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FUNDAMENTALS

HOW TO CALCULATE TRANSPORT TARIFF BY OIL PIPELINE ?

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TARIFF

CALCULATE

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HOW TO CALCULATE TRANSPORT TARIFF BY OIL PIPELINE ?

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1. ***The Tariff is based on the Costs of Service.***

$$CS = Capex + Opex + t$$

2. ***The income must cover the costs of service and a profitability.***

$$IR = CS = (r * B + D) + Opex + t$$

Where:

IR = Income Requirement
CS = Cost of Service
O = OPEX
D = Depreciation
t = Taxes
r = Discount Rate (Profitability)
B = Regulatory Asset Base (RAB)

3. ***Incomes depend on tariff and projected volumes.***

$$IR = T * d = CS$$

$$T = \frac{CS}{d}$$

$$T = \frac{(r * B + D) + Opex + t}{d}$$

Where:

T = Tariff
d = Pipeline Demand

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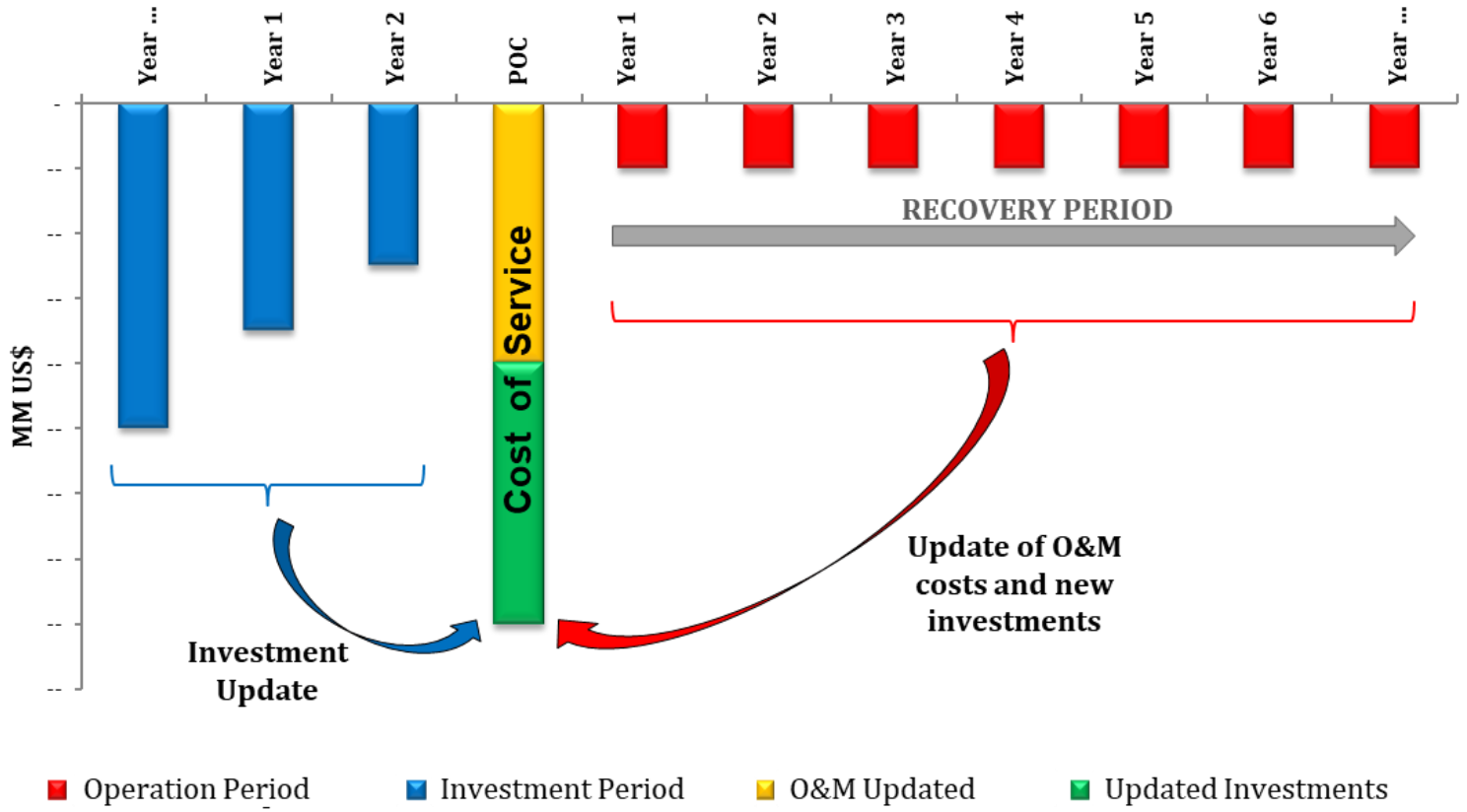
1. ***The tariff is based on the Costs of Service.***

$$CS = Capex + Opex + t$$



Source: *Own elaboration.*

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2. The income must cover the Costs of Service and a profitability in accordance with the risks.

- Income Requierements.

$$IR = (r * B + D) + (Opex + t)$$

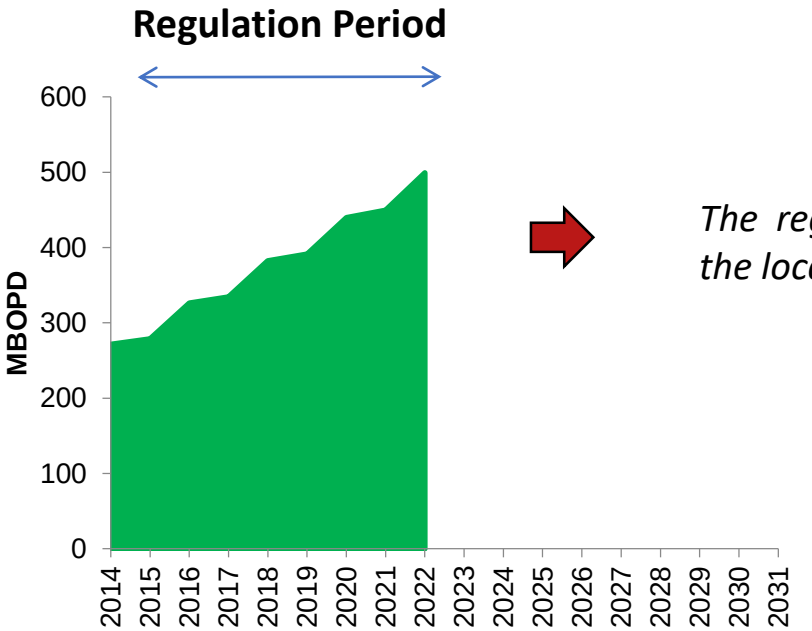
- Income Requierements during the Regulation Period.

$$IR_{RP} = \sum_{i=1}^{i=RP}(r * B_i + D_i) + \sum_{i=1}^{i=RP}(Opex_i + t_i)$$

Where:

RP = Regulation Period

i = year



The regulation period is defined in the local regulatory framework.

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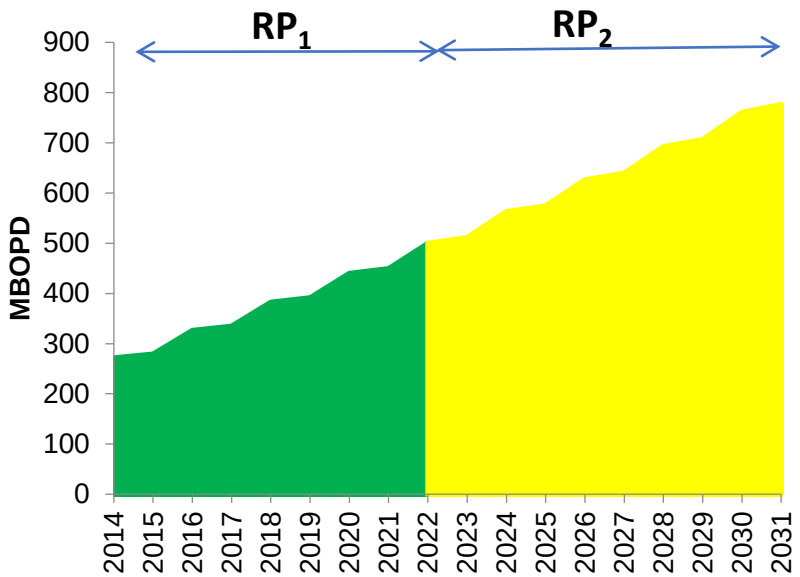
3. Incomes depend on tariff and projected volumes.

$$T = \frac{(r * B + D) + Opex + t}{d}$$

$$T_{RP} = \sum_{i=1}^{i=PR} \left(\frac{\sum_{i=1}^{i=PR}(r * B_i + D_i) + \sum_{i=1}^{i=PR}(Opex_i + t_i)}{(1+r)^i} \right) \Big/ \frac{d_i}{(1+r)^i} \quad \dots(\alpha)$$



- ✓ *The formula (α) represents the general calculation of the oil pipeline transport tariff.*
- ✓ *The tariff is calculated for each regulation period (RP_1, RP_2).*

PARAMETERS DESIGN

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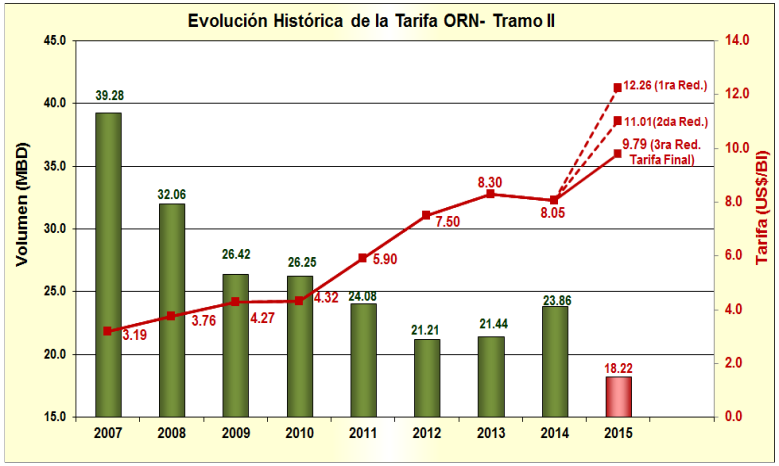
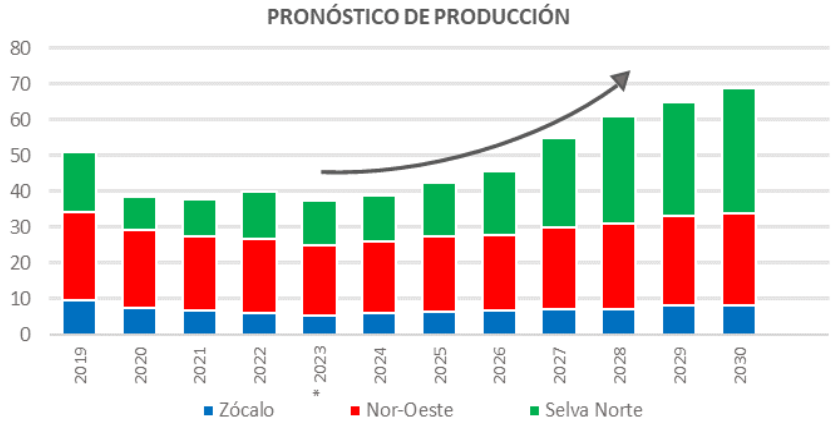
Incomes depend on the rate and projected volumes defining a competitiveness for the pipeline.

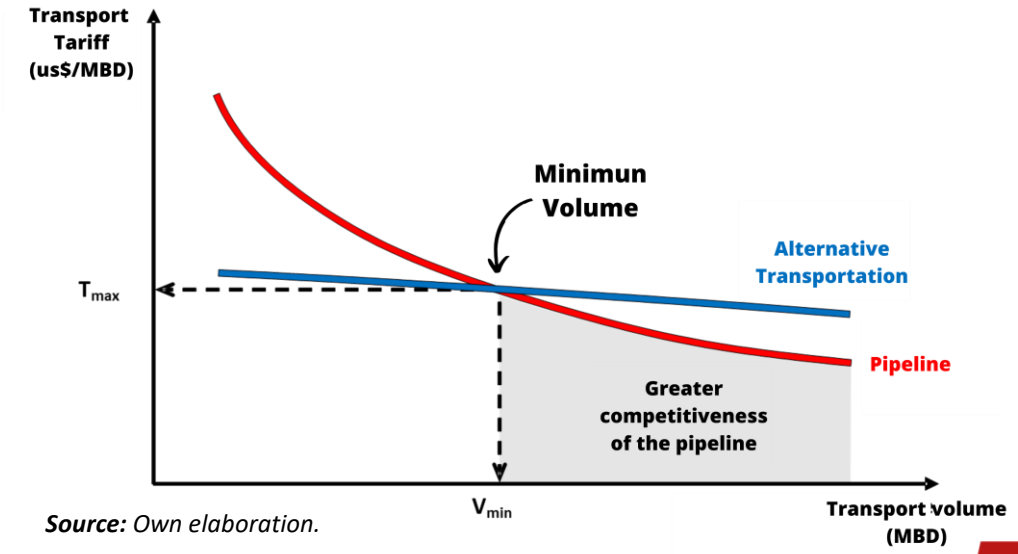




Source: *Own elaboration.*

Below the Minimun Volume threshold, the oil pipeline is no longer sustainable, generating very high tariffs for users.

A Minimum Volume is required for the oil pipeline to be viable.



Source: *Own elaboration.*

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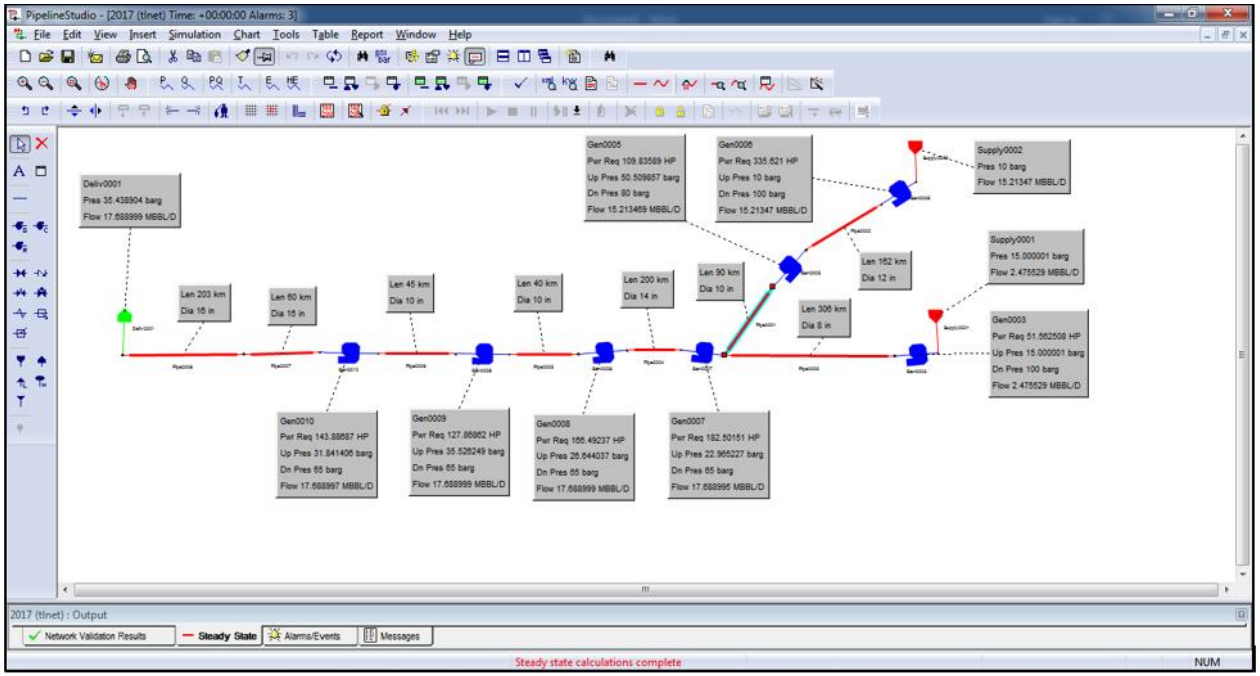
Design of the liquid transport system, using the modeling software, the procedure is as follows:

Define the injection (supply) and delivery (demand) points. → Prepare the layout of the transportation system and the location of the pumping stations. → Define the efficient design volumes and the pressure and temperature conditions at the inlet and outlet of the system. → Determine composition, API, viscosity, etc. of the crude that will be transported. → Develop the hydraulic model in the simulation software. → Using software, the pipe diameters that meet the previously defined boundary conditions will be determined.

Hydraulic analysis that determines the dimensioning



Source: *Own elaboration, Pipeline Studio software.*

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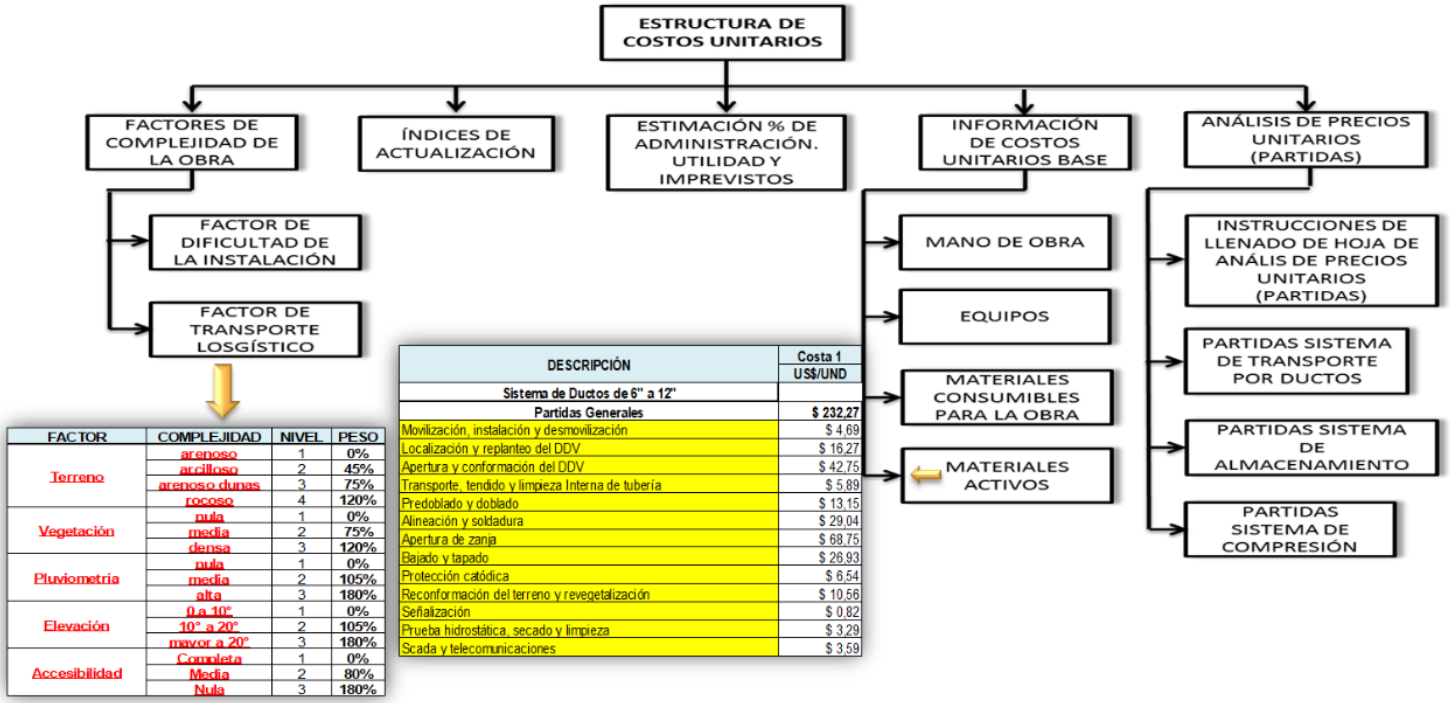
- Efficient investment costs.
- Unit cost structures (BAREMOS) are developed for each of the components of the transportation system: pipelines, pumping stations, valves, etc.



FACTOR	COMPLEJIDAD	NIVEL	PESO
Terreno	arenoso	1	0%
	arcilloso	2	45%
	arenoso dunas	3	75%
	rocoso	4	120%
Vegetación	nula	1	0%
	media	2	75%
	densa	3	120%
Pluviometria	nula	1	0%
	media	2	105%
	alta	3	180%
Elevación	0 a 10°	1	0%
	10° a 20°	2	105%
	mayor a 20°	3	180%
Accesibilidad	Completa	1	0%
	Media	2	80%
	Nula	3	180%

DESCRIPCIÓN	Costa 1 US$/UND
Sistema de Ductos de 6" a 12"	
Partidas Generales	$ 232,27
Movilización, instalación y desmovilización	$ 4,69
Localización y replanteo del DDV	$ 16,27
Apertura y conformación del DDV	$ 42,75
Transporte, tendido y limpieza Interna de tubería	$ 5,89
Predoblado y doblado	$ 13,15
Alineación y soldadura	$ 29,04
Apertura de zanja	$ 68,75
Bajado y tapado	$ 26,93
Protección catódica	$ 6,54
Reconformación del terreno y revegetalización	$ 10,56
Señalización	$ 0,82
Prueba hidrostática, secado y limpieza	$ 3,29
Scada y telecomunicaciones	$ 3,59

Source: *Own elaboration.*

Once the investment cost of the efficient structure is determined, for tariff purposes the Total Investment Cost is not always recognized, but a Regulated Asset Base (RAB) is transferred to the tariff formula.

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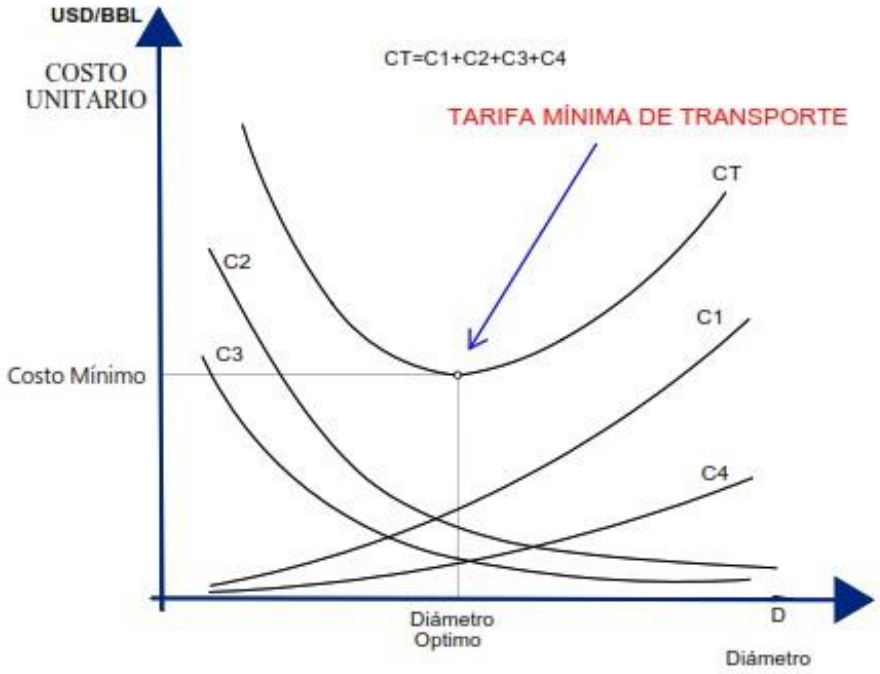
Cost Efficient - Minimum Cost

- An efficient system is considered to be one that uses the lower cost infrastructure.
- For this purpose, hydraulic designs are developed for the various possible scenarios of pipeline diameters, capacities and pumping stations, which satisfy the demand to be transported.



C1=f1 (D), Costo de la cañería y accesorios
C2=f2 (D), Costo de combustible consumido de plantas de bombeo.
C3=f3 (D), Costo de las plantas de bombeo
C4=f4 (D), Costo de linepack.
CT= Costo Total.

Source: *Own elaboration.*

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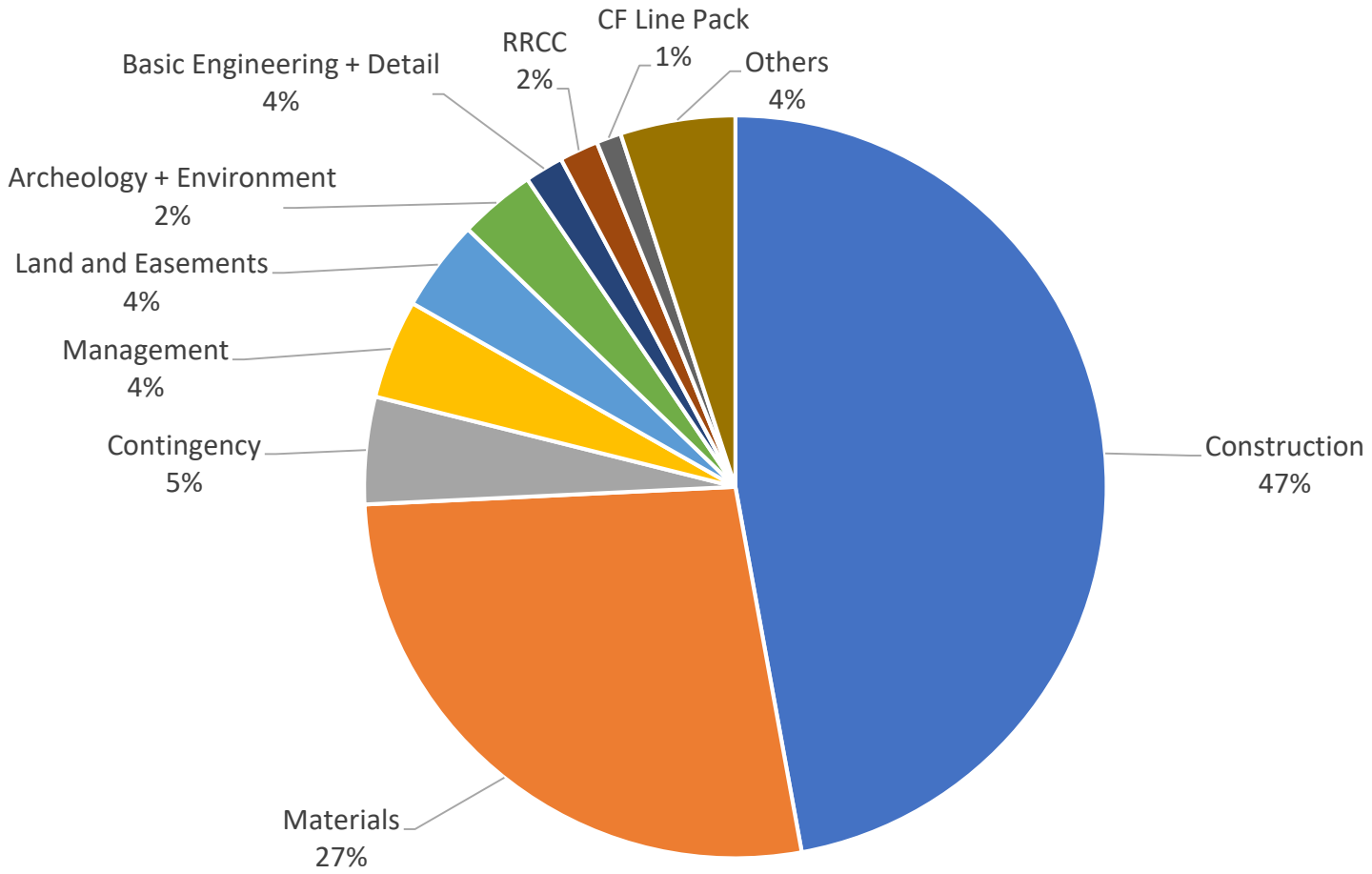
General example of a CAPEX distribution



Source: *Own elaboration.*

OIL PIPELINE TARIFFS

EXPERIENCES IN SOME COUNTRIES

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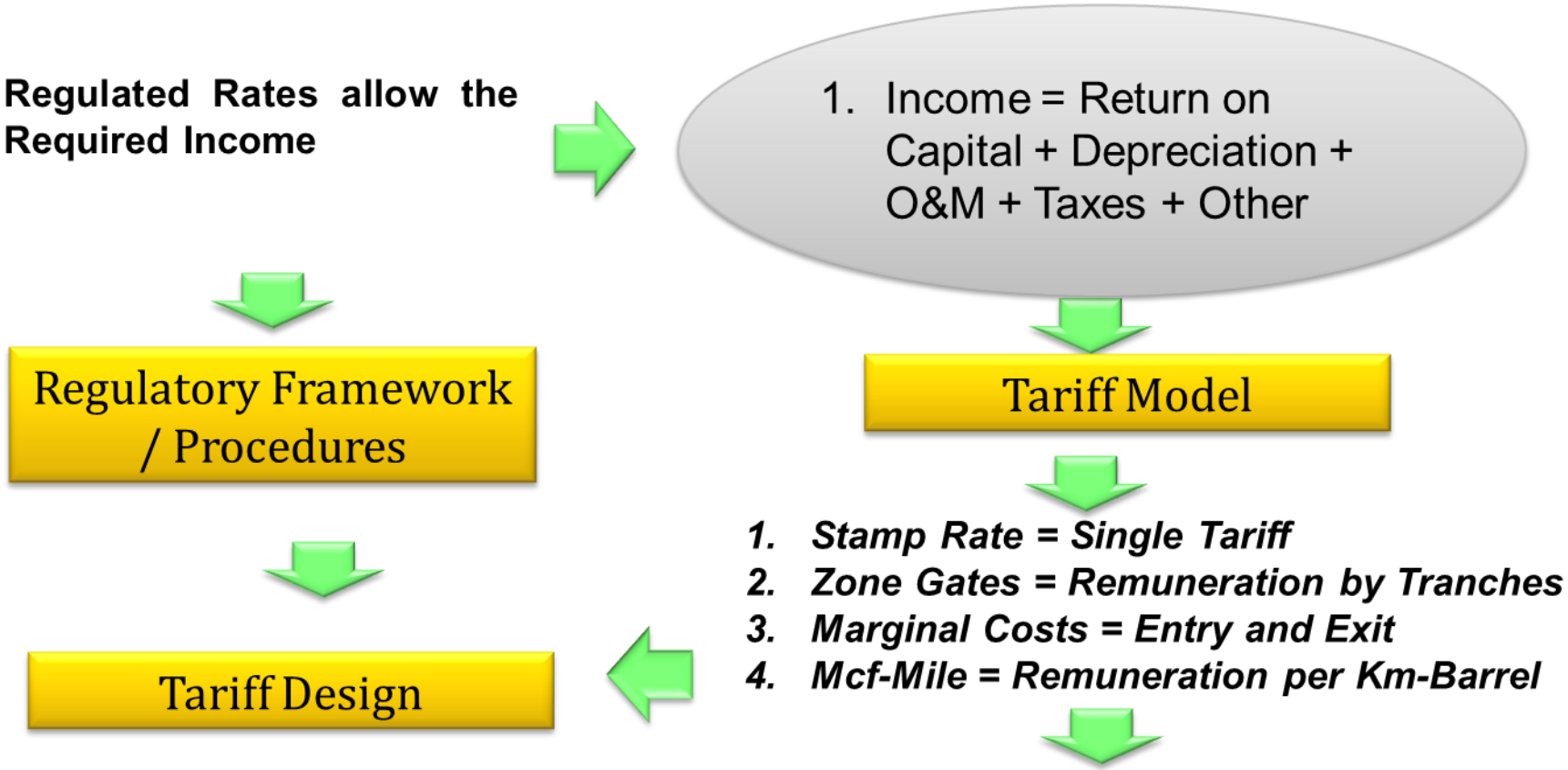
General criteria in all tariff calculation procedures.



Source: *Own elaboration.*

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General criteria in all tariff calculation procedures.

Tariff Design →

- Fixed and Variable Charges Menu
- Fixed charge for AOM

Charges →

- Charges for distance or sections
- Entry and Exit Charges

Source: *Own elaboration.*

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Simplified calculation formula applicable for each year of the 4-year regulation period:

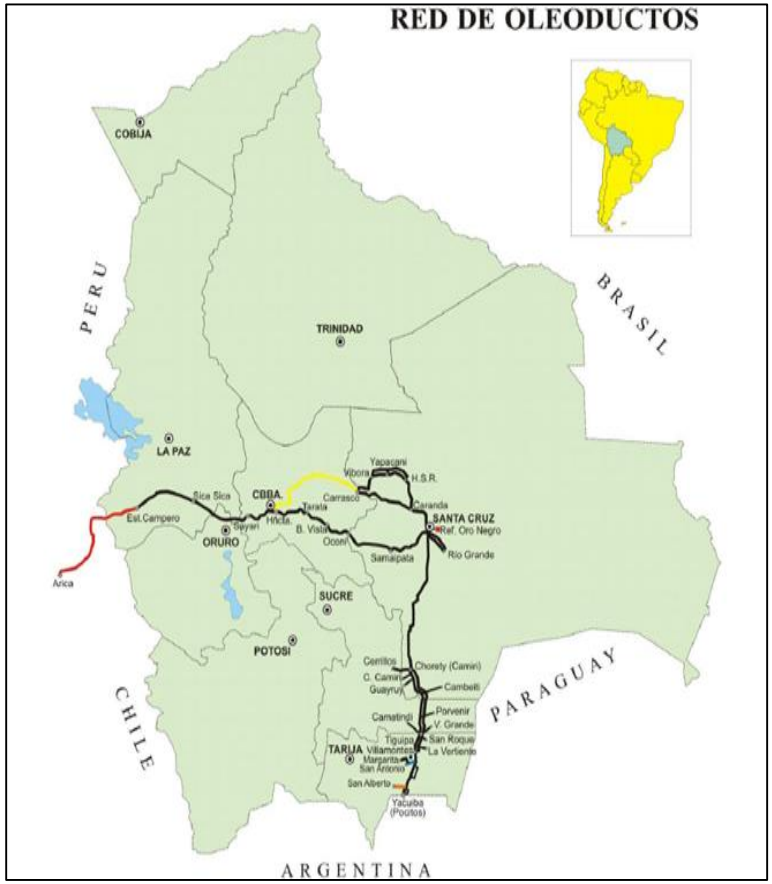
$$Tariff(t) = \frac{O + D + F + I + (R \; x \; P \; x \; B)}{V}$$

- O : Cost of operation, maintenance and annual administration.
- D : Annual depreciation of fixed assets.
- F : Annual financial costs of the debt.
- I : Taxes and fees.
- R : Maximum rate of return on equity.
- P : Percentage of equity in relation to total capital.
- B : Balance of total non-depreciated fixed assets.
- V : Annual volumes transported and/or contracted.

The following fundamental issues are appreciated in the methodology for calculating oil pipeline tariffs in Bolivia:

- The calculation methodology is standard and is very predictable, considering a long-term horizon of 20 years of calculation and a period of validity of the rates of four (4) years.
- The carrier's revenues, although they consider a medium-term horizon (4 years), are constant annual revenues, which gives the carrier and users greater predictability.
- There is no correction factor for changes in the projected volume for the calculation of the rate and the actual volumes transported. Therefore, the carrier bears the demand risk.

Bolivian Oil Pipeline Network



Source: Ministerio de Hidrocarburos y Energía de Bolivia, Anuario de Estadística.

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Applicable Tariff Formula:

$$T = \frac{K + CF + A}{Q} + CV$$

T **: Tariff applied per barrel of crude**
In dollars of the first year of the period in which the rate per barrel will govern according to the contractual modality.

K **: Recognizable annual income from capital remuneration**
It is the constant amount of annual income required to remunerate the invested capital at the discount rate before taxes.

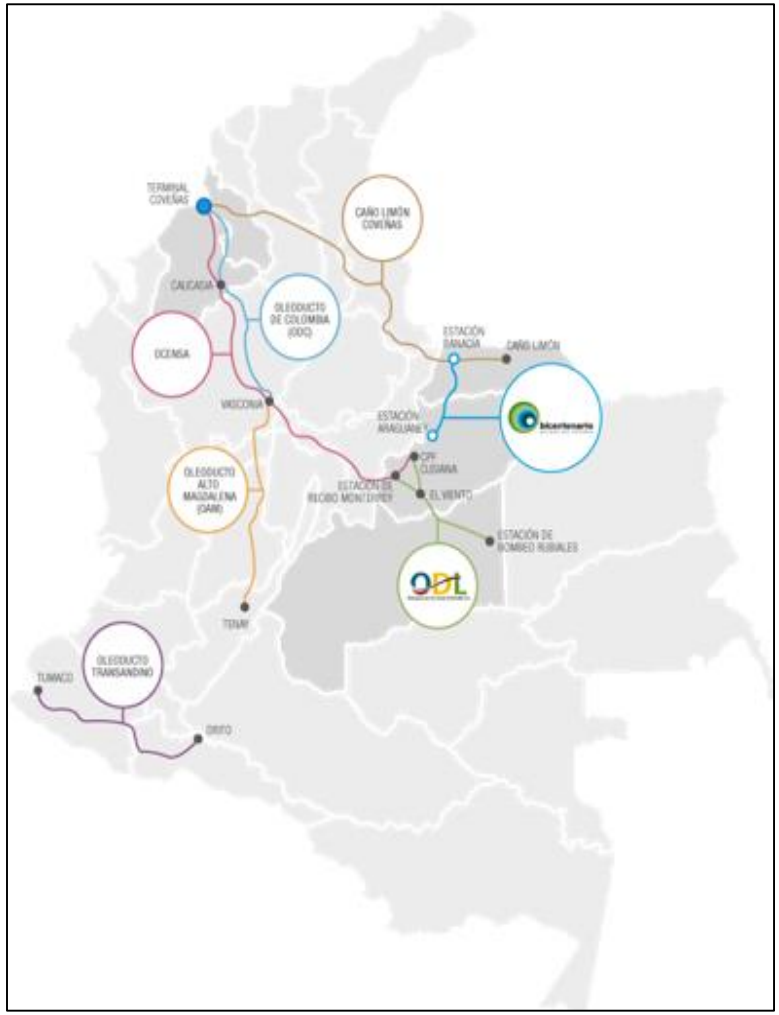
CF **: Recognizable annual income from fixed costs**
It is the constant annual revenue quota required to cover the estimated flow of fixed annual administration, operation and maintenance costs during the projection horizon, calculated with the discount rate before taxes.

A **: Annual income recognizable or discountable by the rate adjustment factor**
The tariff adjustment factor will be carried out in accordance with article 8 of resolution No. 72146 of 2014.

Q **: Equivalent annual volume of crude oil to be transported**
It is the constant annual volume during the projection horizon, equivalent to the projected flow of annual volumes of crude oil to be transported in said period, calculated with the discount rate before taxes.

CV **: Variable operating cost per barrel of crude oil**
It is the constant quota of annual income required to cover the estimated flow of annual variable costs of operation and maintenance that depend on the volume of crude oil transported, during the projection horizon, calculated with the discount rate before taxes.

Main Oil Pipelines of Colombia.



Source: *Bicentenario.*

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Tariff Formula:

$$T = \frac{AR}{\sum V_{SDn}\ x\ L_{SDn}}$$

$$AR = (RAB\ x\ WACC) + D + E + F \pm C + t$$

T : Tariff for the review period.

V_{Sn} : Total volume projected between the point of entry and the point of exit of the pipeline.

L_{Sn} : Length traveled by V_{Sn} between the entry point and the exit point of the pipeline.

AR : Total required income.

RAB : Assets recognized in the tariff base (Regulatory Asset Base).

$$RAB = (PPE - d) + w\ \pm dtax$$

PPE : Original value of assets (property, plant and equipment).

d : Accumulated depreciation and accumulated amortization.

w : Working Capital = Inventories + Line pack + accounts receivable + operating cash – accounts payable.

dtax : Deferred tax

WACC : Weighted Average Cost of Capital.

D : Depreciation and amortization of the tariff period.

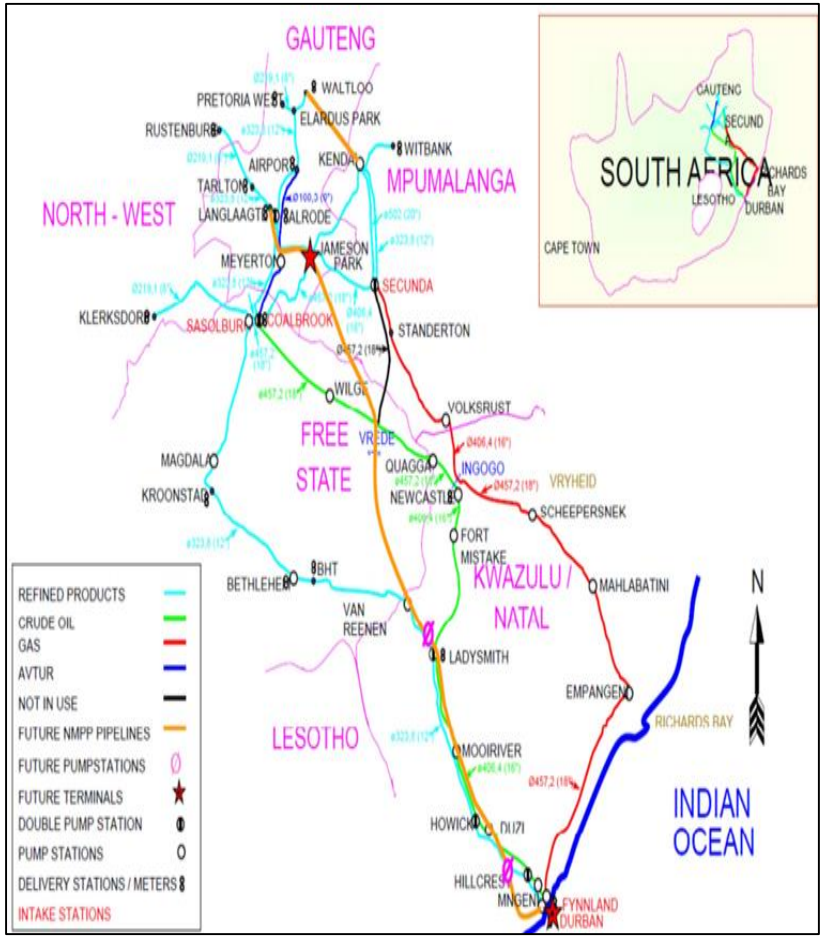
E : Expenses: actual and accumulated operation and maintenance expenses, including provisions for land rehabilitation costs, for the tariff period under review.

F : Projected income to meet debt obligations for the rate period under review.

C : Adjustment Value to correct the differences between the real data and the data approved by regulation of the previous regulation period.

T : Taxes.

Transport System Operated by Transnet



Source: Transnet.

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