Indicative Oil Pipeline Plan

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About Energy Research Office - EPE

Empresa de Pesquisa Energética

The purpose of EPE is to provide energy information, studies **and** research that support the national energy planning.

EPE's expertise areas cover electricity, oil, natural gas, coal, nuclear, renewables and energy efficiency.

Global context calls for energy transition towards low emission sources

Context

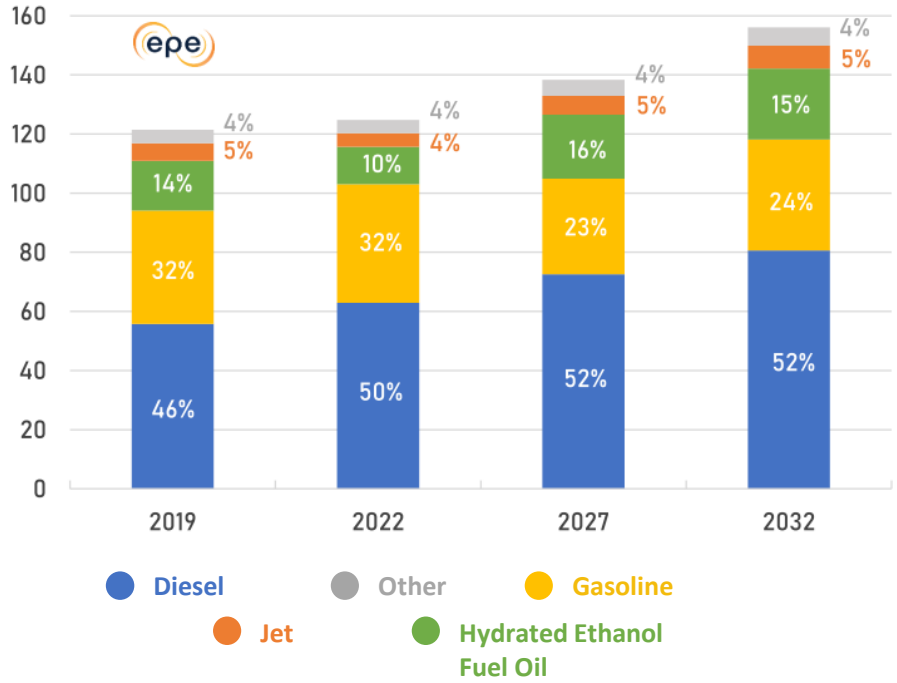
- Climate change and environmental policies
- Oil price uncertainties
- New technologies and energy sources
- Geopolitical threats

Energy trilemma is the main driver

Energy use under transition in order to guarantee **environmental sustainability, energy security and energy equity.**

Energy consumption will grow over the next decade, led by transport

Transport energy consumption by source (billion liters gasoline equivalent)
Source: EPE

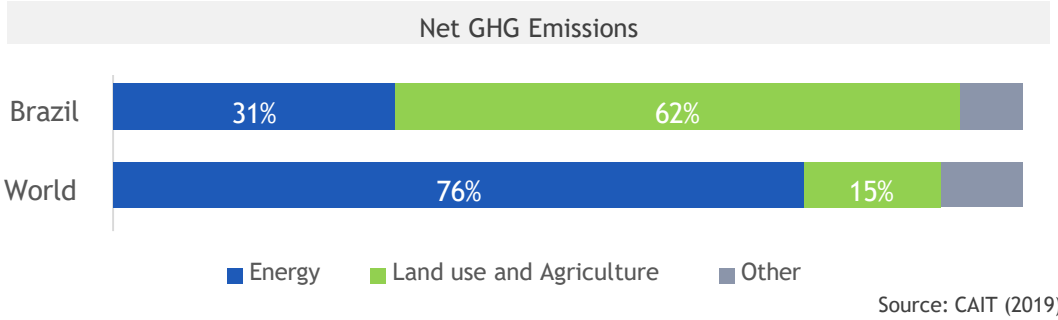


EPE Business as Usual case forecasts an increase in the transport´s sector dependence on fossil fuels.

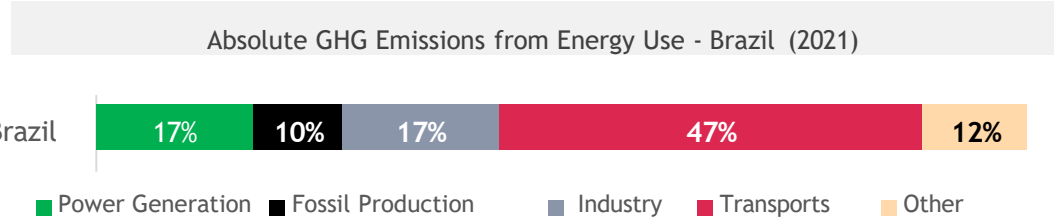
This comes despite incentives for biofuels, that are not expected to fully supply the demand growth.

Brazilian emissions

The emissions profile in Brazil is completely different from the global profile, which implies reconciling the agricultural, energy and environmental agendas. Transport sector has relevant contribution to Absolute GHG Emissions from Energy Use.



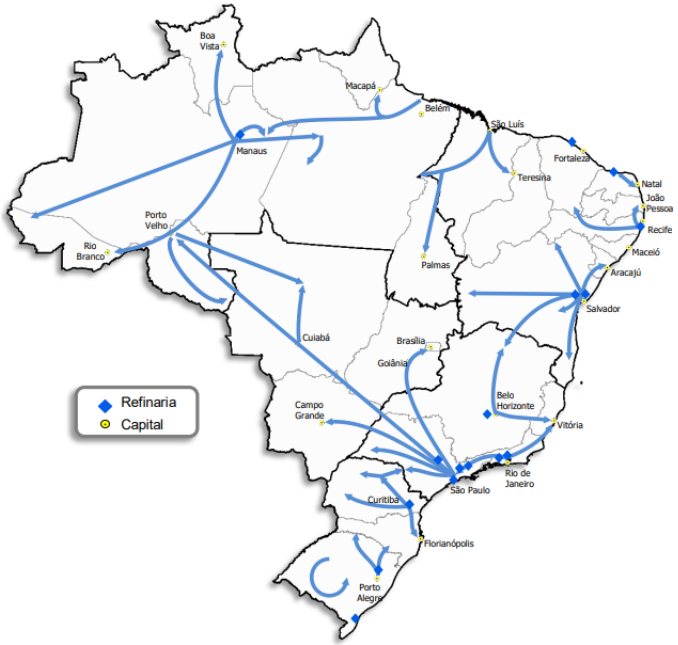
Source: CAIT (2019)



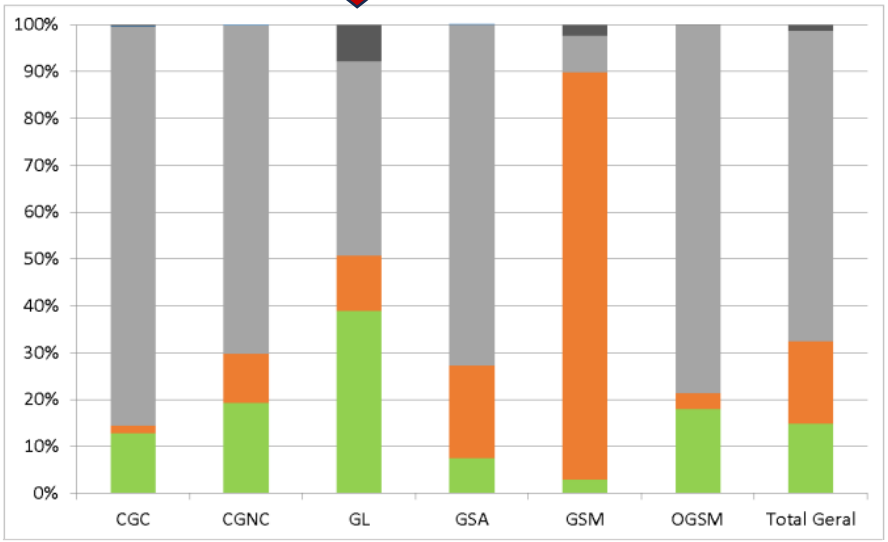
Source: SEEG (2022)

Transport of fossil fuels

Major freight flows – diesel and gasoline
Source: Transport Ministry



Mode distribution by freight type (TKU %, 2017)
Source: EPL (2021)



Road
Pipeline
Shipping
Rail
Air

Oil Products infrastructure in Brazil

	Extension oil pipelines	Extension Oil Products pipelines[2]
Brasil [1]	2,25 thousand km	5,8 thousand km
México	10,0 thousand km	10,4 thousand km
China [3]	27,0 thousand km	21,0 thousand km
United States[1]	135,8 thousand km	103,5 thousand km

[1] In 2020.

[2] In Brazil, 76,5% are transportation pipelines

[3] In 2015.

5,800 km Oil Products pipelines

Indicative Oil Pipeline Plan

With continental dimensions, Brazil has fuel markets distributed throughout its territory, which poses logistical challenges, especially for shipments to the regions farthest from the refineries, such as the consumer centers in the Midwest.

In the projections of the Ten-Year Energy Expansion Plan (EPE, 2022) the supply and demand for fuels continues to grow during the entire period. Furthermore, net imports of oil products should gradually increase, surpassing the historical maximum by the end of the ten-year period.

In this context, the promotion of infrastructure for the fuel transportation will be fundamental. The deficiency of logistics and fuel transportation infrastructure generates vulnerability and can result in loss of competitiveness, causing potential increases in costs in the oil production chain, with the possibility of supply failures, in addition to environmental and health impacts.

The Indicative Oil Pipeline Plan propose a conceptual methodology that includes oil products demand estimation, social environmental analysis and technical economic feasibility evaluation of potential pipelines projects.

Indicative Oil Pipeline Plan

General characterization

- Oil products pipeline infrastructure analysis
- Possible points of supply and potential demands
- Definition of the origin, destination and preliminary route
- Estimation of extensions, products movements, pipeline capacity and preliminary costs

Social Environmental analysis

- Final corridor and proposed route definitions
- Social and environmental areas to avoid

Technical economic feasibility analysis

- Technical and finance detailing
- Capital expenditure estimation (Capex and Opex)
- Physical and financial schedule
- Pipeline competitiveness and potential developments

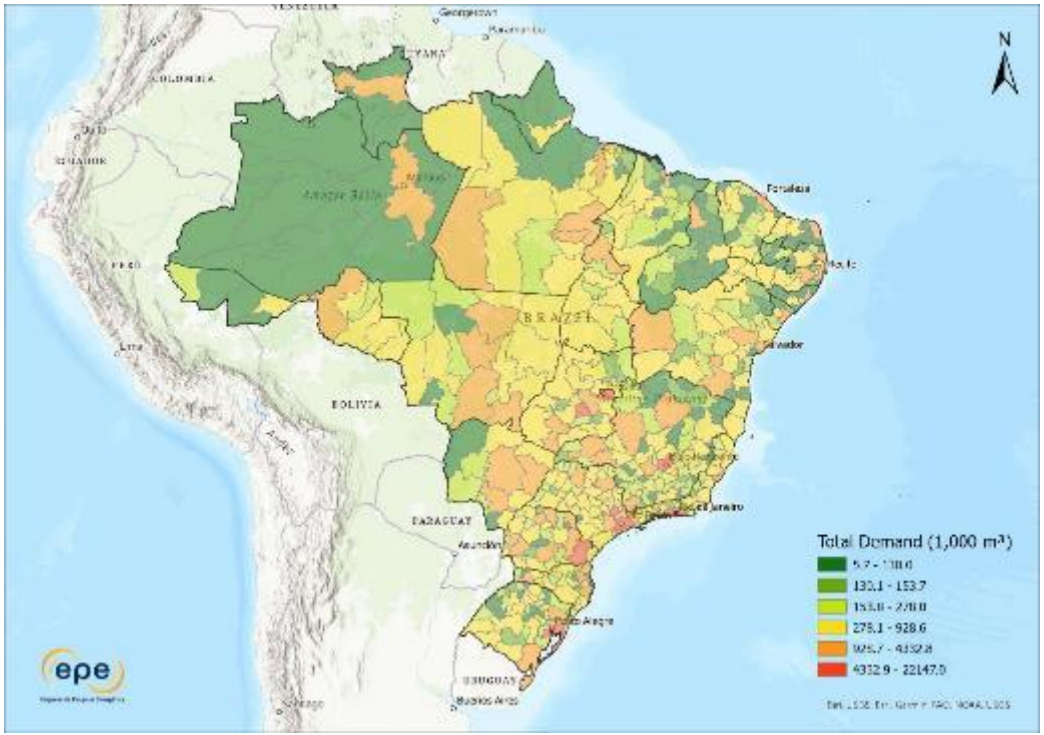
Oil products' demand

General characterization

Identifying key regions

A map with the sum of LPG, gasoline, diesel oil and jet fuel of each *Immediate Geograph Region*[*] in 2031[**] was elaborated, with graduated colors.

This allowed different analysis to be carried out and to identify the key regions for the pipelines.



Source: EPE.

[*] Methodology defined by the Brazilian Institute of Geography and Statistics (IBGE).

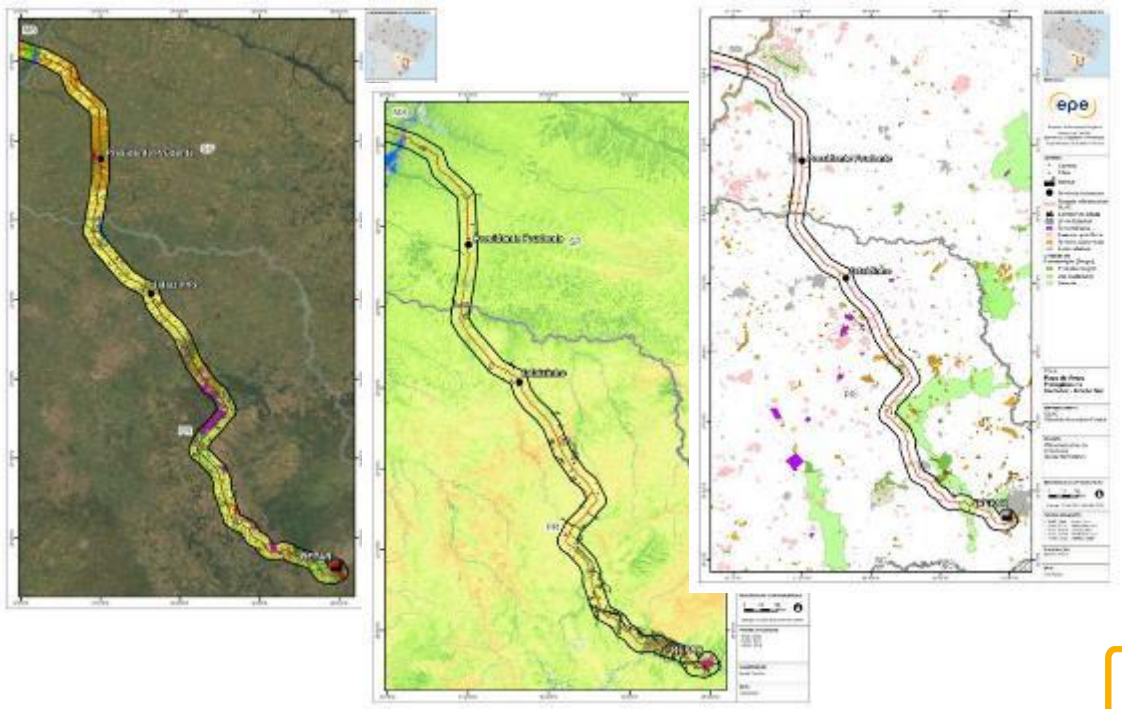
[**] According to *Ten Year Energy Expansion Plan 2031* (EPE, 2022).

Final Corridor

Social Environmental analysis

Avoiding Social and environmental areas

Environmental and social data are used to determinate the Final corridor and proposed route definitions.



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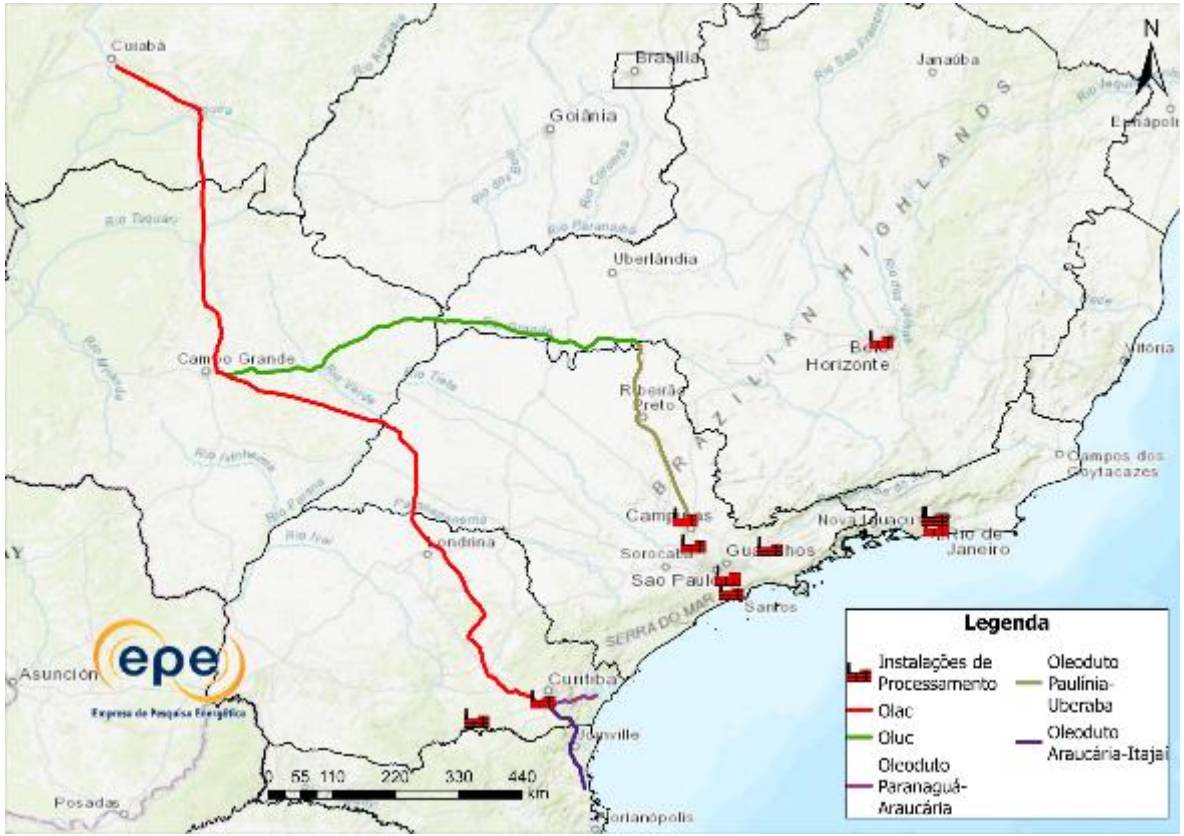
* Methodology defined by the Brazilian Institute of Geography and Statistics (IBGE).

** According to *Ten Year Energy Expansion Plan 2031* (EPE, 2022).

Routes



Pipelines

- Araucária – Cuiabá
- Uberlândia/Uberaba –Cuiabá
- Paranaguá - Araucária (duplication)
- Paulínia - Uberaba (duplication)
- Araucária - Itajaí (duplication)

Routes

Route	Description	Map
1A	Olapa Pipeline Duplication and construction of new pipeline (Araucária – Cuiabá)	
1B	Osbra Pipeline Duplication (section fromPaulínia to Uberaba) and construction of new pipeline (Uberaba - Campo Grande)	
2	Opasc Pipeline Duplication (section from Araucária (PR) to Itajaí (SC)	

Pipelines

- Araucária – Cuiabá
- Uberlândia/Uberaba –Cuiabá
- Paranaguá - Araucária (duplication)
- Paulínia - Uberaba (duplication)
- Araucária - Itajaí (duplication)

Some indicated sections, parts of Olac and Oluc that provide fuels to same key regions, are mutual excludents.

Results

Technical economic feasibility analysis
Capex

Araucária/PR – Cuiabá/MT

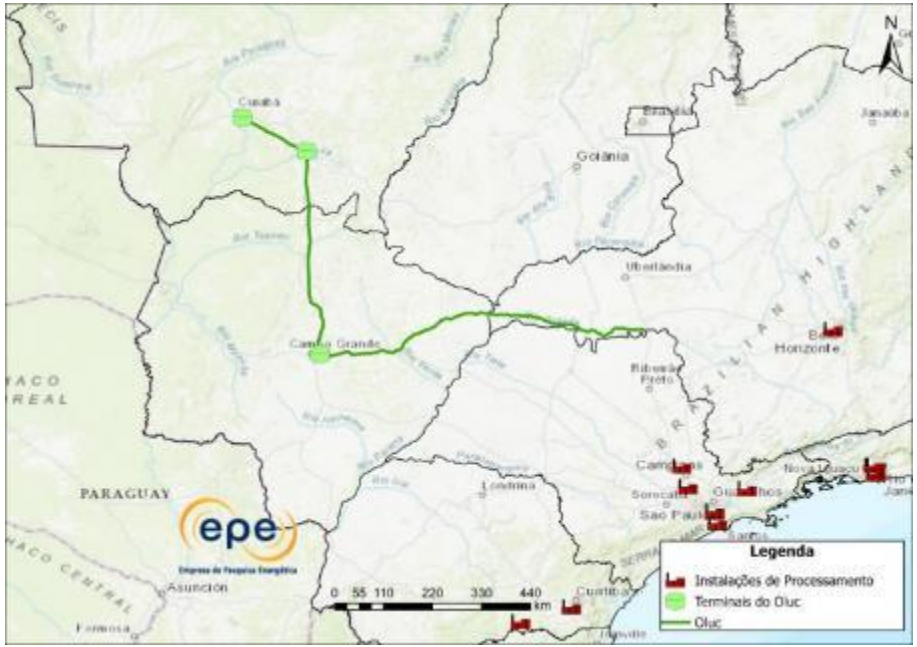
- Terminals: 5
- Extension: 1,568 km
- Supply: Repar or Paranaguá Port (by Olapa)

Section	Diameter (inch)	Maximum Flow (m³/h)
Araucária-Jataizinho	20	1,455
Jataizinho-Presidente Prudente	16	930
Presidente Prudente-Campo Grande	14	715
Campo Grande-Rondonópolis	10	415
Rondonópolis-Cuiabá	8	280

Capex (billion R$)		%
Pipeline	12.2	86.3
Terminals	1.9	13.7

Results

Technical economic feasibility analysis
Capex



Uberaba/MG – Cuiabá/MT

- Terminals: 3
- Extension: 1,338 km
- Supply: Replan or Santos Port (by pipelines)

Section	Diameter (inch)	Maximum Flow (m³/h)
Uberaba-Campo Grande	14	715
Campo Grande-Rondonópolis	10	415
Rondonópolis-Cuiabá	8	280

Capex (billion R$)		%
Pipeline	9.2	92.2
Terminals	0.8	7.8

Results

Technical economic feasibility analysis
Capex

Araucária/PR – Itajaí/SC

- Extension: 197 km
- Supply: Repar or Paranaguá Port (by Olapa)

Section	Diameter (inch)	Maximum Flow (m³/h)
Araucária-Guaramirim	8	280
Guaramirim-Itajaí	8	280

Capex (billion R$)		%
Pipeline	1.2	100
Terminals	-	-

Results

Technical economic feasibility analysis
Capex

Paranaguá/PR - Araucária/PR

- Terminals: 2 (one maritime)
- Extension: 94 km
- Supply: Repar or Paranaguá Port (by Olapa)

Section	Diameter (inch)	Maximum Flow (m³/h)
Paranaguá-Araucária	22	1,765

Capex (billion R$)		%
Pipeline	1.2	21.5
Terminals	4.4	78.5

Results

Technical economic feasibility analysis
Capex

Paulínia/SP – Uberaba/MG

- Extension: 340 km
- Supply: Replan or Santos Port (by pipelines)

Section	Diameter (inch)	Maximum Flow (m³/h)
Paulínia-Ribeirão Preto	22	1,765
Ribeirão Preto-Uberaba	22	1,765

Capex (billion R$)		%
Pipeline	4.0	100
Terminals	-	-

Results

Technical economic feasibility analysis
Capex

Araucária/PR – Cuiabá/MT

Capex (billion R$)		%
Pipeline	12.2	86.3
Terminals	1.9	13.7

Uberaba/MG – Cuiabá/MT

Capex (billion R$)		%
Pipeline	9.2	92.2
Terminals	0.8	7.8

Araucária/PR – Itajaí/SC

Capex (billion R$)		%
Pipeline	1.2	100
Terminals	-	-

Paranaguá/PR – Araucária/PR

Capex (billion R$)		%
Pipeline	1.2	21.5
Terminals	4.4	78.5

Paulínia/SP – Uberaba/MG

Capex (billion R$)		%
Pipeline	4.0	100
Terminals	-	-

Total Investment:

~ R$ 35 billion

Results

Technical economic feasibility analysis
Capex

Araucária/PR – Cuiabá/MT

Capex (billion US$)		%
Pipeline	2.4	86.3
Terminals	0.4	13.7

Uberaba/MG – Cuiabá/MT

Capex (billion US$)		%
Pipeline	1.8	92.2
Terminals	0.2	7.8

Araucária/PR – Itajaí/SC

Capex (billion US$)		%
Pipeline	0.2	100
Terminals	-	-

Paranaguá/PR – Araucária/PR

Capex (billion R$)		%
Pipeline	0.2	21.5
Terminals	0.9	78.5

Paulínia/SP – Uberaba/MG

Capex (billion R$)		%
Pipeline	0.8	100
Terminals	-	-

Total Investment:

~ US$ 7 billion

* - Include exchange rate of R$ 5.032/US$.

Results

Impact of implementing the proposals – environmental externalities
Avoided diesel oil consumption (m^3/month)

	Avoided diesel oil consumption (m^3/month)
Araucária/PR – Cuiabá/MT (OLAC)	15,348
Uberaba/MG – Cuiabá/MT (OLUC)	7,569
Araucária/PR – Itajaí/SC	1,517
Paranaguá/PR – Araucária/PR	2,310
Paulínia/SP – Uberaba/MG	6,380

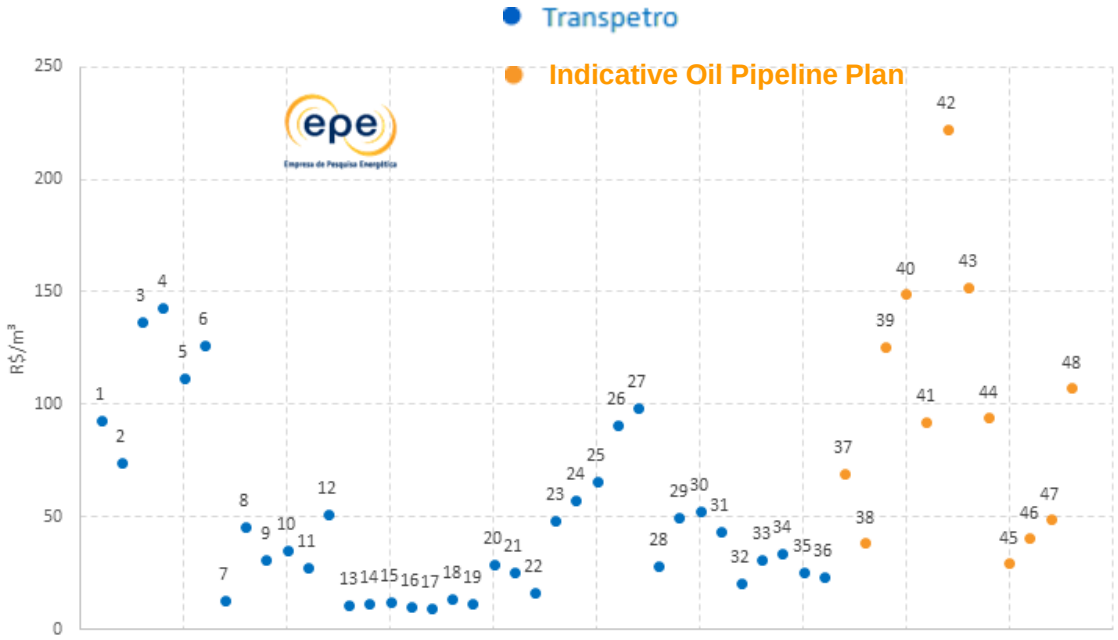
Total avoided diesel oil consumption:

35 m^3/month

The OLAC would avoid 14,200 trips monthly by B-double trucks, an annual consumption greater than 180,000 m^3, averting emissions of 471,000 t of CO_2, 30.4 t of CH_4 and 22.2 t of N_2O.
The Paranaguá-Araucária Oil Pipeline would avoid 18,000 trips monthly by B-double rucks, an annual consumption greater than 27,000 m^3, averting emissions of 71,000 t CO_2, 4.6 t of CH_4 and 3.3 t of N_2O.

Results

Technical economic feasibility analysis
Tariff



Most of feasible PIO tariffs (Net Present Value = 0 ; WACC = 6,91%) are similar in value to pipelines market tariffs.

Final Remarks

- The Ten-Year Energy Expansion Plan (EPE, 2022) forecasts indicate that supply and demand for fuels continues to grow during the entire period. Furthermore, net imports of oil products should gradually increase, surpassing the historical maximum by the end of the ten-year period.
- In this context, the promotion of infrastructure for the fuel transportation will be fundamental. The deficiency of logistics and fuel transportation infrastructure generates vulnerability and can result in loss of competitiveness, causing potential increases in costs in the oil production chain, with the possibility of supply failures, in addition to environmental and health impacts.
- The Indicative Oil Pipeline Plan propose a conceptual methodology that includes oil products demand estimation, social environmental analysis and technical economic feasibility evaluation of potential pipelines projects.

Final Remarks

- The Indicative Oil Pipeline Plan shows that the tariffs obtained using its methodology are similar in value to market tariffs, which can indicate economic opportunity.
- The expansion of the pipeline system can contribute to the reduction of product handling costs, as it stimulates competitiveness in the country's fuel markets.
- With the expansion of pipeline transport, the potential avoided consumption of diesel oil for road use represents one of the positive externalities. Furthermore, pipeline projects contribute to reduce the national deficit of this fuel, to improve national energy security and, possibly for a reduction in the freight cost.
- Deficient logistics infrastructure and bottlenecks limits a country's fuel supply, increasing costs in the production chain and loss of competitiveness in other sectors of the economy.

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