to import volumes of diesel oil, gasoline (in the form of additives) and LPG. In this case the subsidy is of the traditional type; that is, the State covers the difference between value of imports and selling price in the domestic market.[81] The mechanism for calculating the delivery of NOCREs for the import of diesel oil and gasoline will be explained below.

   On December 22, 1994, Law 1606 was promulgated, creating the IEHD, with the purpose of taxing and generating greater tax collection on the commercialization of hydrocarbons or derivatives, whether produced internally or imported. As already discussed, in 1997, the Regulation on Price Regime for Petroleum Products introduced IEHD rate as a price chain component on regulated products. During the 1997-2002 period, the change in IEHD rates responded to sterilization policies to balance the increase in international reference prices.

   Supreme Decree 26783 of September 7, 2002 established a new rate for IEHD for imported diesel oil and instructed the ministry responsible for hydrocarbon policy to conduct a methodology for updating and calculating the IEHD rate for the above-mentioned product. On January 14, 2003, by Supreme Decree 26917, the mechanism for determining the IEHD to be calculated by the former Superintendence of Hydrocarbons was approved. During the 2004 to 2014 period, the mechanism was modified by Supreme Decrees 27440, 27696, 27715, 28046, 28416, and 1905. In these standards, the reference for the average imported diesel oil[82] of Oil 2 Waterborne Gas was updated. The adjustment formula is described in the following equation:[83]

$$IEHD_1 = IEHD_0 + \frac{PP_0 - PP_1}{158.98} \times TC + (PDO_1 - PDO_0)$$

   Where:

   $IEHD_1$ = the new IEHD rate of imported diesel, in Bs./liter.
   $IEHD_0$ = the IEHD rate calculated by ANH for period $t-1$, in Bs./liter, with the initial value being -3.10 Bs./liter.
   PP_1 = the average price of Gas Oil 2 Waterborne of the last five data published by Platts prior to the date of calculation made by ANH, in USD/barrel.
   PP_0 = the effective price corresponding to the day of the last variation

[81] Procedurally, the Bolivian State delivers credit notes to the state-owned oil company YPFB.
[82] Gas Oil 2 Waterborne average value.
[83] The formula is updated only when a variation of Platts product is observed and when it is of a magnitude greater than or less than 7%.

of +/-4%, in USD/barrel, the initial value being 97.99 USD/barrel.

TC = the Bs./USD exchange rate of the day before an observed variation.

158.98 = the constant conversion factor from barrels to liters.

PDO_1 = the new current price of diesel oil calculated by the ANH, in Bs./liter. The initial value is 3.72 Bs./liter.

PDO_0 = the current price of diesel oil calculated by the ANH, in Bs./liter. The initial value is 3.72 Bs./l.

Through this mechanism, the IEHD rate becomes the mechanism for calculating subsidies for diesel oil. For this reason, on February 28, 2003, Supreme Decree 26946 established the subsidy mechanism in favor of companies importing this product through negotiable fiscal credit notes (NOCREs[84]). The issuance of such NOCREs is a function of the negative value of the IEHD rate and the total imported volume. The calculation of the diesel oil subsidy is:[85]

$$NOCRES = IEHD_1 \times Vol$$

Where:

$NOCRES$ = the value of negotiable tax credit notes, in Bs.

$IEHD_1$ = the negative value calculated by the ANH.

Vol = the total volume of imported diesel oil.

Supreme Decree 29868 of 20 December, 2008 (annulled and subsequently replaced by Supreme Decree 286 of 9 September, 2009) marked the beginning of responsibility transfer for the actual cost of importing gasoline (legally referred to as I&A). The variations of the real international price with respect to the cost of producing liquid fuels internally, instead of reflecting this variation (increase or reduction) in the end consumer price of fuels, legislation establishes that this differential is assumed by the State through a subsidy; that is, by the issuance of NOCREs. The recognized structure for the subsidy of I&A is reflected in detail in Ministerial Resolution 48 of April 19, 2017, of the current Ministry of Hydrocarbons and Energies.

According to Supreme Decree 286, the subsidy per liter of I&A in favor of YPFB is equal to the sum of the cost of importing I&A, the price of white gasoline and the IEHD, minus the PPT value (net of VAT) of Special Gasoline published by ANH. In this sense, the issuance of Fiscal Credit Notes (NOCRES) follows the form of the

[84] A fiscal credit note is a document issued by the central government that allows its holder to pay taxes for the value equivalent to the note's value. If this note is negotiable, then its holder can trade it on the secondary market and the buyer can use it to pay taxes that correspond to him.

[85] Mechanism modified by Supreme Decrees 26972 of 25 March 2003 and 27440 of April 7, 2004.

following equation:

$$Subv = \begin{cases} Vol \times (TC_{YPFB} - PPT) & if\ YPFB\ imports \\ Vol \times (TC_{ref} - PexRef) & if\ YPFB\ Refinación\ S.A.\ imports \end{cases}$$

Where:

$Subv$ = total subsidy value in Bs.

Vol= total volume of Special Gasoline obtained from the mixture with I&A, in liters.

TC_{YPFB}= sum of unit costs incurred by Corporate YPFB, which is the sum of proportional cost of I&A plus proportional cost of white gasoline for Special Gasoline production, in Bs/liter.

TC_{ref} = sum of unit costs incurred by YPFB Refinación S.A., which is the sum of proportional cost of I&A plus proportional cost of white gasoline for Special Gasoline production, in Bs./liter.

PPT= Pre-terminal Price, which considers the costs up to the entrance to a storage terminal, excluding VAT, in Bs./liter.

$PexRef$ = Ex-refinery Price, which considers costs up to exit from a refinery, in Bs./liter.

Additionally, Supreme Decree 2358, of May 13, 2015, sets the multi-product pipeline transport margin for regulated petroleum products at 0.80 USD/barrel and Supreme Decree 2717 of April 6, 2016, establishes a methodology for the calculation of different transports.

On January 20, 2022, Supreme Decree 4661 was approved, which established a mechanism for import and recognition of NOCREs for import of crude oil. It established the subsidy as the sum of the costs for import of crude oil placed at the refinery, excluding VAT, discounting administrative costs, minus the reference price of national crude oil excluding VAT at the official exchange rate.

In the case of LPG, Supreme Decree 29166 of June 13, 2007, modified by Supreme Decree 29721 of September 26, 2008, issued an authorization of debt by the Ministry of the Economy and Public Finance subject to regulation, which is still pending approval by a Bi-Ministerial Resolution of the Ministry of the Economy and Public Finance and the Ministry of Hydrocarbons and Energies since 2008. So far there is no clear definition, but there is an accumulated debt by the public sector that at some point must be made effective according to legislation. The accumulation of debt was halted due to the start of operations of PSLs in 2013, when Bolivia covered the domestic market and generated surpluses for export. On the other hand, and as mentioned before, there is a cross-subsidy for LPG bottling reflected in a margin of compensation within price chains of all liquid fuels.

5. Incentive – As previously noted, the Bolivian government grants an incentive to hydrocarbons production. This is based on international oil prices and production. Thus, the overall amount of the incentive is:

$$S_t^i = i_i(pl_{int,t}, V_t^c) \cdot V_t^c$$

Where:

S_t^i = the incentive given to oil producers
$i_i(pl_{int,t}, V_t^c)$ = the incentive (per unit produced) that depends on international prices and production of field "c".
V_t^c = the production of field "c".

The production incentives were implemented through legislation since the end of 2006, when a specific result was not obtained due to lack of regulations. Later, in 2012 the incentives or subsidies favoring producers were regulated. However, it is from the regulations of Law 767 that the Fund for Promotion of Investment in Exploration and Exploitation of Hydrocarbons (FPIEEH) contemplates a reallocation of resources from IDH (12%).

6.2 Applied methodology to natural gas

This section presents the methodology for estimating subsidies present in production and consumption of natural gas. According to the regulations analyzed, at least two types of subsidies are identified in the production, transport, and commercialization of domestically produced natural gas; they are:

1. Opportunity cost – The sale price of natural gas[86] in Bolivia does not adjust to variations observed in export parity prices[87],; for this reason, when the latter price is above domestic prices, an opportunity cost subsidy arises, since producers could export their production and receive a higher price than in domestic market[88]. The following equation shows how this subsidy is estimated:

$$S_t^{co,gn} = (epp_t - xgn_t - \overline{ngp_0}) \cdot Vgn_t$$

Where:

$S_t^{co,gn}$ = the opportunity cost subsidy of natural gas production
epp_t = the export parity price of natural gas

[86] From the producers' side to end consumers or placed at "city gate".
[87] To Brazil and/or Argentina.
[88] The entities receiving royalties and IDH on this price would also benefit, since the sale prices at the wellhead would be higher.

xgn_t = an adjustment factor by transport
$\overline{ngp_0}$ = the domestic price for sale of natural gas in Bolivia
Vgn_t = the volume of natural gas production in Bolivia

2. VAT, is the value added tax that results from applying the tax rate to the opportunity cost subsidy:

$$S_t^{iva,gn} = S_t^{co,gn} \cdot \left(\frac{13}{87}\right)$$

6.3 Subsidy estimation

6.3.1 Oil and derivatives

Table 19 presents an estimate of the opportunity cost subsidy for oil processed in Bolivian refineries, for the 2010-2025 period. Since 2015 there has been an increasing trend due to a decrease in domestic oil production and, for forecasted years, this is also influenced by higher international WTI prices. The last two columns present the sources of financing of this subsidy or, in other words, present the entities that would benefit if the sale price of oil were made at export parity. According to current regulations, 50% would be received by those entities that receive resources for departmental royalties and IDH; on the other hand, the other 50% would be part of the operators' gross margin. It is important to note that this margin covers YPFB's participation[89], operating costs, capital costs, statutory taxes, and the operators' net margin.

[89] Result of Supreme Decree "Héroes del Chaco".

Table 19: Opportunity Cost Subsidy – Oil Production[90]

Year	WTI (USD/Barrel)	Adjustment Factor (USD/Barrel)	Price DS 27691 (USD/Barrel)	Refinery output (MM Barrels)	Subsidy Petroleum Opportunity Cost (MM USD)	Subsidy Operators' Gross Margin (MM USD)	Subsidy Royalties 18% + IDH 32% (MM USD)
2010	79.48	6.29	27.11	10.05	463.28	231.64	231.64
2011	94.88	6.29	27.11	10.96	673.83	336.91	336.91
2012	94.05	6.29	27.11	11.61	704.04	352.02	352.02
2013	97.98	6.29	27.11	12.71	821.13	410.57	410.57
2014	93.17	6.29	27.11	13.74	821.35	410.67	410.67
2015	48.66	6.29	27.11	14.27	217.74	108.87	108.87
2016	43.29	6.29	27.11	14.98	148.11	74.05	74.05
2017	50.80	6.29	27.11	15.80	274.94	137.47	137.47
2018	65.23	6.29	27.11	16.47	524.09	262.05	262.05
2019	56.99	6.29	27.11	16.76	395.27	197.63	197.63
2020	39.16	6.29	27.11	12.91	74.38	37.19	37.19
2021	68.1	6.29	27.11	16.05	557.57	278.78	278.78
2022e	96.9	6.29	27.11	16.00	1,016.10	508.05	508.05
2023e	88.6	6.29	27.11	15.94	879.19	439.59	439.59
2024e	80.0	6.29	27.11	15.85	738.59	369.30	369.30
2025e	70.6	6.29	27.11	15.74	586.27	293.13	293.13

(1) The value of 6.29 is the discount factor taken from the estimated value in Supreme Decree 27691.

(2) Output from refineries is an estimate.

(e) Estimate.

Volumes: Demand growth rate = 3% inter-annual and decreasing domestic production

Price: Estimated by EIA

Source: Compiled by authors based on data from YPFB, EIA, and legislation.

A second component of liquid subsidies in Bolivia is the one that arises from non-updating margins of refining, transport, and commercialization of (regulated) petroleum products. According to regulations, this update should be conducted considering, above all, the costs associated with these activities. Table 20 presents the results for this subsidy for gasoline and domestic diesel oil, using as an update criterion the variation of the CPI in Bolivia. [91] The estimates are presented in detail in the annex to this document. The updated margins correspond to refineries, compensation for LPG bottling, transport (pipelines and tanker trucks), storage plants (logistics), wholesale and retail in gas stations. The decreasing behavior of recent years is because calculations were made for domestic production of both products and not for the total demand for them.

[90] Crude oil used in refineries.

[91] The base period is August 2004.

Table 20: Subsidy for updating margins – Gasoline and Domestic Diesel Oil

Year	CPI (August 2004=100)	Gasoline (MM USD)	National Diesel Oil (MM USD)	Sum Total (MM USD)
2010	150.7	150.7	106.3	257.0
2011	161.1	161.1	121.8	282.9
2012	168.5	184.5	137.3	321.8
2013	179.4	224.1	165.3	389.5
2014	188.7	239.8	189.2	429.0
2015	194.3	247.9	218.1	465.9
2016	202.0	330.4	208.8	539.2
2017	207.5	332.1	196.2	528.4
2018	210.7	324.3	193.5	517.9
2019	213.7	297.6	158.6	456.3
2020	215.2	318.6	170.2	488.7
2021	217.1	308.9	149.7	458.7
2022e	221.5	302.5	137.5	440.0
2023e	225.9	296.2	126.2	422.4
2024e	230.4	290.1	115.8	405.9
2025e	235.0	284.0	106.3	390.4

Source: INE, ANH

(e) Estimate

Compiled by: Authors

If domestic prices were adjusted for opportunity cost associated with oil production and for updating of regulated prices in value chain margins, then this would generate an additional VAT. In this sense, Table 20 presents the estimate for this concept. It is important to note that the VAT rate applied is 14.94%.[92]

[92] 14.94%=13/87

Table 21: VAT subsidy associated with opportunity cost and outdated margins

Year	Subsidy Petroleum Opportunity Cost (MM USD)	Subsidy Gasoline & Diesel Oil Updated Margins (MM USD)	Associated VAT (MM USD)
2010	463.3	257.0	107.6
2011	673.8	282.9	143.0
2012	704.0	321.8	153.3
2013	821.1	389.5	180.9
2014	821.3	429.0	186.8
2015	217.7	465.9	102.2
2016	148.1	539.2	102.7
2017	274.9	528.4	120.0
2018	524.1	517.9	155.7
2019	395.3	456.3	127.2
2020	74.4	488.7	84.1
2021	557.6	458.7	151.9
2022e	1,016.1	440.0	217.6
2023e	879.2	422.4	194.5
2024e	738.6	405.9	171.0
2025e	586.3	390.4	145.9

(e) Estimate

Compiled by: Authors

For more than 30 years there have been two categories of diesel: domestic and imported. Since a 100% supply of demand was not, nor is possible only with domestic production. For this reason, when the end consumer prices of this product stabilized, the diesel oil subsidy began to gain notoriety. As previously explained, the diesel subsidy formula contemplates the use of the negative rate of the IEHD[93] calculated by the ANH, which is adjusted to international reference prices such as Gas Oil 2 Waterborne. Table 22 shows the calculation of import subsidy for diesel oil using negative rates of the IEHD; the forecasted information is made according to the evolution of WTI due its correlation with the international reference.

[93] The IEHD rate is calculated according to the entry point of the product.

Table 22: Import subsidy for diesel oil

Year	Diesel Oil imported volume (MM liters)	Import costs (MM Bs)	Exchange rate (BS/USD)	Unit imports cost (USD/Barrel)	WTI*** (USD/Barrel)	Unit imports cost (Bs/liter)	IEHD rate (Bs/liter)	Imports Subsidy (MM Bs)	Imports Subsidy (MM USD)
	a	b	c	d	e	f	g	-g*a	g*a/c
2010	556.4	2,938.3	7.07	118.8	79.5	5.28	-2.94	1,636.1	231.5
2011	778.9	5,683.4	6.99	166.0	94.9	7.30	-4.32	3,364.4	481.5
2012	780.7	5,845.2	6.96	171.0	94.1	7.49	-4.48	3,498.4	502.6
2013	886.2	6,559.2	6.96	169.1	98.0	7.40	-4.53	4,010.8	576.3
2014	936.8	6,548.4	6.96	159.7	93.2	6.99	-3.71	3,478.9	499.8
2015	809.1	3,544.5	6.96	100.1	48.7	4.38	-1.32	1,071.3	153.9
2016	913.5	3,426.9	6.96	85.7	43.3	3.75	-1.24	1,134.5	163.0
2017	1,071.9	4,536.7	6.96	96.7	50.8	4.23	-1.75	1,880.6	270.2
2018	1,203.9	6,023.8	6.96	114.3	65.2	5.00	-2.63	3,162.1	454.3
2019	1,433.0	6,408.9	6.96	102.2	57.0	4.47	-2.35	3,364.5	483.4
2020	997.3	4,268.0	6.96	97.8	39.2	4.28	-1.14	1,139.5	163.7
2021	1,250.0	6,800.5	6.96	124.3	68.1	5.44	-2.41	3,016.7	433.4
2022e	1,287.5	8,625.7	6.96	153.0	96.9	6.70	-4.54	5,841.0	839.2
2023e	1,326.1	8,401.4	6.96	144.7	88.6	6.34	-4.15	5,499.5	790.2
2024e	1,365.9	8,140.9	6.96	136.1	80.0	5.96	-3.75	5,116.4	735.1
2025e	1,406.9	7,808.5	6.96	126.8	70.6	5.55	-3.31	4,653.2	668.6

(1) Info given by ANH (IEHD rate) until May 1st 2022, onwards values are estimates.

Source: INE, YPFB, EIA, and ANH

Compiled by: Authors

The next category of subsidies refers to I&A imports for the subsequent production of gasoline. Table 23 presents the estimation of this subsidy using the methodology established in legal regulations and linking the unit import costs with the WTI price. In this case, it is observed that the magnitude of the subsidy is increasing due to higher volumes and import prices, except for 2020, due to the COVID-19 pandemic. The estimate of imported volumes of I&A by 2025 considers a natural population growth rate and that production in refineries will stabilize with the application of the Supreme Decree authorizing the import of crude oil to increase the productivity of refineries.[94]

[94] Although the price of crude oil is lower than that of refined products, the demand for transport and storage is different and could therefore have a negative impact on the reduction of subsidies.

Table 23: Subsidy from I&A imports to obtain gasoline

Year	I&A imported volume* (MM liters) a	Import costs (MM Bs) b	Exchange rate (BS/USD) c	Unit imports cost (USD/Barrel) d	WTI*** (USD/Barrel) e	Unit imports cost (Bs/liter) f	Imports Subsidy** (Bs/liter) g= 3.12-f * 0.85	Imports Subsidy (MM Bs) g*a	Imports Subsidy (MM USD) g*a/c
2010	111.2	649.0	7.07	131.3	79.5	5.84	1.84	204.8	29.0
2011	192.5	1,477.5	6.99	174.6	94.9	7.67	3.40	655.2	93.8
2012	208.1	1,601.7	6.96	175.8	94.1	7.70	3.42	712.2	102.3
2013	200.9	1,513.4	6.96	172.1	98.0	7.53	3.28	659.7	94.8
2014	290.6	2,094.8	6.96	164.7	93.2	7.21	3.01	874.0	125.6
2015	367.3	1,903.2	6.96	118.3	48.7	5.18	1.28	471.6	67.8
2016	199.7	903.7	6.96	103.4	43.3	4.53	0.73	145.1	20.8
2017	322.7	1,656.9	6.96	117.3	50.8	5.13	1.24	401.4	57.7
2018	428.9	2,430.3	6.96	129.4	65.2	5.67	1.70	727.7	104.6
2019	648.7	3,413.4	6.96	120.2	57.0	5.26	1.35	877.3	126.1
2020	174.0	788.2	6.96	103.5	39.2	4.53	0.73	127.2	18.3
2021	677.1	3,926.5	6.96	132.5	68.1	5.80	1.81	1,225.0	176.0
2022e	697.4	4,922.3	6.96	161.2	96.9	7.06	2.88	2,008.1	288.5
2023e	718.3	4,808.4	6.96	152.9	88.6	6.69	2.57	1,846.0	265.2
2024e	739.9	4,675.0	6.96	144.3	80.0	6.32	2.25	1,665.4	239.3
2025e	762.1	4,502.9	6.96	135.0	70.6	5.91	1.90	1,449.9	208.3

(*) Estimated based on information from YPFB (35% of 1,934 million liters of estimated demand)

(**) Subsidy coefficient, taking into account a PPT of 3.10 Bs/l without VAT and mixed with white gasoline between 7%-12%

(***) Estimates based on EIA information

Source: Compiled by authors based on YPFB; EIA, and BCB data

As of 2013, Bolivia has energy security in terms of LPG. As indicated in a previous section, the regulations to be issued by a Bi-Ministerial resolution were not approved yet to consolidate and certify volumes and values of the subsidy for LPG imports in the 2009-2013 period. However, following regulations regarding the differentiation of import cost with respect to PPT, Table 24 presents the subsidy for LPG import that was also realized through the issuance of NOCREs. The 10 Kg LPG bottling activity is subject to a certification and subsidy according to legislation, conducted by the head of the sector. After having evaluated the costs presented by YPFB the bottling plant, YPFB Refining and private bottlers such as Peca Gas, Roqui Gas, Cruceña del Norte, Venus Gas, and Pailón Gas, the certifications as of 2010 show the amount of subsidy received for the activity of bottling. The annual amount of these certifications and the projected data are presented in Table 25.

Table 24: LPG import subsidy

Year	Import volume (Ton)	Subsidy (MM USD)
2010	20,685	18.9
2011	33,790	39.4
2012	39,244	47.4
2013 (*)	5,216	5.3

(*) From second quarter Bolivia covers full demand

Source: YPFB

Table 25: LPG Bottled Subsidy 10 Kg

Year	Certified subsidy (MM USD)
2010	1.92
2011	1.95
2012	1.88
2013	1.97
2014	1.99
2015	2.11
2016	2.20
2017	2.20
2018	2.25
2019	2.16
2020	2.07
2021	2.11
2022e	2.15
2023e	2.19
2024e	2.23
2025e	2.27

(e) Estimate
Source: MHE
Compiled by: Authors

There is also a fiscal sacrifice for I&A and diesel oil imports. To the authors' knowledge, so far there is no law exempting YPFB from VAT on the importing of these products, so it is safe to assume that YPFB pays VAT on import values. However, since YPFB resells these products at subsidized prices, it cannot pass on the VAT from at least two segments of the chain to final consumers: the wholesaler and retailer.

Table 26: VAT subsidy associated with wholesale and retail of import of derivatives

Year	I&A imported volume (MM liters)	Diesel Oil imported volume (MM liters)	Wholesaler margin (Bs/liter)	Retail margin (Bs/liter)	Margin value (MM USD)	VAT associated to margins value (MM USD)
2010	111	556	0.08	0.19	16.3	2.4
2011	193	779	0.08	0.19	23.5	3.5
2012	208	781	0.08	0.19	23.9	3.6
2013	201	886	0.08	0.19	26.7	4.0
2014	291	937	0.08	0.19	29.1	4.3
2015	367	809	0.08	0.19	26.5	4.0
2016	200	913	0.08	0.19	27.4	4.1
2017	323	1,072	0.08	0.19	33.2	5.0
2018	429	1,204	0.08	0.19	38.0	5.7
2019	649	1,433	0.08	0.19	46.9	7.0
2020	174	997	0.08	0.19	29.4	4.4
2021	677	1,250	0.08	0.19	42.2	6.3
2022(e)	697	1,288	0.08	0.19	43.4	6.5
2023(e)	718	1,326	0.08	0.19	44.7	6.7
2024(e)	740	1,366	0.08	0.19	46.1	6.9
2025(e)	762	1,407	0.08	0.19	47.4	7.1

(e) Estimate

Source: INE, YPFB, and ANH

Compiled by: Authors

Regarding the incentive granted to operators in the hydrocarbon fields, due to the absence of reliable information, this section assumes that the evolution of the committed payments is reflected in the behavior of the FPIEEH[95]. These resources are committed to the payment of incentives. Table 27 shows the series of observed data of resources allocated from the IDH for the FPIEEH, discounting USD 200 million in 2020 to mitigate the effects of COVID-19, in accordance with Law 1307 of June 29, 2020.

[95] At the date of publication of this document, the approval of disbursements in favor of the holders or operators was not made.

Table 27: Producer Subsidy - FPIEEH Incentives

Year	Departamental level	IDH Total	%	Other uses	Sum Total
2010	0.0	968	0.0%	0.0	0.0
2011	0.0	1,307	0.0%	0.0	0.0
2012	0.0	1,766	0.0%	0.0	0.0
2013	0.0	2,266	0.0%	0.0	0.0
2014	0.0	2,274	0.0%	0.0	0.0
2015	38.2	1,618	2.4%	0.0	38.2
2016	96.2	898	10.7%	-0.4	95.8
2017	98.6	920	10.7%	-2.3	96.3
2018	119.3	1,113	10.7%	-5.2	114.1
2019	100.7	940	10.7%	0.0	100.7
2020	89.8	838	10.7%	-200.0	0.0
2021e*	126.0	1,176	10.7%	0.0	15.7
2022e	158.6	1,481	10.7%	0.0	158.6
2023e	143.7	1,341	10.7%	0.0	143.7
2024e	143.9	1,343	10.7%	0.0	143.9
2025e	132.6	1,238	10.7%	0.0	132.6

(1) In 2020, US$200 million is deducted from the availability of FPIEEH resources by Law 1307.

(e) Estimate

(*) It is assumed that the negative balance of year 2020 is compensated with the resources of year 2021

Source: MHE, and BCB.

Compiled by: Authors

The total amount described above represents an opportunity cost for producers and public investment. It is important to note that these resources are allocated for increase of investments in exploration and exploitation of hydrocarbons, and that soaring prices of WTI as it was in 2022 generates an opportunity cost for the State when incentives to investment do not become effective.

6.3.2 Natural gas

This section estimates two types of subsidies for production and consumption of natural gas: (1) opportunity cost and 2) the fiscal sacrifice of VAT associated with this cost. Although in the transport and sale chain there are tariffs and margins that must be updated, this is beyond the scope of this document because the characteristics of regulated monopolies of both activities require detailed information on the operating and capital costs of the pipeline and distribution system that are not currently freely accessible.

Table 28 presents the estimate of the opportunity cost of the subsidy and the VAT associated with production of natural gas destined for the domestic market. The relevant assumptions in this analysis are: 1) the unit value of natural gas exports reported by the

Central Bank of Bolivia (BCB) is taken; (2) domestic market volumes include the consumption of thermoelectric plants, distribution networks, liquid separation plants and the Ammonia and Urea Plant (PAU); (3) since the comparison is made at the wellhead, it is adjusted for the difference in transport tariffs[96]; (4) the domestic market price is a weighted average[97] of final consumer prices; and (5) the unit value of exports is associated with the behavior of WTI.

The results are clear; this subsidy and the associated fiscal sacrifice are considerable; in fact, in 2022 it is expected to reach USD 1.3 billion, due to the increase in export prices that are expected this year. An additional fact, as in the case of oil, is that the "financing" of this subsidy is conducted in two parts, 50% through the gross margin[98] of the operators of the fields and the other 50% through entities that co-participate in departmental royalties and the IDH. Regarding this last concept, a question of economic policy is: what does society prefer, to receive this money as a subsidy to the price of natural gas or as resources of royalties and taxes?

[96] Difference = (Pem – tem - cf) – (Pim – tim) = (Pem – Pim) – (tem + cf) + tim = (Pem – Pim) + tim – (tem + cf).
Where:
Pem = export sale price; Pim = selling price in the domestic market; tem = transport tariff in the foreign market; tim = transport tariff in the domestic market and cf = compression fee. Then the transport setting is: tim – (tem + cf)

[97] By volume of consumption of each category.

[98] This gross margin must cover YPFB's share, operating costs, capital costs, and rate of profit (positive or negative) for field operators.

Table 28 Opportunity Cost and Associated VAT Subsidy – Natural Gas Production

Year	Natural gas volume for IM* (MM MCF)	IM natural gas price** (USD/MCF)	Unit value natural gas exports*** (USD/MCF)	WTI**** (USD/Barrel)	Transport Difference (USD/MCF)	Subsidy Natural Gas Opportunity Cost (USD/MCF)	Subsidy Natural Gas Opportunity Cost (MM USD)	Subsidy Operator's gross margin (MM USD)	Subsidy Royalties 18% + IDH 32% (MM USD)	Tax sacrifice (MM USD)
	a	b	c	d	e	f = c-b+e	g = f * a	g * 50%	g * 50%	g * 13/87
2010	91.0	1.28	6.84	79.5	0.09	5.65	514	257	257	77
2011	101.2	1.28	9.55	94.9	0.12	8.39	850	425	425	127
2012	105.5	1.27	10.60	94.1	0.15	9.47	999	499	499	149
2013	111.2	1.27	10.21	98.0	0.15	9.09	1,011	506	506	151
2014	125.3	1.27	9.67	93.2	0.16	8.55	1,072	536	536	160
2015	129.9	1.28	6.16	48.7	0.16	5.05	656	328	328	98
2016	148.7	1.28	4.82	43.3	0.16	3.70	550	275	275	82
2017	145.5	1.27	4.78	50.8	0.19	3.69	538	269	269	80
2018	153.4	1.24	6.06	65.2	0.18	5.00	767	383	383	115
2019	146.5	1.23	6.50	57.0	0.19	5.46	800	400	400	120
2020	130.0	1.27	4.66	39.2	0.00	3.39	441	220	220	66
2021	131.8	1.25	4.65	68.1	-0.04	3.36	443	221	221	66
2022(e)	134.7	1.25	9.68	96.9	-0.04	8.39	1,131	565	565	169
2023(e)	137.7	1.24	8.89	88.6	-0.05	7.60	1,047	523	523	156
2024(e)	141.3	1.24	8.06	80.0	-0.05	6.78	958	479	479	143
2025(e)	144.1	1.24	7.17	70.6	-0.05	5.88	848	424	424	127

(e) Estimate

(*) Includes sales to thermoelectric plants, natural gas distribution networks, separation plants, ammonia and urea plants

(**) Weighted average price

(***) Central Bank of Bolivia

(****) EIA

Source: BCB, INE, YPFB, and ANH

Compiled by: Authors

6.3.3 Global analysis

Table 29 presents a summary of the hydrocarbon subsidies analyzed in this document, both in USD and as a percentage of GDP, for the 2010-2025 period. There is a high correlation between the value of the subsidy and the behavior of WTI. Fiscal expenditures, either by the issuance of NOCREs or loss due to opportunity cost and lower tax collection, will have a greater impact on GDP when international prices are high. A shock from international prices generates a high share of subsidies on national accounts through GDP, magnified by a greater need for imports of I&A, diesel oil, and the opportunity cost of maintaining cap prices on hydrocarbon prices in the domestic market.

Table 29: Summary of hydrocarbon subsidies (Millions of USD)

Year	Opportunity Cost (MM USD)	Updated margins (MM USD)	NOCREs (MM USD)	Tax sacrifice from VAT (MM USD)	Incentive (MM USD)	Total (MM USD)	GDP (MM USD)
2010	978	257	281	187	-	**1,703**	15,769
2011	1,524	283	617	273	-	**2,696**	18,573
2012	1,703	322	654	306	-	**2,985**	20,428
2013	1,832	389	678	336	-	**3,236**	22,839
2014	1,893	429	627	351	-	**3,301**	24,570
2015	874	466	224	204	38	**1,806**	25,343
2016	698	539	186	189	96	**1,708**	27,558
2017	813	528	330	205	96	**1,973**	30,640
2018	1,291	518	561	276	114	**2,760**	32,999
2019	1,195	456	612	254	101	**2,617**	33,962
2020	515	489	184	154	-	**1,343**	30,979
2021	1,000	459	612	224	16	**2,311**	34,325
2022(e)	2,147	440	1,130	393	159	**4,268**	36,855
2023(e)	1,926	422	1,058	358	144	**3,907**	39,572
2024(e)	1,696	406	977	321	144	**3,544**	42,488
2025(e)	1,434	390	879	280	133	**3,116**	45,620

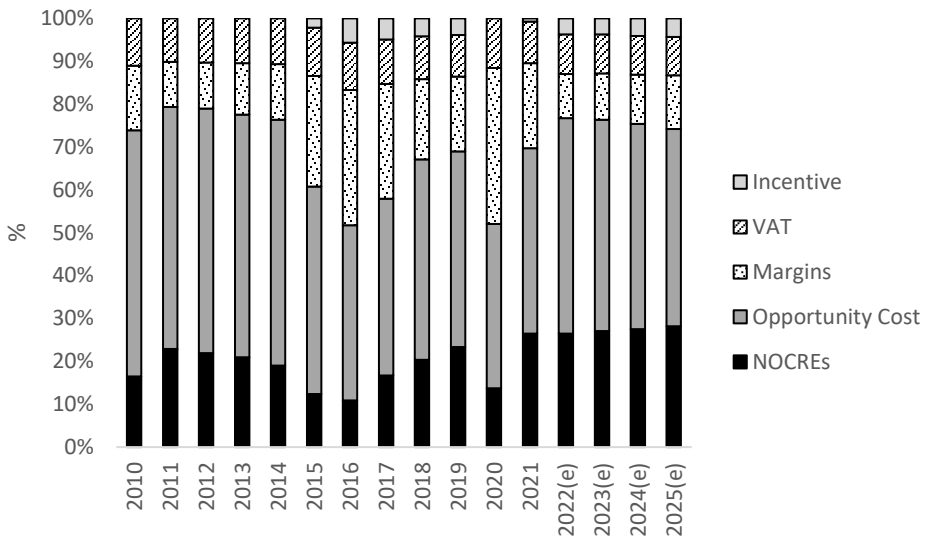
Year	Opportunity Cost (% GDP)	Updated margins (% GDP)	NOCREs (% GDP)	Tax sacrifice from VAT (% GDP)	Incentive (% GDP)	Total (% GDP)	GDP
2010	6.2%	1.6%	1.8%	1.2%	0.0%	**10.8%**	100.0%
2011	8.2%	1.5%	3.3%	1.5%	0.0%	**14.5%**	100.0%
2012	8.3%	1.6%	3.2%	1.5%	0.0%	**14.6%**	100.0%
2013	8.0%	1.7%	3.0%	1.5%	0.0%	**14.2%**	100.0%
2014	7.7%	1.7%	2.6%	1.4%	0.0%	**13.4%**	100.0%
2015	3.4%	1.8%	0.9%	0.8%	0.2%	**7.1%**	100.0%
2016	2.5%	2.0%	0.7%	0.7%	0.3%	**6.2%**	100.0%
2017	2.7%	1.7%	1.1%	0.7%	0.3%	**6.4%**	100.0%
2018	3.9%	1.6%	1.7%	0.8%	0.3%	**8.4%**	100.0%
2019	3.5%	1.3%	1.8%	0.7%	0.3%	**7.7%**	100.0%
2020	1.7%	1.6%	0.6%	0.5%	0.0%	**4.3%**	100.0%
2021	2.9%	1.3%	1.8%	0.7%	0.0%	**6.7%**	100.0%
2022(e)	5.8%	1.2%	3.1%	1.1%	0.4%	**11.6%**	100.0%
2023(e)	4.9%	1.1%	2.7%	0.9%	0.4%	**9.9%**	100.0%
2024(e)	4.0%	1.0%	2.3%	0.8%	0.3%	**8.3%**	100.0%
2025(e)	3.1%	0.9%	1.9%	0.6%	0.3%	**6.8%**	100.0%

(e) Estimate

Source: INE, YPFB, and ANH

Compiled by: Authors

Figure 7: Composition of hydrocarbon subsidies in Bolivia (%)



With respect to quantification of the subsidy for production and consumption of hydrocarbons in Bolivia, five broad categories were considered in this document: opportunity cost of selling production to the domestic market instead of its export; direct import of I&A, diesel oil, and LPG at high prices for subsequent sale at low prices; non-updating of value chain margins of petroleum products; fiscal sacrifice for non-collected VAT and; incentive given to operators of fields in Bolivia. In total, it is estimated that by 2022 these five categories will represent 11.6% of GDP, with the following disaggregation: opportunity cost (5.8%), direct import (3.1%), margin update (1.2%), tax sacrifice for VAT (1.1%), and incentive (0.4%).

As made evident in the document, these policies not only promote the transition to a clean energy matrix, but also promote efficiency and avoid the creation of fictitious prices within the links of the productive chain. A reality check in the Bolivian economy, without altering the welfare of consumer surplus, would generate efficiency and normalization of prices in the markets, promoting in the medium-term investments and consumption within the hydrocarbon value chain.

7. Comparative analysis of prices at an international level

In this section a brief comparison is made between end consumer prices of gasoline, diesel, and LPG in Bolivia's neighboring countries. The methodology consists of comparing prices in US dollars and as a percentage of GDP (measured at current prices) per capita per month. This second indicator allows comparing the burden represented by prices of these three oil derivatives to the people of each country. This exercise is done because comparing only the prices in US dollars hides the economic differences (and scale) of the

countries subject to analysis. Below are the most important statistics. In the annex to this document all information used, with its respective sources, is shown.

Regarding gasoline, Table 30 presents information (in USD per liter) for neighboring countries and Bolivia in the 2015-2021 period. Clearly the highest prices are found in Chile and Brazil, while the lowest in Bolivia and Argentina. These figures are known in the region and therefore it is stated that Bolivia has one of the lowest prices in the region and, therefore, the associated subsidy is high. However, Figure 8 presents a contrasting reality, in which it is observed that Bolivia has one of the highest indicators in relation to the price of gasoline as a % of GDP per capita per month; that is, although in absolute terms the price is low, in relative terms it is high. Chile is the country with the lowest indicator, because the size of its GDP is larger than the rest of the countries.

Table 30: Price of gasoline (USD/liter)

Country	2015	2016	2017	2018	2019	2020	2021
Argentina	1.09	1.60	1.75	1.09	0.87	0.48	0.60
Bolivia	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Brasil	1.00	1.06	1.18	1.21	1.11	0.83	1.08
Chile	1.10	1.01	1.13	1.25	1.14	1.00	
Paraguay	1.05	0.92	0.90	0.97	0.93	0.85	
Perú	1.10	0.92	1.01	1.06	1.05	0.87	0.92
Average	**0.98**	**1.01**	**1.08**	**1.02**	**0.94**	**0.76**	**0.78**

Source: OLADE, INDEC, Secretaría de Energía, ANH, INE, OSINERGIM, Ministerio de Energía y Minas del Perú, Central Banks of South America

Compiled by: Authors

Figure 8: Gasoline price as % of GDP per capita per month

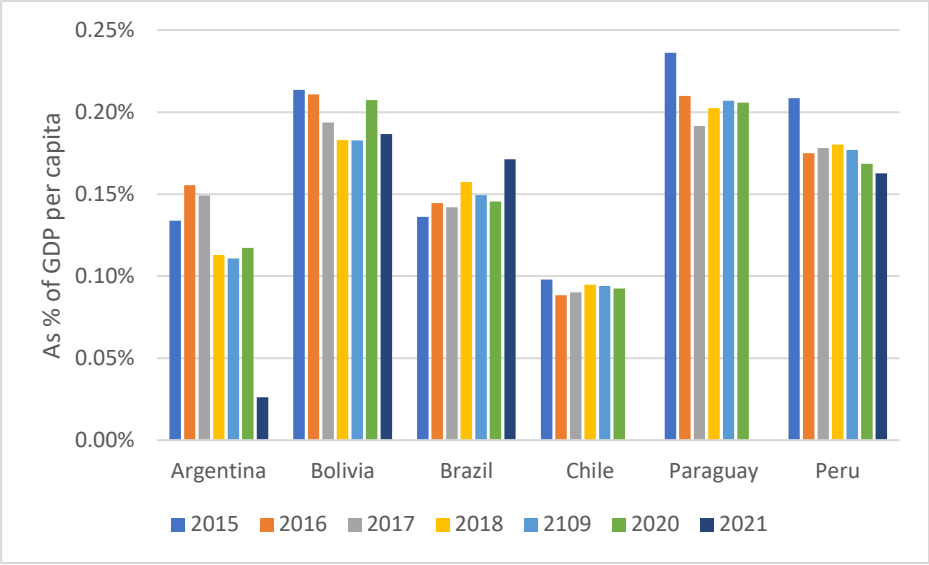


Table 31 presents the price in absolute terms for diesel oil. As in the case of gasoline, Bolivia has the lowest prices in the region; only Argentina in 2020 had a lower price. Also,

as in the case of gasoline, Bolivia has one of the highest indicators (with respect to GDP per capita) in the region; in fact, it is the highest; see Figure 9.

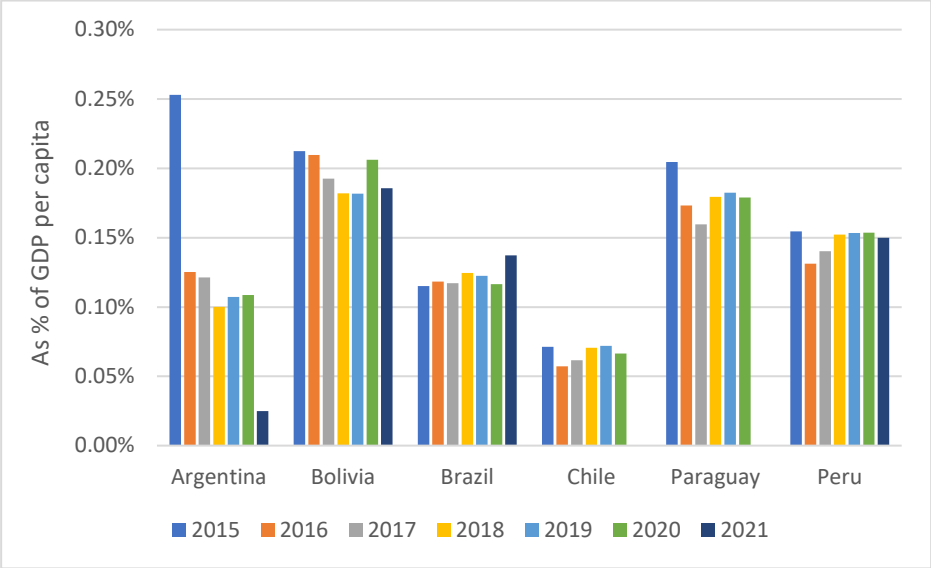
Table 31: Price of diesel (USD/liter)

Country	2015	2016	2017	2018	2019	2020	2021
Argentina	2.07	1.29	1.43	0.96	0.84	0.44	0.57
Bolivia	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Brazil	0.85	0.87	0.97	0.95	0.91	0.66	0.86
Chile	0.80	0.66	0.77	0.93	0.88	0.72	
Paraguay	0.91	0.76	0.75	0.86	0.82	0.74	
Peru	0.81	0.69	0.80	0.89	0.91	0.79	0.84
Average	**1.00**	**0.80**	**0.88**	**0.86**	**0.81**	**0.65**	**0.70**

Source: OLADE, INDEC, Secretaría de Energía, ANH, INE, OSINERGIM, Ministerio de Energía y Minas del Perú, Central Banks of South America

Compiled by: Authors

Figure 9: Oil price of diesel as % of GDP per capita per month



Finally, Table 32 and Figure 10 present the statistics for LPG. Price in absolute values is one of the lowest in the region; however, it is also the relative value to GDP per capita. So, unlike gasoline and diesel, the price of LPG is the one that has the least pressure on the budget of families in the countries of the region. This opens an interesting space for a policy of eliminating subsidies in Bolivia.

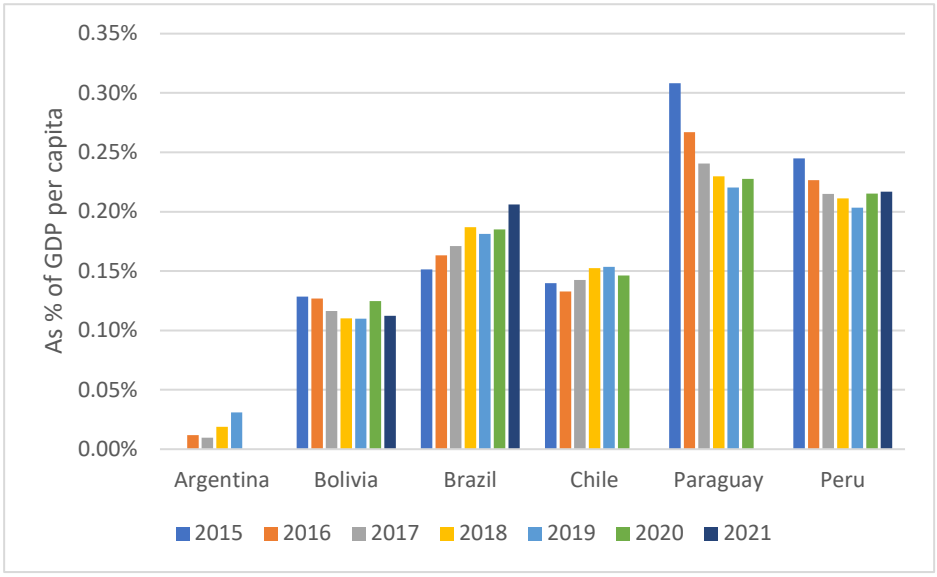
Table 32: LPG price (USD/kg)

Country	2015	2016	2017	2018	2019	2020	2021
Argentina		0.12	0.12	0.18	0.24		
Bolivia	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Brazil	1.11	1.19	1.42	1.43	1.35	1.06	1.29
Chile	1.57	1.52	1.78	2.01	1.87	1.59	
Paraguay	1.37	1.17	1.13	1.10	0.99	0.94	
Peru	1.29	1.19	1.22	1.24	1.20	1.11	1.22
Average	**1.13**	**0.92**	**1.00**	**1.05**	**1.00**	**1.00**	**0.95**

Source: OLADE, INDEC, Secretaría de Energía, ANH, INE, OSINERGIM, Ministerio de Energía y Minas del Perú, Central Banks of South America

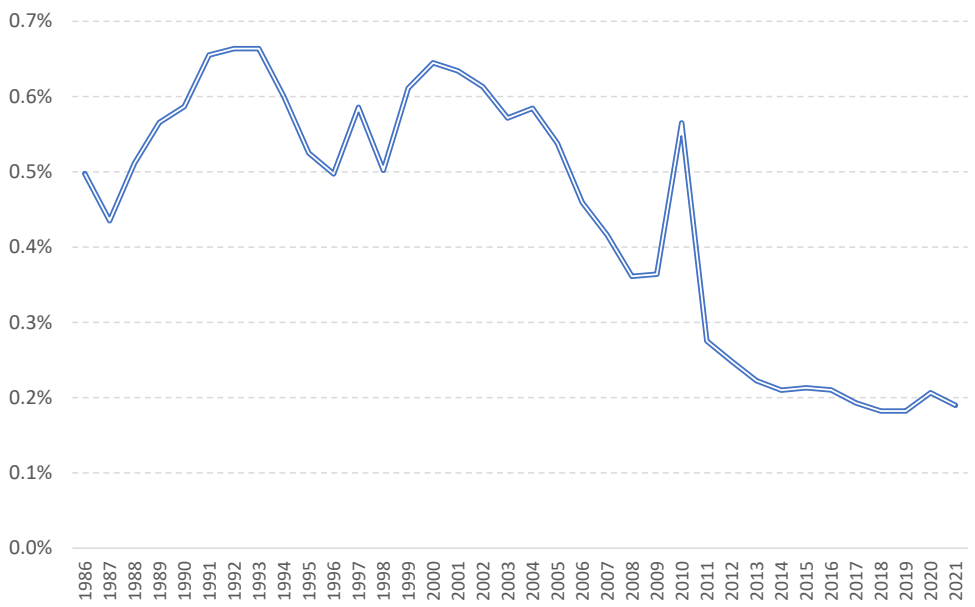
Compiled by: Authors

Figure 10: LPG price as % of monthly GDP per capita



Although prices of petroleum derivatives in Bolivia, as a percentage of GDP, are high, it is also true that the Bolivian population experienced even greater pressures. According to Figure 11, over time the participation of the price of gasoline in the monthly income of the Bolivian consumer (approximated by the monthly GDP per capita) was decreasing.

Figure 11: Special gasoline price as % of GDP per capita per month



At the international level, prices (expressed in USD per liter) of Bolivian gasoline, diesel oil and LPG are the lowest in the region, which is consistent with several sources of information. However, when these prices are contrasted with monthly GDP per capita, Bolivia has the highest indicators; that is, although absolute prices are low, they represent a high burden on households' budgets, except for LPG. In this sense, any subsidy elimination policy in Bolivia must consider that it is still a nation with a modest economic level; for this reason, such policy should be accompanied by mitigation measures in the poorest households, even those with middle income.

8. Conclusions

Having evaluated the policies of explicit subsidies and other measures that represent an opportunity cost for producers and consumers, according to the reviewed literature, we can conclude the following:

- Like any other price in the economy, energy prices must provide correct information on opportunity costs, production costs, the scarcity of a product and consumer preferences. When these prices are distorted, for example, with the presence of subsidies, imbalances arise between (lower) supply and (higher) demand that also have severe environmental consequences. Although the presence of these subsidies allows low-income families to access energy and reduces inflationary pressures, negative consequences in the medium and long term on fiscal stability and economic growth are considerable. Finally, strategies analyzed for eliminating these subsidies stand out: gradual removal, either directly or through VBA with competitive prices,

adequate communication between economic policy makers and civil society, and support programs – direct money transfers – serve to mitigate price increases and transparency in the use of fiscal resources released thanks to the elimination of said subsidies.

- This study identifies five periods with different price regimes (for main hydrocarbons): 1) 1986-1996, where these prices are part of the government's fiscal policy to finance part of the structural adjustment policies after the inflationary period; 2) 1997-1999, when a new methodology for price determination based on three central components is implemented, international reference prices, transport, refining and sale margins, and direct, indirect and consumption-specific taxes; 3) 2000-2003, period of privatization of refineries, transport and storage, where policies of stabilization of fuel prices took on greater relevance within the regulatory framework, an aspect that allowed to keep almost unchanged the final prices of gasoline and diesel, but with a considerable fiscal cost due to adjustment of the IEHD; 4) 2004-2005, where in 2004 a price band was determined for international reference price behavior; in this sense, international prices above 27.11 USD/barrel are not transferred to end consumers; and 5) 2005-2022, because in 2005 the last price adjustment was made (with the 2010 temporary increase exception) of gasoline, diesel oil and LPG, and they remained in force until 2022.

- At the international level, prices (expressed in USD per liter) of Bolivian gasoline, diesel and LPG are the lowest in the region, which is consistent with several sources of information. However, when these prices are contrasted with monthly GDP per capita, Bolivia has the highest indicators; that is, although absolute prices are low, they represent a high burden on households' budgets, except for LPG. In this sense, any subsidy elimination policy in Bolivia must consider that it is still a nation with a modest economic level; for this reason, such policy should be accompanied by mitigation measures in the poorest households, even those with middle income.

- Explicit subsidies from the issuance of NOCREs, in terms of I&A, diesel oil, and LPG enable household consumers to maintain stability in energy prices. However, these measures could be generating an excessive and inefficient use of scarce energy resources and the non-application of energy efficiency policies.

- On the other hand, the implementation of incentives through the FPIEEH did not generate, due to the non-execution (non-compliance) of payments, a significant increase in exploration and exploitation investments. Indirect measures to mitigate the opportunity cost of producing a barrel of oil with respect to its export parity do not generate incentives equated with direct market measures to reactivate the sector that is in decline from the production perspective.

- Fiscal pressure due to the increase in NOCREs, due to an increase in WTI, added to the fiscal sacrifice for non-collection of VAT reflected in opportunity cost, exerts deficit

pressure and its financing. Applying current regulations, such as Law 1098, and evaluating alternatives to reduce opportunity cost subsidies, would allow the State not only to improve the fiscal balance but would also generate savings and circulation of currency, and favor the trade balance.

- It is observed that growing demand for liquid fuels contributes to a higher fiscal pressure; a higher import cost to cover the supply-demand deficit has been gradually growing to such an extent that it is likely that in the short term the issuance of debt will be unsustainable. A lower collection of taxes due to the use of NOCREs prevents the State from having the necessary sources of income to face the growing expenses and needs of the public sector. Therefore, it is necessary to reduce public spending so as not to incur debt or generate incentives for an increase in taxes or monetary issuance. Let us recall that the increase in debt can be financed, in terms of economic policy, with monetary issuance, taxes or greater debt. Consequently, it ends up affecting the present or future of the end consumer, mainly vulnerable households.

- The lack of updating of legislation within the framework of a policy that favors the use of environmentally friendly technologies resulted in an increase in the opportunity cost subsidy in a regulatory framework 20 years old. Moving derived products with a decontextualized regulated price scheme tends to disadvantage the productive activity of the hydrocarbons sector, and disguises economic reality of the end consumer through price-fixing mechanisms.

- It is necessary to avoid committing debt or taxes to future generations due to subsidies. This together with the challenge of avoiding increasing the purchase price of products from hydrocarbons, allows exploring the feasibility of using anhydrous ethanol if production of said plant-based additive is promoted at economies of scale. According to law, after the investment recovery period (five years), the purchase price, considering a reduction in variable costs, will tend to be reduced until it equals the export parity value. In other words, anhydrous ethanol could eliminate, in the long term, the subsidies for Inputs and Additives without the need to increase the price for the final consumer.

  Promote research and planning, within the framework of Law 1098, through induction to produce VBA at large scale; that is, increase efficiency in all links of the production chain, as well as guaranteeing and inducing the efficient production of raw materials and supplies necessary for VBA production.

- Regarding the quantification of subsidies for production and consumption of hydrocarbons in Bolivia, five broad categories were considered in this document: an opportunity cost of selling production to the domestic market instead of its export; a direct import of petrol, diesel and LPG at higher prices for subsequent sale at lower prices; a non-updating of margins from the value chain of petroleum products; a fiscal sacrifice for non-collected VAT and; an incentive given to field operators in Bolivia. In

total, it is estimated that by 2022 these five categories will represent 11.6% of GDP, with the following disaggregation: opportunity cost (5.8%), direct import (3.1%), margin update (1.2%), tax sacrifice – VAT (1.1%), and incentive (0.4%).

9. Bibliography

Achakulwisut, P.; Erickson, P.; & Koplow, D. (2021). Effect of subsidies and regulatory exemptions on 2020-2030 oil and gas production and profits in the United States. Environmental Research Letters 16.

Acharya, R. & Sadath, A. (2017). Implications of Energy Subsidy Reform in India. Energy Policy, March 2017.

Aldubyan, M. & Gasim, A. (2021). Energy price reform in Saudi Arabia: Modeling the economic and environmental impacts and understanding the demand response. Energy Policy 148 (2021) 111941.

Amin, S.; Marsiliani, L. & Renström, T. (2018). The Impacts of Fossil Fuel Subsidy Removal on Bangladesh Economy. Bangladesh Development Studies Vol. XLI, June 2018, No. 2.

Balke, N.; Plante, M. & Yücel, M. (2015). Fuel Subsidies, the Oil Market and the World Economy. The Energy Journal, Vol. 36, SI1.

Batlle, C. (2011). A method for allocating renewable energy source subsidies among final energy consumers. Energy Policy 39 (2011) 2586-2595.

Bazilian, M. & Onyeji, I. (2012). Fossil fuel subsidy removal and inadequate public power supply: Implications for businesses. Energy Policy 45 (2012) 1-5.

van Beers, C. & Strand, J. (2013). Political Determinants of Fossil Fuel Pricing. Policy Research Working Paper 6470. World Bank.

Belfiori, M. (2021). Fossil Fuel Subsidies, the Green Paradox and the Fiscal Paradox. Economics of Energy & Environmental Policy, Vol. 10, No. 1.

Boughanmi, H. & Khan, N. (2019). Welfare and Distributional Effects of the Energy Subsidy Reform in the Gulf Cooperation Council Countries: The Case of Sultanate of Oman. International Journal of Energy Economics and Policy, 2019, 9 (1), 228-236.

Breisingera.C.; Mukashovb, A.; Raoufa, M. & Wiebeltb, N. (2019). Energy subsidy reform for growth and equity in Egypt: The approach matters. Energy Policy 129 (2019) 661-671.

Bruce, N. (1990). Measuring Industrial Subsidies: Some Conceptual Issues. Department of Economics and Statistics OECD. Working Paper No. 75.

Butler-Bowdon, T. (2017). 50 economic classics. Nicholas Brealey Publishing. USED.

Calì, M.; Cantore, N.; Iacovone, L.; Pereira-López, M. & Presidente, G. (2019). Too Much Energy: The Perverse Effect of Low Fuel Prices on Firms. Policy Research Working Paper 9039. World Bank.

Calvo-Gonzalez, O.; Cunha, B. & Trezzi, R. (2015). When Winners Feel Like Losers: Evidence from an Energy Subsidy Reform. Policy Research Working Paper 7265. World Bank.

Clements, B.; Rodriguez, H. & Schwartz, G. (1998). "Economic Determinants of Government Subsidies". IMF Working Paper. WP/98/166.

Clements, B., Coady, D., Fabrizio, S., Gupta, S. Coleridge Alleyne, T.S. & Sdralevich C.A. (2013). Energy Subsidy Reform Lessons and Implications. International Monetary Fund. ISBN: 9781475558111

Clements, B.; Coady, D.; Fabrizio, S.; Gupta, S. & Shang, B. (2014). Energy subsidies: How large are they and how can they be reformed? Economics of Energy & Environmental Policy, Vol. 3, No. 1.

Coady, D.; Parry, I.; Le, N. & Shang, B. (2019). Global Fossil Fuel Subsidies Remain Large: An Update Based on Country-Level Estimates. IMF Working Paper WP/19/89.

Coaxhead, I. & Grainger, C. (2018). Fossil Fuel Subsidy Reform in the Developing World: Who Wins, Who Loses, and Why? Asian Development Review, Vol. 35, No. 2, pp. 180-203.

Davis, L. (2013). The economic cost of global fuel subsidies. National Bureau of Economic Research. Working Paper 19736.

Davis, L. (2017). The Environmental Cost of Global Fuel Subsidies. The Energy Journal, Vol. 38, SI1.

El-Katiri, L. & Fattouh, B. (2015). A Brief Political Economy of Energy Subsidies in the Middle East and North Africa. Oxford Institute for Energy Studies, 2015, pp. 2-7, http://www.jstor.org/stable/resrep31025.5 Accessed 18 Apr. 2022.

Enami, To.; Lustig, N. & Taqdiri, A. (2019). Fiscal policy, inequality, and poverty in Iran: assessing the impact and effectiveness of taxes and transfers. Middle East Development Journal, 11:1, 49-74.

Groot, L. & Thijs, O. (2019). Welfare Effects of Energy Subsidy Reform in Developing Countries. Review of Development Economics, Vol. 23, Issue 4, pp. 1926-1944. Available at SSRN: https://ssrn.com/abstract=3618496 or http://dx.doi.org/10.1111/rode.12619

Jara, X.; Lee, P.; Montesdeoca, L. & Varela, M. (2018). Fuel subsidies and income redistribution in Ecuador. WIDER Working Paper 2018/144. United Nations University.

Koplow, D. 2009. Measuring Energy Subsidies Using the Price- Gap Approach: What Does It Leave out? IISD Trade, Investment and Climate Change Series (Winnipeg: International

Institute for Sustainable Development). Available via the Internet: http://www.iisd.org /gsi /sites /default /files /bali_2_copenhagen_ff_subsidies_pricegap.pdf

McCulloch, N.; Moerenhout, T. & Yang, J. (2021). Fuel subsidy reform and the social contract in Nigeria: A micro-economic analysis. Energy Policy 156 (2021) 112336.

Medinaceli, M. (2002). "Fiscal Participation in the 'upstream' of the hydrocarbon sector in Bolivia: 2002-2006". Monthly Report January-February-March 2002. Bolivian Fiscal Oil Fields. April 2002. La Paz, Bolivia.

Medinaceli, M. (2003). "Tax Systems Applied to the Oil Sector in Bolivia". Mimeo. Bolivian Chamber of Hydrocarbons. November 2003.

Medinaceli, M. (2004). "How to Take Advantage of Favorable External Contexts in the Hydrocarbons Sector?". The Main Export Sectors of Bolivia. Economic Bulletin – Economic Analysis No. 2. Millennium Foundation. La Paz, Bolivia.

Medinaceli, M. (2006). "Tax Aspects of hydrocarbons Law No. 3058 and Supreme Decree No. Economic Bulletin: Economic Analysis. Nationalization Under the Magnifying Glass. Millennium Foundation. 28701"

Medinaceli, M. (2007a). The Nationalization of the New Millennium: when the price was an ally. Let's melt. First Edition. La Paz, Bolivia.

Medinaceli, M. (2007b). Direct Tax on Hydrocarbons: Origin, mistreatment and uses. Millennium Foundation. Economic Colloquia. No. 9. December 2007.

Medinaceli, M. (2008). "Direct Tax on Hydrocarbons: origin, uses and destinations". **The Income of Hydrocarbons between the Urgent and the Important**. Series: Workbooks. International Institute for Democracy and Electoral Assistance.

Medinaceli, M. (2009). Efficient State Hydrocarbon Enterprises. Latin American Energy Organization (OLADE). Quito, Ecuador.

Medinaceli, M. (2010a). The International Crisis and Hydrocarbons. Economic Colloquia No. 19. Millennium Foundation. September 2010. La Paz, Bolivia.

Medinaceli, M. (2010b). "The Departmental Income Tax as an Alternative to the Direct

Tax on Hydrocarbons". Bases for the Financing of the New State and the Regime of Autonomies. Ministry of Autonomy – Pulse – GTZ. First Edition.

Medinaceli, M. (2010c). Methodologies for the determination of prices of the main petroleum derivatives: South America. Latin American Energy Organization (OLADE). Quito, Ecuador.

Medinaceli, M. (2012a). The Challenges of Hydrocarbons Policy in a Globalized Scenario. Mimeo. Pasoskanki Foundation.

Medinaceli, M. (2012b). The Hydrocarbons Sector in Bolivia. Policy Paper 02/2012. FES – Bolivia.

Medinaceli, M. (2014). Balance and perspective of hydrocarbon policy 2006-2013. Notebooks of Reflection and Analysis of Public Policies No. 5. UNDP. La Paz, Bolivia.

Medinaceli, M. (2017). Historical overview of the hydrocarbons sector in Bolivia (1916-2016). A follow of economy in Bolivia 1900-2015. Volume II. Konrad Adenauer Stiftung. Plural Editors.

Medinaceli, M., Müller, H. & Cavero, R. (2003). "The Tax Regime in the Hydrocarbon Sector in Bolivia". Confidential Report No. 126. July-August 2003. Müller & Asociados. La Paz, Bolivia

Medinaceli, M. & Mokrani, L. (2010). "Impact of Bonds Financed with Oil Revenue". Thresholds Magazine, Number 20. CIDES. June 2010. La Paz, Bolivia.

Medinaceli, M. (2021). Brief analysis and foresight of the Bolivian natural gas industry: 1980-2021. Revista Latinoamericana de Desarrollo Económico No. 36. Institute of Socio-Economic Research. Bolivian Catholic University "San Pablo".

Muangjai, P.; Wongsapai, W. & Damrongsak, D. (2017). Impact of Petroleum Products Subsidization to Energy Demand in Thailand. Energy Procedia Volume 138, October 2017, 1011-1016.

OLADE. (2020). Energy prices in Latin America and the Caribbean. Annual Report April 2020.

OLADE. (2021). Energy prices in Latin America and the Caribbean. Annual Report April 2020.

Parry, I.; Black, S. & Vernon, N. (2021). Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies.

Rentschler, J. (2016). Incidence and impact: The regional variation of poverty effects due to fossil fuel subsidy reform. Energy Policy 96 (2016) 491-503.

Riedy, C. (2011). "Public Subsidies and Incentives to fossil fuel production and consumption in Australia". Draft Discussion Paper Institute for Sustainable Future. Australia.

Rose, S. & Plant, M. (2021). Fuel Subsidy Reform in Fragile States: Forging a Constructive IFI-UN Partnership. Center for Global Development.

Sovacool, B. (2017). Reviewing, Reforming, and Rethinking Global Energy Subsidies: Towards a Political Economy Research Agenda. Ecological Economics 135 (2017) 150-163.

Surrey, S. (1973). Pathways to tax reform: The Concept of Tax Expenditures. Harvard University Press. 2nd Printing edition.

Vieites, Y.; Weiss, M.; Andretti, B.; Jacob, J. & Hallack, M. (2022). Increasing the Acceptance of Energy Subsidy Reforms: Behavioral Insights for Latin America and the Caribbean. Inter-American Development Bank – Energy Division. Technical Note No. IDB-TN-2488.

Annex 1: Selected legal regulations

CHRONOLOGICAL ORDER OF REGULATIONS RELATED TO SUBSIDIES AND HYDROCARBON CHAIN			
DATE	**TYPE**	**NUMBER**	**OBJECT**
13/03/1937	Resolution	None	First Nationalization of Hydrocarbons
17/10/1969	Supreme Decree	8956	Second Nationalization of Hydrocarbons
20/05/1986	Law	843	Creates Tax Reform Law. (Ordered Text Law 843R1 of May 20, 1995, and last ordered text approved by SD 27947, of December 20, 2004)
01/11/1990	Law	1194	Hydrocarbons Law Approved (repealed by Law 1689)
28/10/1994	Law	1600	Approves Law on the Sectoral Regulation System – SIRESE
22/12/1994	Law	1606	Creates the Special Tax on Hydrocarbons and their Derivatives (IEHD)
24/06/1995	Supreme Decree	24055	Establishes the products of domestic origin and those imported subject to the payment of IEHD (Amended by SD 24217 and SD 24265)
20/01/1996	Supreme Decree	24217	Establishes rates of products subject to payment of IEHD
27/03/1996	Supreme Decree	24265	Modifies the IEHD for diesel oil established in SD 24217
30/04/1996	Law	1689	Hydrocarbons Law Approved (repealed by Law 3058)
31/10/1996	Supreme Decree	24399	Annex II. Approves gas sales regulations (amended by SD 25144 and SD 25473)
14/05/1996	Supreme Decree	24616	Approves regulatory fee amounts to be paid by YPFB
23/07/1997	Supreme Decree	24721	Regulations for the Construction and Operation of LPG Bottling Plants (amended by SD 26477)
04/08/1997	Supreme Decree	24804	Approves the Regulation on the Price Regime for Petroleum Products
05/12/1997	Supreme Decree	24914	Ratifies the Regulation approved by SD 24804 with supplements and updates (amended by SD 26926)
06/04/1998	Supreme Decree	25005	Modifies the refinery margin for LPG and the reference ceiling price for LPG
22/07/1998	Supreme Decree	25108	Modifies the refinery margin for LPG established in SD 25005
03/08/1998	Supreme Decree	25114	Modifies transfers from YPFB to the Treasury, established in Art. 15 of SD 24914

31/08/1998	Supreme Decree	25144	Modifies the gas sales regulation incorporating definitions on permits and reserves, among others
14/12/1998	Supreme Decree	25249	Establishes calculation of Pre-Terminal Prices with respect to variation of the Reference Price
18/12/1998	Supreme Decree	25254	Modifies the refinery margin for LPG established in SD 25108
11/06/1999	Supreme Decree	25417	Modifies the calculation of the Ex-Refinery Price of the Regulation approving the Petroleum Products Price Regime
30/07/1999	Supreme Decree	25473	Modifies the gas sales regulation incorporating definitions on exportable proven reserves
03/09/1999	Supreme Decree	25504	Establishes VAT refund for exports of the hydrocarbons sector
30/09/1999	Supreme Decree	25530	Modifies the way of calculating the prices of regulated products, Ex-Refinery and Pre-Terminal Price
06/10/1999	Supreme Decree	25535	Establishes application of the official exchange rate in Ex-Refinery and Pre-terminal prices, as well as refinery margins, and transport (multi-product pipelines and different transportation)
06/10/1999	Supreme Decree	25536	Modifies the Regulation on the price regime of petroleum products, LPG treatment and service stations at more than 35Km
17/12/1999	Supreme Decree	25616	Public Service – declares the commercialization of hydrocarbons, throughout its chain of services of sale of regulated products (abrogated by SD 25628)
24/12/1999	Supreme Decree	25628	Public Service – declares the commercialization of regulated products from the phase of storage plants, wholesale commercialization and retail sales
28/01/2000	Law	2047	Establishes IEHD fees and authorizes modifications by SD
28/01/2000	Supreme Decree	25660	Establishes IEHD rates in application of Law 2047
25/02/2000	Supreme Decree	25680	Establishes new IEHD rate for imported diesel oil
07/04/2000	Supreme Decree	25731	Abrogates SD 25660

07/04/2000	Supreme Decree	25732	It has a mechanism for the calculation of the preterminal and final prices of hydrocarbons and their derivatives
25/04/2000	Supreme Decree	25753	Establishes new IEHD rate for imported diesel oil
19/05/2000	Supreme Decree	25774	Approves IEHD rates and modifies the regulation approved by DS 24804 and its amendments
19/05/2000	Supreme Decree	25781	Establishes IEHD rate of imported diesel oil
07/07/2000	Supreme Decree	25835	Establishes the definition and treatment of Large Consumers of Regulated Products (LCRP)
07/07/2000	Supreme Decree	25836	Authorizes YPFB to sign contracts with private companies aimed at stabilizing prices of Special Gasoline and diesel oil; validity extended 30 days by SD 26242
07/07/2000	Supreme Decree	25837	Validates contract indicated in SD 25836
29/08/2000	Supreme Decree	25885	Authorizes the issuance of NOCREs in favor of companies importing diesel oil
08/09/2000	Supreme Decree	25893	Complements SD 25885 with functions of state entities
22/11/2000	Law	2152	Complements the Economic Reactivation Law and establishes IEHD rates
27/11/2000	Supreme Decree	26004	Establishes IEHD rates for regulated products
22/12/2000	Supreme Decree	26028	Approves mechanism of fixing IEHD of imported diesel oil
22/12/2000	Supreme Decree	26037	Excludes natural gas thermoelectric generation from the application of the Gas Sales Regulation (abrogated by SD 27354)
16/03/2001	Supreme Decree	26116	Approves the Regulation on the Transport of Hydrocarbons by Pipelines
30/04/2001	Supreme Decree	26170	Establishes extension of two additional years of pricing by the State (modified by SD 27021)
04/05/2001	Supreme Decree	26177	Simplifies SD 26028 calculation process, modifies formula
21/06/2001	Supreme Decree	26225	Establishes IEHD rate of imported diesel oil
05/08/2001	Supreme Decree	26270	Establishes IEHD adjustment mechanism (abrogated by DS 27344)
28/12/2001	Supreme Decree	26476	Establishes IEHD rate of imported diesel oil
28/12/2001	Supreme Decree	26477	Modifies Regulations for the Construction and Operation of LPG Gripping Plants

08/05/2002	Supreme Decree	26616	Establishes IEHD rate of imported diesel oil
14/05/2002	Supreme Decree	26621	Establishes IEHD rate of imported diesel oil
07/09/2002	Supreme Decree	26783	Establishes IEHD rate of imported diesel oil
14/01/2003	Supreme Decree	26917	Introduces IEHD determination mechanism for imported diesel oil (amended by SDs 27440, 27696, 27715, 28046, 28416, and 1905)
25/01/2003	Supreme Decree	26926	Amends the Regulation on the Price Regime for Petroleum Products
11/02/2003	Supreme Decree	26933	Establishes rapid procedure for YPFB to contract the import of diesel oil
28/02/2003	Supreme Decree	26946	Establishes compensation mechanism for importers of diesel through NOCREs (repealed by SD 26972 and SD 27440)
25/03/2003	Supreme Decree	26972	Modifies the definition of PP1 for imported diesel oil and establishes compensation mechanism through NOCREs (modified by SD 27440)
29/04/2003	Supreme Decree	27021	Establishes extension of five additional years of pricing by the State
06/06/2003	Supreme Decree	27065	Creates incentive mechanism to produce diesel oil – IPD to current refineries (abrogated by SD 27959)
04/08/2003	Law	2493	Modifies Law 843 and determines new maximum rates for IEHD
11/10/2003	Supreme Decree	27209	Declares national emergency supply of liquid fuels throughout the nation's territory
12/10/2003	Supreme Decree	27210	Determines that natural gas will not be exported to new markets, until consultations and discussions are held on this resource (abrogated by SD 27511)
20/12/2003	Supreme Decree	27297	Approves Regulation of the Regime of Conversion of Vehicles that use Gasoline and Diesel to the VNG System
31/01/2004	Supreme Decree	27343	Establishes new pricing policy for LPG (suspended by SD 27697 and abrogated by SD 27992)
31/01/2004	Supreme Decree	27344	Reestablishes Methodology for Calculating Final Prices of Special Gasoline and Diesel and Updates IEHD Adjustment Mechanism (suspended by SD 27697 and abrogated by SD 27992)

04/02/2004	Supreme Decree	27354	Establishes calculation to determine the sale price of natural gas for thermoelectric generation and natural gas distribution companies by networks (abrogated by SD 28275)
07/04/2004	Supreme Decree	27440	Modifies SD 26972. New IEHD update formula and the total calculation of NOCREs issued
07/04/2004	Supreme Decree	27442	Introduces New Methodology for the Determination of the IEHD Rates of Special Gasoline and Domestic Diesel (Modified by SD 27516, SD 27678 and abrogated by SD 27992)
13/04/2004	Supreme Decree	27448	Authorizes the signing of an Agreement for the Purchase and Sale of Natural Gas between the Republic of Bolivia and the Republic of Argentina (Modified by SD 27505, SD 27511 and SD 27865)
30/04/2004	Supreme Decree	27473	Suspends the calculation of the Different Transport Margins and their application in the price chain (abrogated by SD 29768)
17/05/2004	Supreme Decree	27499	Establishes new Reference Price and sets a new refinery margin for LPG
17/05/2004	Supreme Decree	27500	Reduces the impact of the variation of the international reference prices on the final prices of Special Gasoline and diesel
19/05/2004	Supreme Decree	27503	Approves contracts for the sale of natural gas to the Republic of Argentina
19/05/2004	Supreme Decree	27505	Modifies exportable volume of natural gas to the Republic of Argentina and YPFB remuneration (abrogated by SD 27511)
20/05/2004	Supreme Decree	27511	Modifies exportable volume of natural gas to the Republic of Argentina (modified by SD 27865)
25/05/2004	Supreme Decree	27516	Modifies IEHD rates for Special Gasoline and diesel (suspended by SD 27690)
29/06/2004	Supreme Decree	27601	Approves mechanism of gradual adjustment of final LPG prices (abrogated by SD 27992)
07/07/2004	Supreme Decree	27617	Suspends application of IEHD calculation methodology
19/07/2004	Supreme Decree	27632	Standards for the production, refining and sale of the product called Agro Fuel
17/08/2004	Supreme Decree	27677	Approves mechanism for the gradual adjustment of LPG final prices

17/08/2004	Supreme Decree	27678	Modifies the mechanism of gradual adjustment of the IEHD in the final prices of diesel oil
19/08/2004	Supreme Decree	27690	Regulates methodology for calculating the IEHD for national diesel and establishes price variation mechanisms for National A-1 Jet Fuel A-1, International A-1 Jet Fuel and kerosene (repealed by SD 27697)
19/08/2004	Supreme Decree	27691	Adjusts the conditions of commercialization of crude oil in the domestic market; price cap 27.11 USD/barrel and 24.53 USD/barrel minimum
20/08/2004	Supreme Decree	27695	Establishes transport and refinery margins for LPG and compensation margin
23/08/2004	Supreme Decree	27696	Modifies methodology for calculating the IEHD of imported diesel and IPD
23/08/2004	Supreme Decree	27697	Stabilizes the prices of Special Gasoline, diesel, and LPG (extends terms of SD 27770 and SD 27863)
26/08/2004	Supreme Decree	27700	Extends the suspension to 40 additional days to the provisions of SD 27697 (extends term of SD 27863)
07/09/2004	Supreme Decree	27715	Modifies methodology for calculating the IEHD of imported diesel oil
06/10/2004	Supreme Decree	27778	Establishes that the Regulatory Entity must use the reference prices in force on the date of publication of this Supreme Decree
12/11/2004	Supreme Decree	27832	Modifies definition of PP0 established in SD 27715
26/11/2004	Supreme Decree	27863	Extends to an additional 40 days the scope of SD 27697 as amended by SD 27700
26/11/2004	Supreme Decree	27865	Extends term, exportable volume, and export permit to the Republic of Argentina
30/12/2004	Supreme Decree	27959	Modifies Regulation on Price Regime of Petroleum Derivatives, sets the Reference Price at 16.91 USD/barrel for LPG and establishes IEHD rates
03/01/2005	Supreme Decree	27963	Declares national emergency supply of diesel oil
04/01/2005	Supreme Decree	27964	Temporarily modifies the definitions of the IEHD rate adjustment mechanism for

			30 days (extended by SD 28000 abrogated by SD 28046)
07/01/2005	Supreme Decree	27967	Regulates domestic and foreign market prices of crude oil, LPG, and natural gas (as amended up to SD 28106)
19/01/2005	Supreme Decree	27983	Establishes IEHD rates for national diesel and Agro Fuel
28/01/2005	Supreme Decree	27989	Establishes IEHD rate for domestic diesel
28/01/2005	Supreme Decree	27992	Stabilizes prices of major oil products and repeals rules that adjust their prices to international prices and by exchange rate
28/01/2005	Supreme Decree	27993	Establishes a mechanism for the price of the International A-1 Jet Fuel to be competitive with the prices of neighboring markets, introducing the IEHD rate
03/02/2005	Supreme Decree	28000	Extends to an additional 90 days the IEHD mechanism defined in SD 27964 (abrogated by SD 28046)
07/03/2005	Supreme Decree	28027	Authorizes YPFB to sign contracts for the sale of natural gas to the Republic of Argentina
22/03/2005	Supreme Decree	28046	Modifies the definitions of the IEHD fee adjustment mechanism, established in SD 26917
01/04/2005	Supreme Decree	28059	Modifies the formula of the IEHD adjustment mechanism
27/04/2005	Supreme Decree	28103	Establishes new IEHD rate of Agro Fuel
29/04/2005	Supreme Decree	28106	Establishes methodology for setting the price of natural gas for distribution by networks in the domestic market
16/05/2005	Supreme Decree	28117	Instructs revision of transport margins (both) new refinery margin and new LPG compensation margin
16/05/2005	Supreme Decree	28121	Establishes price chain of LPG produced in plants. Establishes methodology for calculating compensation for subsidy to LPG 10 Kg bottle
17/05/2005	Law	3058	Hydrocarbons Law approved (in force)
19/05/2005	Supreme Decree	28173	Provides for the transitional regime that must govern the hydrocarbon activities regulated by the Superintendency of Hydrocarbons
23/06/2005	Law	3086	Provides for the incorporation of anhydrous ethanol in a minimum mixture of 10%, up to 25% (abrogated by Law 1098)

08/08/2005	Supreme Decree	28275	Abrogates SD 27354
17/05/2005	Law	3207	Approves graduality in the implementation of biodiesel (abrogated by Law 1098)
21/10/2005	Supreme Decree	28416	Modifies definitions of SD 26917
01/05/2006	Supreme Decree	28701	Third Nationalization of Hydrocarbons "Héroes del Chaco"
20/11/2006	Supreme Decree	28932	Establishes adjustment band for import of A-1 International Jet Fuel and supply for Domestic A-1 Jet Fuel
22/12/2006	Supreme Decree	28984	Regulations for production incentives for small and marginal fields
16/02/2007	Supreme Decree	29032	Modifies minimum IEHD for the import of A-1 International Jet Fuel
01/03/2007	Supreme Decree	29049	Sets adjustments to the A-1 Jet Fuel import mechanism
06/05/2007	Supreme Decree	29122	Establishes commercialization of reconstituted crude and white gasoline
13/06/2007	Supreme Decree	29166	Establishes mechanisms for the import of LPG by YPFB, to cover the internal market
09/04/2008	Supreme Decree	29508	Establishes the storage margin of liquid fuels (abrogated by SD 970)
09/04/2008	Supreme Decree	29510	Establishes guidelines for natural gas prices in the domestic market for natural gas distribution by networks, thermoelectric generation, direct consumers, and VNG
02/07/2008	Supreme Decree	29629	Regulates the price regime for vehicular natural gas (VNG) (as amended up to SD 2782)
08/10/2008	Supreme Decree	29732	Regulates and establishes mechanisms that facilitate, expedite, and enable the recovery of the subsidy through the issuance of endorsable (negotiable) NOCREs for the import of liquid hydrocarbons conducted by YPFB
22/10/2008	Supreme Decree	29753	Extensive mechanisms of control and sanctioning of the illicit distribution, transport and commercialization of LPG, diesel and gasoline
29/10/2008	Supreme Decree	29768	Updates the calculation of different transport margins for regulated products (amended by SD 2717)
05/11/2008	Supreme Decree	29777	Updates the refinery margin and current IEHD rates for regulated products

26/11/2008	Supreme Decree	29814	Establishes mechanism for determining the price of International Special Gasoline and International Diesel (modified by SD 1905)
20/12/2008	Supreme Decree	29868	Establishes the tax and tariff treatment necessary for the import of inputs and additives to obtain Special Gasoline (abrogated by SD 286)
17/06/2009	Supreme Decree	176	Establishes mechanisms for the recovery of the subsidy for the import of diesel through the issuance of endorsable (negotiable) NOCREs in favor of YPFB
09/09/2009	Supreme Decree	286	Establishes procedures, tax, and tariff treatment for the import of inputs and additives to obtain Special Gasoline, as well as authorizing the respective subsidy
26/12/2010	Supreme Decree	748	Defines new IEHD rates for regulated products (abrogated by SD 759)
31/12/2010	Supreme Decree	759	Abrogates SD 748
07/09/2011	Supreme Decree	970	Authorizes the head of sector Ministry to define by means of a Ministerial Resolution the maximum storage rate of liquid fuels
18/04/2012	Supreme Decree	1202	Incentives for oil and natural gas production
11/09/2013	Supreme Decree	1719	Establishes definition of Direct Consumer and guideline to determine the natural gas price for PSLs
28/10/2013	Ministerial Resolution	255	Approves methodology to determine the gas price for PSLs
26/02/2014	Supreme Decree	1905	Modifies the definitions for the determination of the IEHD of imported diesel, International Special Gasoline, and International Diesel Oil
15/05/2014	Supreme Decree	1996	Regulates the technical, legal, economic conditions, as well as the administrative procedures, to conduct activities of Distribution of Natural Gas by Networks
08/01/2015	Supreme Decree	2242	Establishes min. IEHD for International A-1 Jet Fuel and establishes purchase price for International Special Gasoline and International Diesel
13/05/2015	Supreme Decree	2358	Sets the multi-pipeline transport margin for regulated petroleum products at 0.80 USD/barrel
11/12/2015	Law	767	Promotion for investment in exploration and exploitation of hydrocarbons

06/04/2016	Supreme Decree	2717	Establishes criteria for the calculation of the margin of different transports
01/06/2016	Supreme Decree	2782	Modifies SD 29629 of the VNG price regime
06/07/2016	Supreme Decree	2830	Regulates Law 767
03/08/2016	Supreme Decree	2863	Approves methodology to determine gas price for gas lift and for liquefying extraction plants
16/12/2016	Ministerial Resolution	289	Determines deadlines, mechanisms and procedures for the application of incentives
19/04/2017	Ministerial Resolution	48	Approves regulation establishing the structure of costs resulting from the import of inputs and additives for the manufacture of Special Gasoline, method of calculation of the subsidy and procedures
22/12/2017	Ministerial Resolution	147	Approves methodology to determine gas price as raw material and fuel for the Ammonia and Urea Plant (PAU)
20/01/2018	ANH Administrative Resolution	173	Approves at 0.90 USD/MCF the price of natural gas as raw material and fuel for the PAU
15/09/2018	Law	1098	Approves the production and sale of VBA to gradually reduce the subsidy of inputs and additives and diesel oil, authorizes regulation by SD and Ministerial Resolution
25/09/2018	Supreme Decree	3672	Determines that the fuels to be sold with anhydrous ethanol content will have a volumetric proportion of up to 12% of said VBA
03/10/2018	Ministerial Resolution	121	Regulates the technical characteristics of quality of the base gasoline for its mixture with VBA up to 12%, for obtaining fuel with anhydrous ethanol RON 92
18/10/2018	Ministerial Resolution	127	Approves the Methodology for the Determination of the Price of Anhydrous Ethanol (modified by MR 133)
19/10/2018	Ministerial Resolution	130	Approves guidelines to determine the price of liquid fuel with octane 92, resulting from the mixture of anhydrous ethanol with base gasoline, as well as its update; and regulates the trading aspects related to the final fuel and the base gasoline (modified by MR 185)

24/10/2018	Ministerial Resolution	133	Modifies the variable "rdes" of MR 127
31/12/2018	Ministerial Resolution	184	Approves the methodology for the determination of prices of Anhydrous Ethanol, as an VBA
31/12/2018	Ministerial Resolution	185	The description of the parameter Ψ established in Equation (2) of Article 4 of the Annex to the MR 130 is modified
02/01/2019	ANH Administrative Resolution	2	Approves the price of anhydrous ethanol
28/01/2019	Ministerial Resolution	15	Regulates the methodology for the determination and updating of prices of final fuels resulting from the mixture of anhydrous ethanol with base gasolines
01/04/2019	Ministerial Resolution	42	Approves base gasoline quality to obtain Special+ Gasoline with mixture of up to 8% anhydrous ethanol
01/04/2019	Ministerial Resolution	45	Approves the calculation methodology for the determination of the Ex-Refinery Price and Pre-Final Price of the base gasoline
25/07/2019	Supreme Decree	3992	Establishes procedures and tax treatment for the import of inputs and additives by YPFB or YPFB Refinación S.A. to obtain base gasolines and authorizes the subsidy
25/09/2019	Bi-Ministerial Resolution MHE and MEFP	1	Approves the methodology for calculating the subsidy for obtaining base gasolines resulting from the mixture or not of I&A with white gasoline
09/08/2020	ANH Administrative Resolution	73	Approves at 1.31 USD/MCF the price of Natural Gas for PSLs
18/08/2020	Ministerial Resolution	60	Approves base A gasoline quality to obtain Special+ Gasoline with 12% anhydrous ethanol blend
07/09/2020	ANH Administrative Resolution	240	Instructs YPFB to blend Base A gasoline with 12% anhydrous ethanol for Special Gasoline+
20/01/2022	Supreme Decree	4661	Establishes conditions for the import of crude oil by YPFB, as well as tax and tariff treatment for this purpose and authorizes the subsidy

Annex 2: Historical prices of gasoline and diesel oil in Bolivia

Date	Special Gasoline	Diesel Oil	Date	Special Gasoline	Diesel Oil
5-Dec-97	2.56	2.50	25-Jun-99	2.66	2.59
19-Dec-97	2.56	2.46	1-Jul-99	2.71	2.59
8-Jan-98	2.56	2.42	5-Jul-99	2.71	2.66
13-Jan-98	2.52	2.42	14-Jul-99	2.71	2.71
27-Jan-98	2.52	2.38	28-Jul-99	2.71	2.77
7-Feb-98	2.48	2.38	18-Aug-99	2.71	2.83
10-Mar-98	2.48	2.35	20-Aug-99	2.77	2.83
12-Mar-98	2.44	2.35	18-Nov-99	2.77	2.93
24-Mar-98	2.44	2.32	20-Nov-99	2.84	2.93
17-Jun-98	2.44	2.31	15-Dec-99	2.97	3.02
5-Aug-98	2.42	2.31	12-Feb-00	2.98	3.05
8-Aug-98	2.42	2.28	3-Mar-00	3.06	3.05
26-Aug-98	2.38	2.28	15-Mar-00	3.13	3.05
19-Sep-98	2.38	2.34	11-Apr-00	3.13	3.02
29-Sep-98	2.38	2.37	30-Apr-00	3.13	3.12
14-Nov-98	2.38	2.35	3-May-00	3.22	3.12
19-Nov-98	2.36	2.35	24-Jun-00	3.31	3.12
24-Nov-98	2.36	2.32	29-Mar-02	3.30	3.12
2-Dec-98	2.36	2.28	11-Apr-02	3.31	3.12
9-Dec-98	2.36	2.25	8-Apr-04	3.34	3.15
19-Dec-98	2.42	2.34	10-May-04	3.35	3.15
2-Feb-99	2.42	2.38	13-May-04	3.35	3.16
23-Mar-99	2.42	2.43	21-May-04	3.37	3.16
27-Mar-99	2.42	2.47	8-Jun-04	3.37	3.21
2-Apr-99	2.42	2.51	11-Jun-04	3.38	3.21
9-Apr-99	2.42	2.54	9-Aug-04	3.40	3.23
22-Apr-99	2.48	2.54	30-Dec-04	3.74	3.98
24-Apr-99	2.48	2.59	19-Jan-05	3.74	3.72
5-May-99	2.52	2.59	26-Dec-10	6.47	6.80
14-May-99	2.56	2.59	31-Dec-10	3.74	3.72
28-May-99	2.61	2.59			

Source: Superintendencia de Hidrocarburos, Agencia Nacional de Hidrocarburos

Compiled by: Authors

Annex 3: Estimation of subsidies for not updated margins

Year	CPI (August 2004=100)	Refinery margin (Bs/liter)	Compensation margin (Bs/liter)	Pipeline margin (Bs/liter)	Different Transportation margin (Bs/liter)	Storage margin (Bs/liter)	Wholesaler margin (Bs/liter)	Retail margin (Bs/liter)	Gasoline volume (MM liters)	Subsidy (MM Bs)	Exchange rate (Bs/USD)	Subsidy (MM USD)
2010	150.74	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	873.0	1,064.8	7.07	150.7
2011	161.14	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	863.1	1,125.3	6.99	161.1
2012	168.46	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	942.1	1,284.1	6.96	184.5
2013	179.37	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,074.8	1,560.0	6.96	224.1
2014	188.69	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,093.3	1,669.2	6.96	239.8
2015	194.26	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,097.5	1,725.2	6.96	247.9
2016	202.04	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,406.7	2,299.6	6.96	330.4
2017	207.52	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,376.6	2,311.6	6.96	332.1
2018	210.65	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,324.4	2,257.4	6.96	324.3
2019	213.74	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,197.8	2,071.6	6.96	297.6
2020	215.18	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,273.6	2,217.5	6.96	318.6
2021	217.12	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,223.9	2,150.2	6.96	308.9
2022e	221.46	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,175.0	2,105.4	6.96	302.5
2023e	225.89	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,128.0	2,061.6	6.96	296.2
2024e	230.41	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,082.8	2,018.8	6.96	290.1
2025e	235.01	0.3048	0.0800	0.0405	0.0734	0.0390	0.0800	0.1914	1,039.5	1,976.8	6.96	284.0

Estimation of subsidies for not updating margins of National Diesel Oil

Year	CPI (August 2004=100)	Refinery margin (Bs/liter)	Compensation margin (Bs/liter)	Pipeline margin (Bs/liter)	Different Transportation margin (Bs/liter)	Storage margin (Bs/liter)	Wholesaler margin (Bs/liter)	Retail margin (Bs/liter)	National Diesel Oil volume (MM liters)	Subsidy (MM Bs)	Exchange rate (Bs/USD)	Subsidy (MM USD)
2010	150.74	0.30	0.08	0.04	0.07	0.04	0.08	0.16	641.5	751.6	7.07	106.3
2011	161.14	0.30	0.08	0.04	0.07	0.04	0.08	0.16	679.6	851.1	6.99	121.8
2012	168.46	0.30	0.08	0.04	0.07	0.04	0.08	0.16	729.9	955.6	6.96	137.3
2013	179.37	0.30	0.08	0.04	0.07	0.04	0.08	0.16	825.4	1,150.8	6.96	165.3
2014	188.69	0.30	0.08	0.04	0.07	0.04	0.08	0.16	897.7	1,316.5	6.96	189.2
2015	194.26	0.30	0.08	0.04	0.07	0.04	0.08	0.16	1,005.2	1,517.7	6.96	218.1
2016	202.04	0.30	0.08	0.04	0.07	0.04	0.08	0.16	925.4	1,453.1	6.96	208.8
2017	207.52	0.30	0.08	0.04	0.07	0.04	0.08	0.16	846.8	1,365.9	6.96	196.2
2018	210.65	0.30	0.08	0.04	0.07	0.04	0.08	0.16	822.7	1,346.9	6.96	193.5
2019	213.74	0.30	0.08	0.04	0.07	0.04	0.08	0.16	664.5	1,104.0	6.96	158.6
2020	215.18	0.30	0.08	0.04	0.07	0.04	0.08	0.16	708.1	1,184.2	6.96	170.2
2021	217.12	0.30	0.08	0.04	0.07	0.04	0.08	0.16	617.6	1,042.2	6.96	149.7
2022e	221.46	0.30	0.08	0.04	0.07	0.04	0.08	0.16	555.8	956.7	6.96	137.5
2023e	225.89	0.30	0.08	0.04	0.07	0.04	0.08	0.16	500.3	878.3	6.96	126.2
2024e	230.41	0.30	0.08	0.04	0.07	0.04	0.08	0.16	450.2	806.3	6.96	115.8
2025e	235.01	0.30	0.08	0.04	0.07	0.04	0.08	0.16	405.2	740.2	6.96	106.3

Annex 4: Statistical basis for international comparative analysis

Argentina

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Gas Oil grade 2 [1]	$/liter	29.12	19.70	24.50	27.68	43.39	54.79	84.97
Gas Oil grade 3 [1]	$/liter	14.61	17.42	28.46	32.60	49.17	64.99	101.01
Gasoline (between 92 and 95 RON)	$/liter	15.40	24.45	30.11	31.21	44.81	59.19	89.23
LPG [2]	USD/Kilo		0.12	0.12	0.18	0.24		
Electricity								
Residential [3]	USD/MWh		68.90	87.01	94.56	90.85	76.24	
Industrial [4]	USD/MWh		51.71	77.71	68.08	68.44	52.78	
Natural Gas								
VNG [5]	$/CM	5.85	8.08	11.63	14.54	20.91	25.35	41.05
Industrial [6]	USD/MM BTU				4.26			
Residential [7]	USD/MM BTU		4.34	5.70	7.29	7.35	6.19	
Electricity [8]	USD/MM BTU			5.20	3.98	2.42	2.00	
GDP [9]	current MM $	5,954,511	8,228,160	10,660,228	14,744,811	21,802,256	27,481,440	187,787,007
Population [10]	MM people	43.1	43.6	44.0	44.5	44.9	45.4	45.8
Exchange rate [11]	$/USD	14.1	15.3	17.2	28.7	51.6	123.8	148.0

Source:

(1) Secretaría de Energía

(2) OLADE 2016 - 2019

(3) OLADE 2016 - 2019

(4) OLADE 2016 - 2019

(5) Secretaría de Energía

(6) Secretaría de Energía. Year 2018 Res 1/2018

(7) OLADE 2016 - 2019

(8) OLADE 2017 - 2019

(9) INDEC. Estimate 2021 data based on official data until september 2021

(10) INDEC

(11) Informal Dollar Sell, Source: https://www.ambito.com/contenidos/dolar-informal-historico.html

Bolivia

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Diesel Oil [1]	Bs/liter	3.72	3.72	3.72	3.72	3.72	3.72	3.72
Gasoline [2]	Bs/liter	3.74	3.74	3.74	3.74	3.74	3.74	3.74
LPG [3]	Bs/Kilo	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Electricity								
Residential [4]	USD/MWh	103.79	106.90	112.76	118.43	119.96	115.44	116.84
Industrial [5]	USD/MWh	80.94	83.79	89.89	96.86	97.29	97.12	91.79
Natural Gas								
VNG [6]	USD/MM BTU	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Industrial [7]	USD/MM BTU	1.64	1.64	1.64	2.14	2.14	2.14	2.14
Residential [8]	USD/MM BTU	5.33	5.33	5.33	5.33	5.33	5.33	5.33
Electricity [9]	USD/MM BTU	1.35	1.35	1.35	1.35	1.35	1.35	1.35
GDP [10]	Current MM Bs	228,031	234,533	259,185	278,388	282,587	252,718	284,573
Population [11]	MM people	10.9	11.0	11.2	11.3	11.5	11.7	11.8
Exchange rate [12]	Bs/USD	6.96	6.96	6.96	6.96	6.96	6.96	6.96

Source:

(1) ANH

(2) ANH

(3) ANH

(4) Autoridad de Fiscalización de Electricidad y Tecnología Nuclear, end consumer tariff with taxes

(5) Autoridad de Fiscalización de Electricidad y Tecnología Nuclear, end consumer tariff with taxes

(6) OLADE 2015 - 2019, ANH 2020 - 2021

(7) OLADE 2015 - 2019, ANH 2020 - 2021

(8) OLADE 2015 - 2019, ANH 2020 - 2021

(9) OLADE 2015 - 2019, ANH 2020 - 2021

(10) INE 2015 - 2020, 2021 own estimates bassed on quarterly data from INE from January to September 2021

(11) INE

(12) BCB

Brazil

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Diesel Oil [1]	R$/liter	2.83	3.01	3.11	3.49	3.59	3.42	4.65
Gasoline [2]	R$/liter	3.34	3.68	3.77	4.41	4.38	4.28	5.81
LPG [3]	R$/Kilo	3.72	4.16	4.54	5.23	5.31	5.44	6.98
Electricity								
Residential [4]	R$/kWh	0.42	0.60	0.64	0.64	0.72	0.75	0.90
Industrial [5]	R$/kWh	0.33	0.52	0.54	0.54	0.62	0.65	0.81
Natural Gas								
VNG [6]	R$/CM	2.06	2.25	2.34	2.73	3.16	3.09	3.79
Industrial [7]	R$/CM	1.50	1.49	1.62	1.95	2.32	2.14	2.80
Residential [8]	R$/CM	3.24	3.36	3.74	4.53	5.11	4.92	6.80
Electricity [9]	USD/MM BTU	3.96	3.94	4.18	4.22	4.16	4.25	4.63
GDP [10]	Current MM R$	5,995,787	6,269,328	6,585,479	7,004,141	7,389,131	7,467,616	8,679,490
Population [11]	MM people	203.5	205.2	206.8	208.5	210.15	211.76	213.32
Exchange rate [12]	Reais/USD	3.34	3.48	3.19	3.66	3.95	5.16	5.39

Source:

(1) ANP, Estimated 2021 value based on graphic info from ANP

(2) ANP, Estimated 2021 value based on graphic info from ANP

(3) ANP, Estimated 2021 value based on graphic info from ANP

(4) Ministerio de Minas y Energía de Brasil 2015 - 2020, data of 2021 until September. All prices include taxes

(5) Ministerio de Minas y Energía de Brasil 2015 - 2020, data of 2021 until September. All prices include taxes

(6) ANP, Data for 2016 taken from Ministerio de Minas y Energía

(7) Ministerio de Minas y Energía, corresponds to the consumption rate up to 20,000 CMD

(8) Ministerio de Minas y Energía, prices correspond to the months of December of each year. From year 2018 the price corresponds to January 2019

(9) Ministerio de Minas y Energía, Thermoelectric Priority Program (PPT)

(10) Banco Central do Brasil

(11) Instituto Brasileño de Geografía y Estadística

(12) Banco Central do Brasil

Chile

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Diesel Oil [1]	$/liter	525.0	444.0	500.7	595.0	615.0	570.0	
Gasoline [2]	$/liter	721.0	685.0	731.4	799.0	804.0	794.0	
LPG [3]	$/Kilo	1,028.3	1,028.0	1,156.6	1,283.9	1,311.1	1,256.1	
Electricity								
Residential [4]	USD/MWh	157.87	169.22	199.13	197.47	196.38	180.27	
Industrial [5]	USD/MWh	114.65	124.58	140.23	159.04	159.66	164.46	
Natural Gas								
VNG [6]								
Industrial [7]	USD/MM BTU							
Residential [8]	USD/MM BTU	27.42	25.17	28.91	35.91	31.60	29.72	
Electricity [9]	USD/MM BTU							
GDP [10]	Thousands MM of $	158,623	168,765	179,315	189,435	195,816	200,344	240,633
Population [11]	MM people	18.0	18.2	18.4	18.8	19.1	19.5	19.7
Exchange rate [12]	$/USD	654.25	676.83	649.33	640.29	702.63	792.22	759.27

Source:

(1) Comisión Nacional de Energía

(2) Comisión Nacional de Energía

(3) Comisión Nacional de Energía

(4) OLADE 2015 - 2020

(5) OLADE 2015 - 2020

(6) .

(7) .

(8) OLADE 2015 - 2020

(9) .

(10) Banco Central de Chile

(11) INE

(12) Banco Central de Chile

Paraguay

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Diesel Oil [1]	USD/liter	0.91	0.76	0.75	0.86	0.82	0.74	
Gasoline [2]	USD/liter	1.05	0.92	0.90	0.97	0.93	0.85	
LPG [3]	USD/Kilo	1.37	1.17	1.13	1.10	0.99	0.94	
Electricity								
Residential [4]	USD/MWh	76.53	70.89	76.84	78.10	75.12	69.72	
Industrial [5]	USD/MWh	53.44	48.01	59.87	61.98	55.56	52.01	
Natural Gas								
VNG [6]	USD/MM BTU	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Industrial [7]	USD/MM BTU	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Residential [8]	USD/MM BTU	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Electricity [9]	USD/MM BTU	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GDP [10]	Thousands MM of G$	188,477	204,647	219,122	230,576	236,681	239,915	268,061.8
Population [11]	MM people	6.8	6.9	7.0	7.1	7.2	7.3	7.4
Exchange rate [12]	G$/USD	5,228	5,674	5,591	5,688	6,138	6,671	6,757.53

Source:

(1) OLADE 2015 - 2020

(2) OLADE 2015 - 2020

(3) OLADE 2015 - 2020

(4) OLADE 2015 - 2020

(5) OLADE 2015 - 2020

(6) No consumption of this type of energy is recorded in the country

(7) No consumption of this type of energy is recorded in the country

(8) No consumption of this type of energy is recorded in the country

(9) No consumption of this type of energy is recorded in the country

(10) Banco Central del Paraguay

(11) INEI

(12) Banco Central del Paraguay, is for sell Exchange Rate

Peru

Concept	Unit	2015	2016	2017	2018	2019	2020	2021
Hydrocarbons								
Diesel Oil [1]	Soles/Gallon	11.80	10.58	11.79	13.36	13.79	12.58	14.90
Gasoline [2]	Soles/Gallon	15.93	14.12	14.99	15.82	15.89	13.79	16.16
LPG [3]	Soles/Kilo	4.12	4.02	3.98	4.08	4.02	3.88	4.74
Electricity								
Residential [4]	Soles/MWh	519.54	545.21	535.16	552.85	566.71	583.68	604.25
Industrial [5]	Soles/MWh	333.79	354.50	351.18	374.36	379.73	397.30	415.92
Natural Gas								
VNG [6]	Soles/CM	1.76	1.65	1.59	1.57	1.54	1.51	1.45
Industrial [7]	USD/MM BTU	0.51	0.50	0.56	0.54	1.20	1.30	
Residential [8]	USD/MM BTU	5.79	5.03	7.04	6.33	7.15	6.95	
Electricity [9]	USD/MM BTU	0.54	0.49	0.57	0.74	0.82	0.97	
GDP [10]	Current MM soles	604,416	647,668	687,989	731,588	761,984	704,939	866,342
Population [11]	MM people	30.0	30.4	31.0	31.6	32.1	32.6	33.0
Exchange rate [12]	Soles/USD	3.19	3.38	3.26	3.29	3.34	3.50	3.88

Source:

(1) Ministerio de Energía y Minas; Banco Central del Perú

(2) Ministerio de Energía y Minas; Banco Central del Perú. 95 octane

(3) Ministerio de Energía y Minas; Banco Central del Perú. Price in Lima

(4) OSINERGMIN, Banco Central dek Perú. BT5 Tariff

(5) OSINERGMIN, Banco Central dek Perú. MT2 Tariff

(6) Ministerio de Energía y Minas; Banco Central del Perú. Price in Lima

(7) OSINERGMIN, is the implicit rate resulting from dividing the sales value and the sales volume, for the Lima/Callao concession and 1 CF = 1,000 BTU

(8) OSINERGMIN, is the implicit rate resulting from dividing the sales value and the sales volume, for the Lima/Callao concession and 1 CF = 1,000 BTU

(9) OSINERGMIN, is the implicit rate resulting from dividing the sales value and the sales volume, for the Lima/Callao concession and 1 CF = 1,000 BTU

(10) INEI

(11) INEI

(12) Banco Central del Perú, bank exchange rate for sale