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Ex-refinery prices

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Empresa de Pesquisa Energética (EPE), or Energy Research Office, is a government-owned entity, attached to the Brazilian Ministry of Mines and Energy. The purpose of EPE is to provide energy information, studies and research that support the planning of the national energy sector.

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Ex-refinery prices

Brazil's Energy Research Office (Empresa de Pesquisa Energética - EPE) prepared this Special Report in order to help clarify ex-refinery-prices and its main components to group of potential investors and other stakeholders.

1. Introduction

When assessing the formation of fuel prices, it is usual to subdivide them in the following portions: i) ex-refinery price, ii) taxes and subsidies, and iii) gross distribution and resale margins. When there is formation of fuel by a blend, there is an additional portion of the realization price of the blend´ second chemical component. The main examples of fuels formed by blend in Brazil are: diesel B13 (fossil diesel and biodiesel) and gasoline E27 (gasoline and anhydrous ethanol). In both cases, the largest portion of the blend is represented by an oil product and the smallest by a biofuel, as illustrated in **Erro! Fonte de referência não encontrada.**.

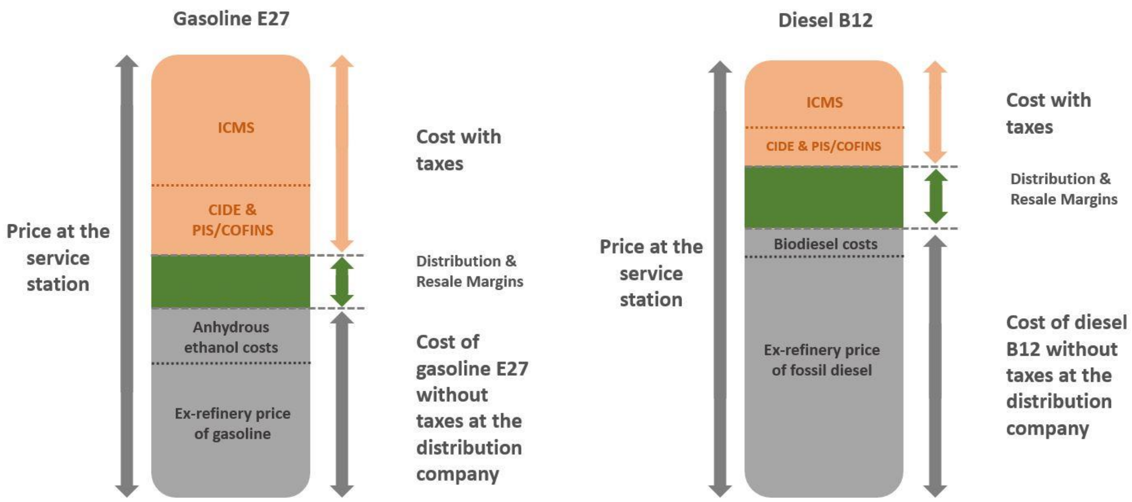

Figure 1 - Composition of prices at the pump for consumers of gasoline C and diesel B
Source: EPE.

It is important to note that a large part of the Brazilian consumer is unaware of how the ex-refinery price of oil products is determined. To address this, EPE initiates a series of studies in order to clarify the topic and better inform society about various aspects related to the fuel pricing. This document, part of the Fuel Price Series, aims to describe the composition of the ex-refinery price of oil products, which represents only a portion of the price the final consumer is charged at the service stations.

2. Ex-refinery price of oil products

Ex-refinery price means the prices of oil products sold by refineries (when produced in the country) or exiting the terminal (when imported), less, in both cases, taxes and subsidies. The ex-refinery price comprises the costs related to the import of the product or the purchase of inputs and the producer/refining[1] cost structure, in addition to the profit margin of the producer or importer. Figure 2 compares the composition of the ex-refinery price of a refined oil product in the country with an imported one.

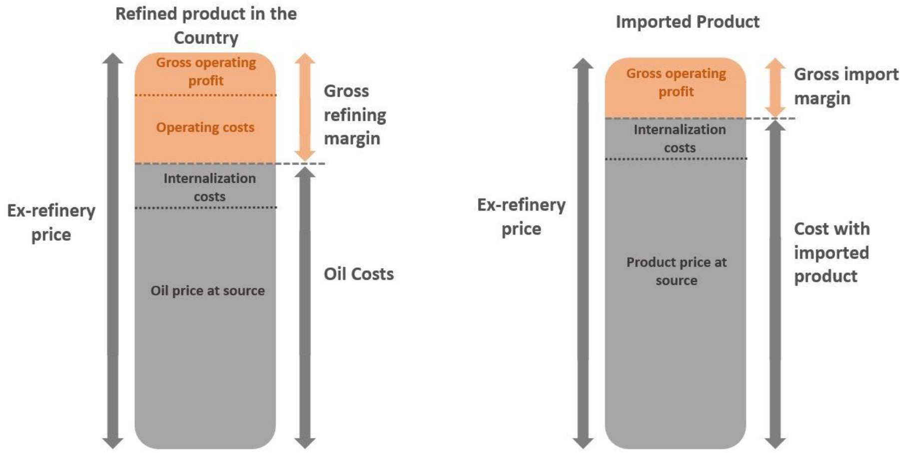

Figure 2 - Composition of the realization price
Source: EPE.

It is worth mentioning that an importer usually purchases a product directly and its accounting for calculating gross operating profit is simpler, always dealing with a specific product. Although usually the ex-refinery prices of each oil product are presented individually, the decomposition of the costs inherent to refining for each product is subject to a certain degree of subjectivity. In addition, the basket of products generated at each refining plant differs substantially from one to another. For these reasons, refining margins from the perspective of a processed oil barrel, rather than by volume of product made, are analyzed more frequently. Among the several variables that affect the economy of a refinery or importer, the following stand out:

- purchase price of oil or oil product;
- internalization[2];
- operational costs;
- gross operating profit.

Next, we will briefly address each of these aspects.

[1] Includes government interests on oil, and direct and indirect taxes generated in the Exploration and Production segments of the oil chain.
[2] Transporting the product from its point of origin to the location of the agent, with all costs involved in the process.

2.1. Acquisition of oil or oil products

The economy of a refinery relates to both the revenue side and the cost side. In the latter, the most representative cost relates to the acquisition of oil. No oil is the same as another, with the main characteristics that distinguish it being its density and its contaminants. Lighter (less dense) oils tend to result in higher value-added products, so the tendency is for them to have a premium[3] spread over heavier oils. There are, however, other important factors in oil pricing. A higher content of contaminants, such as sulfur and nitrogen compounds, devalues commercialized oil. The above indications serve as a rule of thumb, but geopolitical factors also have the potential to affect the relationship between supply and demand, affecting the price and premium between different types of oil (EPE, 2019).

When the purchase price of the oil to be processed is strictly analyzed, a more complex refinery, with a greater number of conversion units[4], has an apparent relative advantage over a simpler one, as it is the first most conducive to the processing of heavier oils[5]. However, market conditions constantly change over time, and it is unwise to assume that any relationship between the prices of two different oils remains constant *ad aeternum*. Furthermore, one should also consider the geolocations of the examined refineries and the sources of oil supply[6]. The use of foreign oil at a discounted FOB price may not be the best choice if its internalization is too expensive.

Regarding the import of oil products, the purchase price varies with the balance of supply and demand for each product in different locations. Although generally treated as a homogeneous product, an oil product has a specification range. Once the specification for consumption in the country is met, competition with domestic production occurs through an arbitration mechanism, that is, the ability of an economic agent to place the product at prices that dispute part of the domestic market. Additionally, one can purchase compounds without specification for consumption for blend and/or formulation of a specific oil product.

2.2. Internalization costs

When the domestic market is supplied through imports, the ex-refinery price resulting from an oil product comes from the price in the home market plus the costs of internalization and the gross operating profit of the importer. Furthermore, when there is production of oil product on national soil, there is a cost of internalizing the oil to the refinery, whether imported or produced domestically - offshore or onshore. The main components of internalization costs are listed below.

[3] Term used to designate the positive price differential of a product with higher benefit in relation to another, of lower value.

[4] The operating units of a refinery can be simplified as separation, when their objective is to separate the load from the unit without the occurrence of chemical reactions, or conversion, when chemical reactions occur - resulting in the formation of compounds of greater economic value.

[5] It is worth mentioning that, depending on the cost of acquisition of light and heavy oil, even a more complex refinery could optimize its economic result when using the light type - even though its structure has not been ideally sized for processing of such oil.

[6] If refineries in a given geographic region were optimized for the processing of heavier oil and the local market had mainly the offer of light oils, this situation would certainly influence the premium of light oil in relation to heavy and, consequently, the prices of different types of oil. If there was a deficiency in the local supply of raw material, there would be a need to import the load, raising the market value of this type of oil in the region. An eventual producer of heavy oil in the locality would benefit from the situation, pricing its product based on the price of imported oil at source plus the costs of internalization. On the other hand, the local excess supply of light oil would lead its producers to export it. In this case, the reduction of the price at the origin of this oil would be fundamental for it to reach the international market at a competitive value. In this way, a refinery located there with a profile focused on the processing of light oils would also benefit, since its cost with the acquisition of raw materials would be reduced.

2.2.1. Most relevant costs

1. *Cost with Offshore Transport*

The freight of the offshore transport from the origin to the destination port in Brazil. In the case of national offshore oil production, transportation to the coast can also take place via oil pipelines, the cost of transportation being, in this case, the sum of the depreciation of the oil pipeline and its operating costs.

2. *Additional Rate to Freight for Renewal of the Merchant Navy (AFRMM, in Portuguese initials)*

To meet the costs of the Federal Government's intervention in supporting the development of the Merchant Navy and the Brazilian shipbuilding and repair industry (it constitutes a basic source of the Merchant Navy Fund). Corresponds to 25% of the value of international freight and currently applies only to ports in the South and Southeast regions (until January 8, 2022, AFRMM will not apply to goods whose final destination is a port located in the North or Northeast Region - Law No. 13.458/2017). Their participation in the total cost of internalization is moderate (South and Southeast) or null (other regions), being null in any region when it is not an import operation.

3. *Storage at Terminal*

Cost of storage at Brazilian port terminals. It varies greatly between ports.

4. *Cost with Land Transportation*

Road freight from the port to the point of supply, in case the internalizing establishment is not located near the first. Land transportation can also take place by rail or pipeline, the latter being the most usual for oil supply in large and medium-sized refineries.

2.2.2. Less relevant costs

1. *Losses*

Losses inherent in the transport of volatile liquids.

2. *Insurance*

Insurance of transported load.

3. *Financial Cost*

Refers to the costs of raising funds to finance the activity.

4. *Cost with Hedge*

Protection cost for the risks of the operation (exchange rate and international product price volatility).

5. *Cost with Customs Broker*

Customs broker is responsible for legal and administrative procedures for the entry or exit of goods from the country.

6. *Operational Breakdown at Terminal*

Losses in product handling and evaporation at the terminal.

7. *Demurrage*

Cost of surcharge at the ports, paid by the charterer to the carrier for the time used beyond that provided for in the charter party. It reflects insufficiencies in port infrastructure.

8. *Supervisor*

Obligation to hire a company approved by ANP to certify volume and quality of products in Brazilian ports.

9. Ship diversion

Additional cost for ports that cannot receive all load at once and/or have an extraordinary pilotage cost[7] (Cabedelo, Fortaleza, Belém, Itacoatiara).

2.3. Refining operating costs

In an accounting manner, the operating costs of a refinery is divided into two major groups: i) processing; and ii) depreciation.

2.3.1. Processing

When the oil product is imported, these costs are included in the purchase price of the product, so they are not apparent in the distribution of costs. Thus, this description refers essentially to oil products produced in national refineries, including:

1. Energy

Refining activity is highly energy intensive, which is the main component of a plant's operating costs. Part of the internal currents is for consumption in the generation of energy, both directly in the burning in furnaces[8] and in boilers for the generation of steam[9]. In the past, it was common for the fuel used to burn the units to be fuel oil, due to its low economic value. However, currently, due to environmental restrictions and employees' health regulations, the burning of gases (fuel gas[10] and natural gas) is preferred. Electricity not generated internally is acquired from the power grid (MAPLES, 2000).

2. Maintenance

Given the high capital involved in the construction and operation of a refinery, unscheduled downtime, as well as accidents, should be minimized. The annual cost of maintenance varies between 3% and 8% of the refinery's CAPEX, being 5.5% on average (PETROLEUM REFINING, 2007). This percentage already includes the labor required for maintenance.

3. Personnel

Although refineries are not labor intensive[11], their workers are highly qualified, which generally leads to higher wages. Thus, personnel expenses make up, together with energy and maintenance expenses, the three main refining costs.

4. Others

Indirect costs of the production process, such as utilities, cooling water, wastewater treatment, sulfur recovery and *flare*.

2.3.2. Depreciation

Depreciation stems from the deterioration and obsolescence of non-reversible capital expenditures. Its accounting as a cost usually uses the straight-line depreciation method. Therefore,

[7] Pilotage is a mandatory advisory activity for shipmasters in mooring and unberthing maneuvers, carried out by (pilot) professionals who are specialists in the characteristics and details of the region where the maneuver occurs.

[8] Furnaces are used for direct heating of loads, such as at the entrance to atmospheric distillation units, vacuum distillation and delayed coking.

[9] Steam is the main heating fluid in a refinery, through heat exchangers. In addition, it can also be used to generate electricity.

[10] Obtained inside the refinery itself as a by-product of several units (FCC, UCR). It has no economic value for commercialization, so it must be consumed *in loco* or burned (*flare*).

[11] Due to the high mechanization of the refineries, the ratio of the number of workers to the economic value added in the process is low.

the economic life ordinarily adopted for a refinery is 20 years (PETROLEUM REFINING, 2007). Obviously, a refinery does not stop operating in 20 years. Paulínia Refinery (Replan), for example, the largest refinery in Brazil, has been operating since 1972. It turns out that, after 20 years of an investment in refining, it is no longer book-entry depreciated, resulting in a lower accounting operating cost.

Among the new costs to be depreciated in the existing refineries, we highlight those related to revamps[12] necessary to comply with more stringent laws and regulations. In this line, the definitions of State for the exercise of an activity or the imposed limits of product specification are important components of the cost structure of the agents that work in the refining segment. The search for an ever smaller environmental footprint of oil-derived fuels, for example, calls for the elaboration of increasingly stringent technical specifications. For this implementation, in turn, these calls for adaptations in the refining facilities, which directly affect the price of the resulting fuels.

In early 2017, the sulfur content in gasoline produced for the North American market was reduced from 30 ppm to 10 ppm due to legal requirements. Therefore, there are estimates that US refineries have invested US$ 1.2 billion to achieve this goal (PETCHEM, 2016). Investments of this amount are amortized, in the form of depreciation costs, in the ex-refinery prices of the oil products.

In Brazil, this was observed with the start of production of S10 diesel oil (with a concentration of 10 ppm of sulfur) in 2012[13]. To meet this specification, several hydrotreatment units (HDTs) were built in the national refining facilities. The last unit to be completed, for example, was an HDT of 10,000 m^3/day of capacity at the Presidente Bernardes Refinery (RPBC - SP), built at a cost of more than R$ 2.4 billion (MP, 2018), or US$ 646 million.

The comparison between the depreciation costs of Petrobras and Valero[14], illustrated in Figure 3, does not mean that an agent was more or less efficient, but only that, in the last 20 years, it made more significant investments in downstream, for example, per processed barrel, than the other.

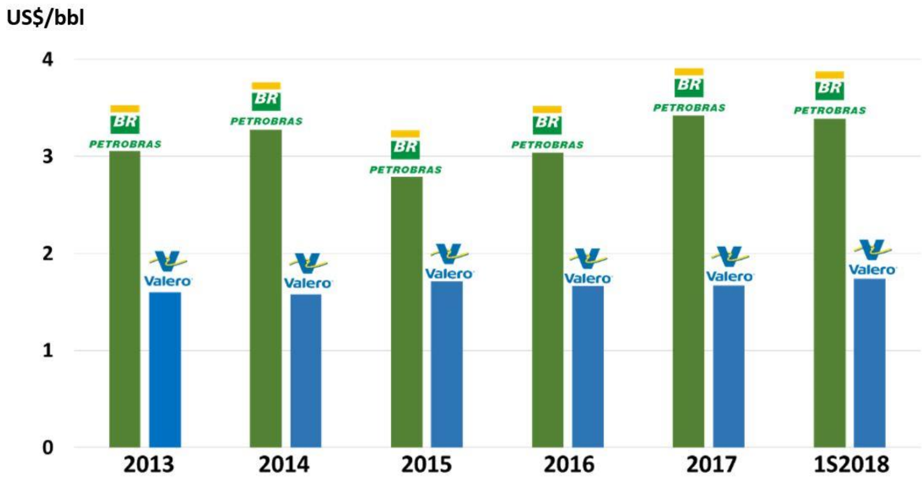

Figure 3 - Depreciation costs
Source: EPE from Petrobras (2018) and Valero (2018).

[12] Revamps carried out with the aim of adapting an industrial plant to new technical requirements or making it more efficient.
[13] Since 2012, new trucks and buses produced and licensed in Brazil need to meet the specifications of phase P7 of the Air Pollution Control Program by Motor Vehicles (Proconve), developed along the lines of the European standard EURO V. Gas treatment and the new technologies of this phase require the use of S10 diesel.
[14] Valero is one of the largest independent refiners in the world, with a major presence in the North American market. The business group also operates in several links in the supply of liquid fuels, including biofuels.

2.4. Gross operating profit

It is important to highlight that the ex-refinery price in Brazil is, according to current legislation, freely defined by the economic agent. This means that there is a tendency for the price to reflect the oscillations of the international market. Gross operating profit, in turn, will depend on the ex-refinery price less the price of oil or oil product at source, internalization costs and the operational costs of the offerer (refer to Figure 2). When comparing two refineries of the same complexity and with equivalent oil processing capacity that refine the same oil, what will distinguish them in terms of economic results is, essentially, the basket of products generated. For different production profiles[15], the market prices of each product greatly affect the revenue of each plant, so that the gross refining margins change constantly with the dynamism of the relationship between supply and demand for each oil product.

One should also discount the gross operating profit from administrative expenses, selling expenses, financial expenses, tax expenses, equity income, expenses with provisions and losses on adjustment to the recoverable value of assets, to then, reach net income.

3. Final remarks

Knowing the fuel pricing process is the first step to analyze the real reasons behind its fluctuations or even its stability. In Brazil, the price of a fuel for the final consumer is essentially composed of the gross margin of distribution and resellers companies, taxes, the cost of adding biofuels (when blended) and the ex-refinery price.

This specification booklet focused on clarifying the ex-refinery price, subdividing it into four composition items: i) product price (crude oil or fuel), ii) internalization costs, iii) refining operating costs; and iv) gross operating profit of the producer or importer.

The ex-refinery price of oil products at refineries depends directly on the cost of acquiring the oil to be processed. Thus, the national refineries can benefit from increased volumes of oil prospected in the country, since the sale of it to agents abroad requires the transportation of the *commodity*, allowing the discount of this cost when commercialized in the national territory. In such a case, new refineries tend to install themselves in Brazil, with the possibility of increasing competition, causing a lower price of the oil product to the final consumer.

In relation to operational refining costs, a reduction in the price of the energy used by refineries, especially natural gas, would boost the sector. Along these lines, government programs such as the Novo Mercado do Gás can be beneficial to the entry of new agents in the national refining, which is directly and indirectly associated with other programs, such as Abastece Brasil and REATE.

From the perspective of depreciation costs, it is worth mentioning that the promotion of refining activity through CAPEX tax relief programs could serve as an important instrument for new enterprises. These programs include Reidi (Special Incentive Scheme for Infrastructure Development - Law No. 11.488/2007 and Decree No. 6.144/2007) and Repenec (Special Incentive Scheme for the Development of Infrastructure in the

[15] EPE (2018) signals the basket of oil products produced in existing refineries in Brazil in 2017.

Oil Industry in the North, Northeast and Midwest Regions - Law No. 12.249/2010).

As for the ex-refinery price of oil products on import, the key variable is the cost of internalization - also present, in fact, when transporting oil to national refineries. Therefore, an optimization and/or expansion of the national port infrastructure would be reflected in benefits for all agents in the sector. Facilitating the entry of importing agents in a market of low competitiveness in the refining sector to increase the number of suppliers is very relevant, in order to contest the market and allow adjustments of the ex-refinery prices to this competition, thus benefiting the Brazilian consumer.

It is worth mentioning that, discounting general expenses, such as administrative, sales, financial, taxes, provisions, equity income and losses on adjustment to the recoverable value of assets, net income can be obtained from operating income of the producer and the importer.

Finally, this first section of the series sought to fulfill the role of clarifying an important part of the fuel pricing. In this sense, and in order to better inform society and reduce information asymmetries, EPE will continue to analyze and publish technical studies on the topic.

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