Valorisation of plastic waste in Algeria

Techno-economic project

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The global surge in waste generation demands innovative solutions to mitigate environmental impact and harness untapped energy resources

REDUCE
THE USE OF PLASTIC OR OTHER WASTE.

PYROLYSIS, A THERMOCHEMICAL CONVERSION PROCESS, PRESENTS A PROMISING AVENUE FOR THE TRANSFORMATION OF ORGANIC WASTE MATERIALS INTO VALUABLE LIQUID FUELS

PYROLYSIS PROCESS

BY HARNESSING PYROLYSIS FOR THIS PURPOSE, WE CONTRIBUTE TO A GREENER, MORE EFFICIENT PARADIGM FOR WASTE PROCESSING AND RESOURCE CONSERVATION.

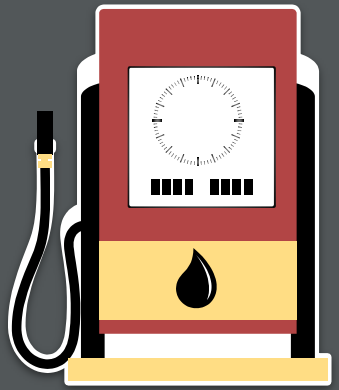
CHAR

GAS

TURN ORGANIC WASTE INTO OIL.

OUR TEAM

Hamel Rima



Carmen

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Pyrolysis process

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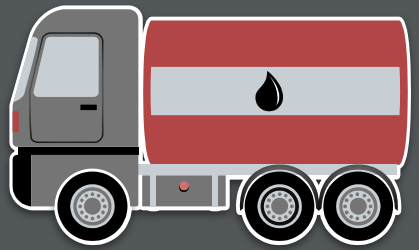
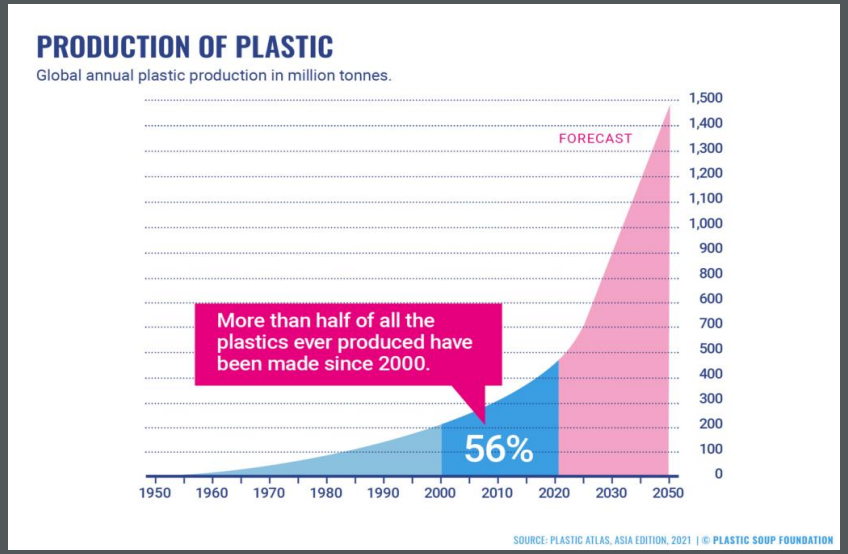


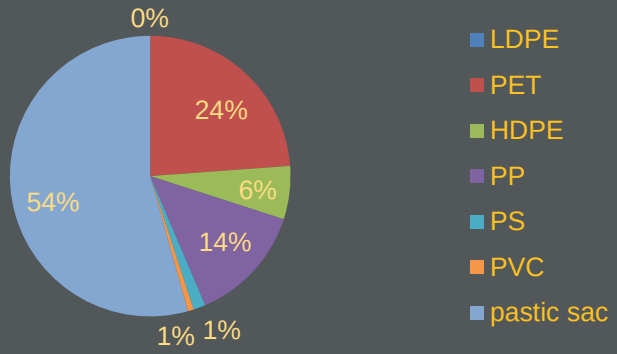
Introduction



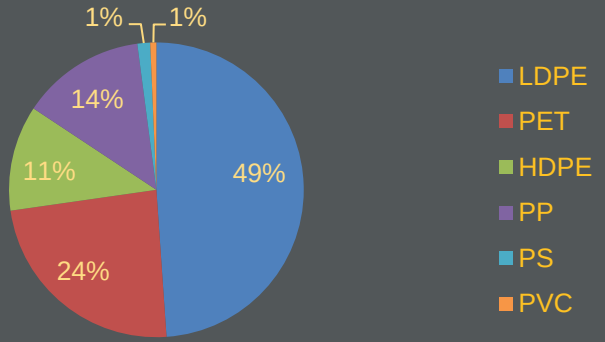
Income of plastics

Algeria plastic feed stock			income to the process (%)	income to the process (t/d)
	over 15%	over 100%	LDPE assumption	mass tones/day
	Lit. values	calc		
PLASTIC SAC	8,14	54,34	0	0
LDPE	0	0,00	48,91	4,891
PET	3,57	23,83	23,83	2,383
HDPE	0,92	6,14	11,58	1,158
PP	2,04	13,62	13,62	1,362
PS	0,21	1,40	1,40	0,140
PVC	0,1	0,67	0,67	0,067
total	14,98	100,0	100	10

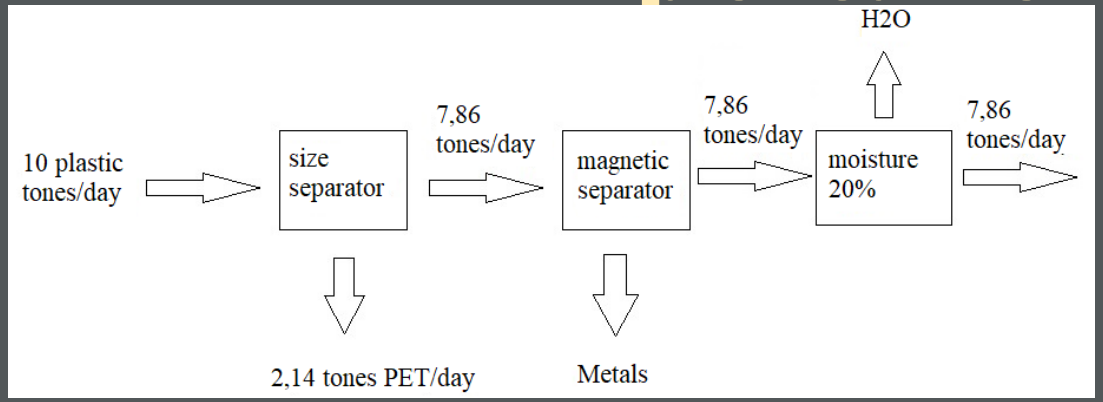
1. algeria plastic feed stock



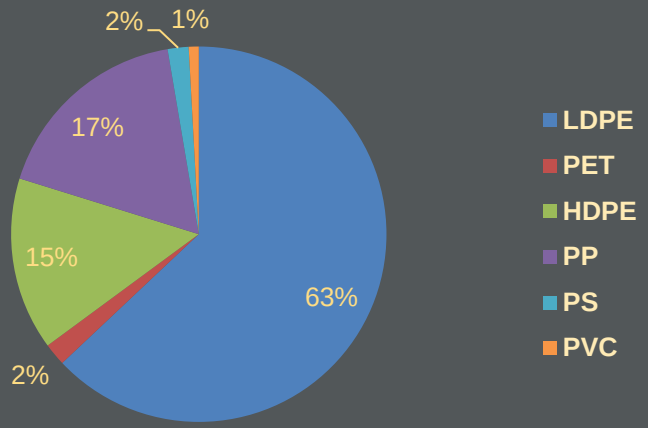
2. Income to pretreatment



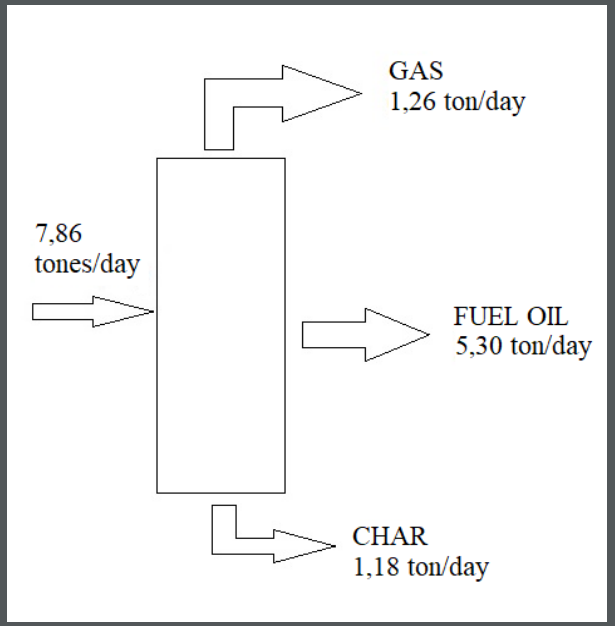
pretreatment



3. after pretreatment

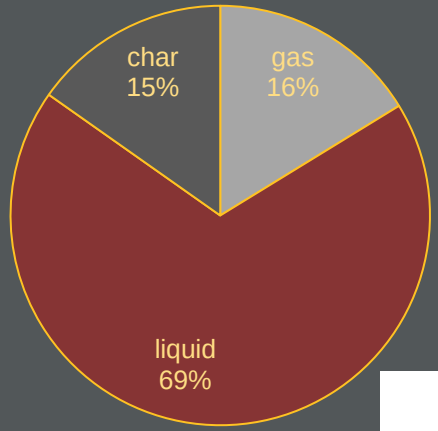


Pyrolysis tower



T pyrolysis	270	ºC
	350	ºC
rate	2	ºC/min
residence time	6	Hours
gas ret. Time	90	Min

Outside pyrolysis



In slow plastic pyrolysis, the main product is oil, while non-condensable gas and char are by products.

Characteristics of Fuel Oil obtained

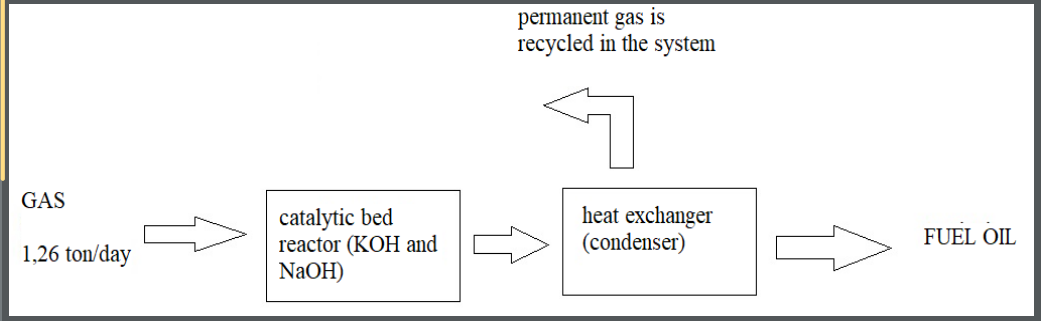
Lower heating value	**46.5**	**MJ/kg FO**
Density 20 °C	0.786 – 0.847	g/cm³
Viscosity 50°C	2.318	mm²/s cst
Viscosity 100°C	1.085	mm²/s cst
Sulphur content	1.785	mg/kg FO

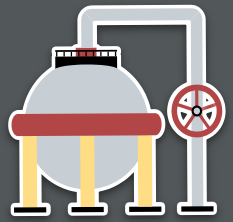
a: Company, BEINTEC Inovações Tecnológicas, based in RS/Brazil, personal communication, 2020.

The FO obtained through the thermochemical conversion of PSW in the BEINTEC technology has a lower heating value (LHV) of 46.5 MJ/kg.

This value is higher than market fuels such as diesel oil and gasoline that have LHV of 42 MJ/Kg and 43 MJ/kg, respectively.

Gas treatment

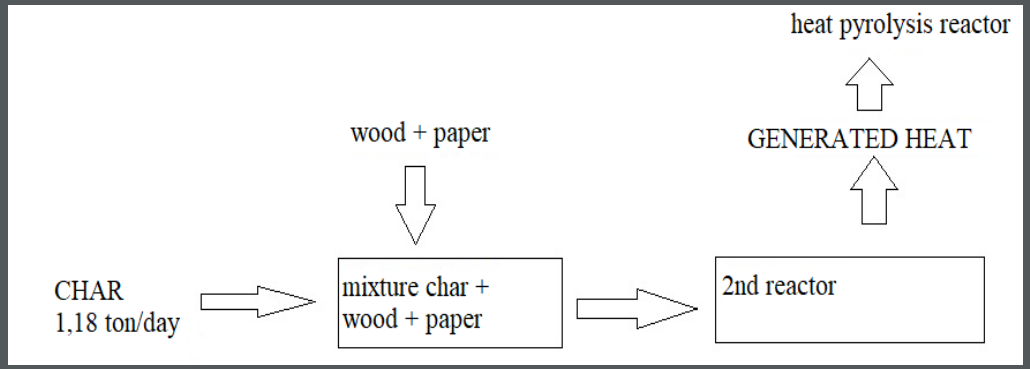




In the pyrolysis process, the gas generated will pass through a catalytic bed (KOH and NaOH) for the treatment of de-nitrogenization, de-chlorination, and desulphurization.

The fusion of these materials occurs between the temperatures of 350°C to 400°C

Char treatment

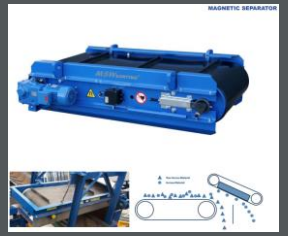


The char → is mixed with woody biomass and wastepaper, the blend produced is used in co-gasification in a second reactor to generate the heat required required by the pyrolysis reactor.

to ensure that the process is thermally self-sustaining.

Machines overall

Total BESTON equipment pretratment and pyrolysys: 89000$



Mixer (5000L) = 3500$

Thermal reactor (3000L)= 10000 $

Catalytic bed reactor (200L)= 1650*5=8250$

Condenser (200L) = 1800*5 = 9000 $

2

Economical part

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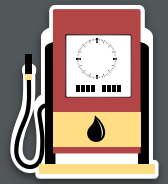
Project Scope Definition

- The plant is scaled to handle an input of 10 tons of plastic waste per day.
- This scale was chosen based on factors such as the availability of plastic waste, market demand for pyrolysis products, and available resources..

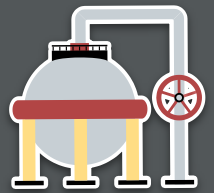


CAPEX

	Item	Details	unit	unit price	quantity	amount	total amount
fixed investment cost	Equipment	BLJ-16 (beston)	Set	89000	1	89000	
		Char treatment	Set	13500	1	13500	
		gas treatment	Set	17250	1	17250	
	Transportation	Seafreight	Set	64600	1	64600	
		from port to site	Set	3000	1	3000	
	custom tax	15%	Set	13350	1	13350	
	installation	Tech Salary	Day	50	50	2500	
		round trip	Ea	3000	2	6000	
		Visa	Ea	750	1	750	
		Local welder	Day	30	100	3000	
		Local plumber	Day	30	20	600	
		local labor	Day	23	50	1150	
		crane forklift	Day	130	30	3900	
	Materials	installation material	Set	4000	1	4000	
	License		Ea	1500	1	1500	
	Workshop	500	m^2	70	500	35000	
							259100$

259100$

OPEX



operating cost

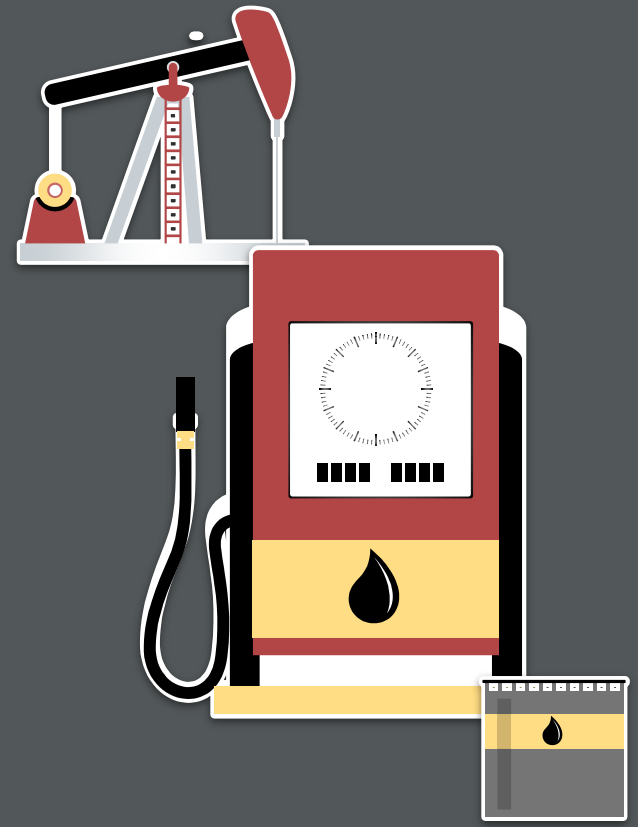
Raw materials	Waste plastic	Ton	180	10	1800
water		m3	0,3	3	0,9
Electricity		KW/H	0,035	864	30,24
Fuel	Natural gas	Liter	0,004	240	0,96
Labor		People	20	4	80
maintenance		Day	85	1	85
Depreciation (8 years)	8	Day	108	1	107,9583 333

2105,058333

Revenue estimation

	Pyrolysis oil		**KG**	**5,8**	**530**	**3074**	
End product	char		kg	3	118	354	
	Gas			0	126	0	
							3428$
Taxes	**17%**						
Daily income		working day					**1098,04$**

329412,48$



The selling price of pyrolysis oil is assumed to increase by 4% each year.
technician salaries are considered to rise by 1.3% annually with a discount rate of 10%.

(NPV) indicates that the plastic waste pyrolysis project in Algeria is has the potential to generate significant returns.

IRR at 136% is high. This signifies that the project is expected to yield substantial returns on the initial investment.

Payback period:

The cumulative cash flow for the first year surpassing the initial investment implies a quick payback period.

2027096,5$

Net Present Value

136%

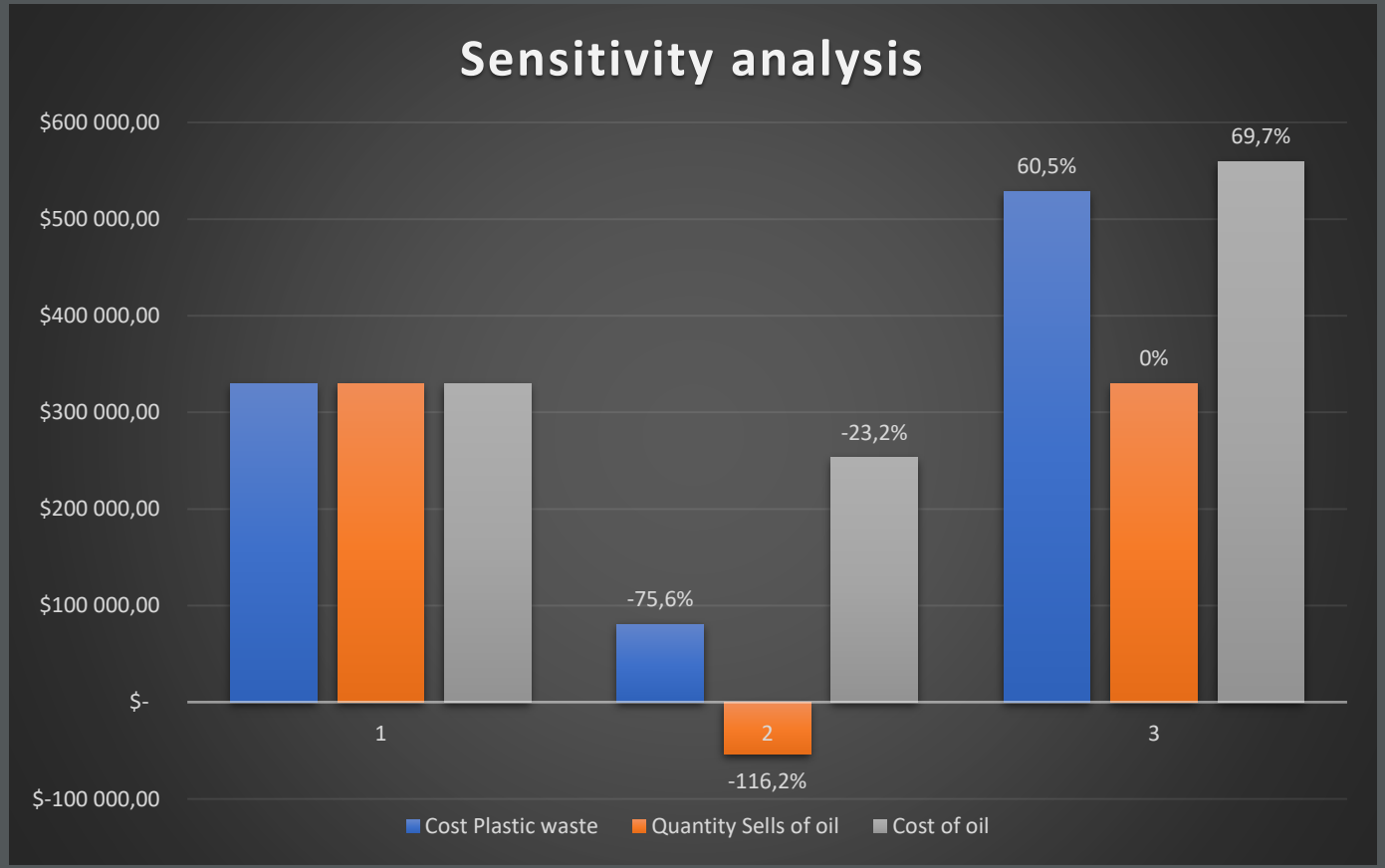
The Internal Rate of Return

236 days

Payback Period

Analysis Risk

assumptions	Impact Level	Risk	Mitigation
Supply of Plastic Waste	Very High	Low	Diversified supply sources, long-term contracts, and continuous monitoring of recycling trends can help mitigate the impact.
Market Demand for End Products	Moderate to Low	High	Regular market analysis, exploration of new applications, and strategic partnerships can help manage the impact of fluctuating market demand.
Raw Material Price Variability	Low	moderate	|Utilizing forward contracts, diversifying sources, and ongoing analysis of international markets can help mitigate the impact of price variability.
Regulatory Risks	Low to moderate	Low	A dedicated team to monitor regulatory changes, proactive engagement with authorities, and adherence to environmental best practices can help manage regulatory risks.
Technological Risks	Moderate to Low	Low	Selecting proven technologies, rigorous preventive maintenance programs, and continuous staff training can help mitigate potential technological risks.
Geopolitical Risks	Very High to high	high	Very High to Low | Continuous monitoring of political and economic developments, diversification of energy and raw material sources, and proactive engagement with local authorities can help manage geopolitical risks.
Financial Risks	Very High	Low	Establishing contingency budgets, using financial instruments to hedge against exchange risks, and regular review of financial performance can help mitigate potential financial risks.
Commercialization Risks	Moderate to Low	moderate	Developing a robust marketing strategy, identifying potential buyers in advance, and establishing long-term sales contracts can help manage commercialization risks.


Sensitivity analysis
$600 000,00
$500 000,00
$400 000,00
$300 000,00
$200 000,00
$100 000,00
$-
$-100 000,00
-75,6%
-116,2%
-23,2%
60,5%
0%
69,7%
1
2
3
Cost Plastic waste
Quantity Sells of oil
Cost of oil

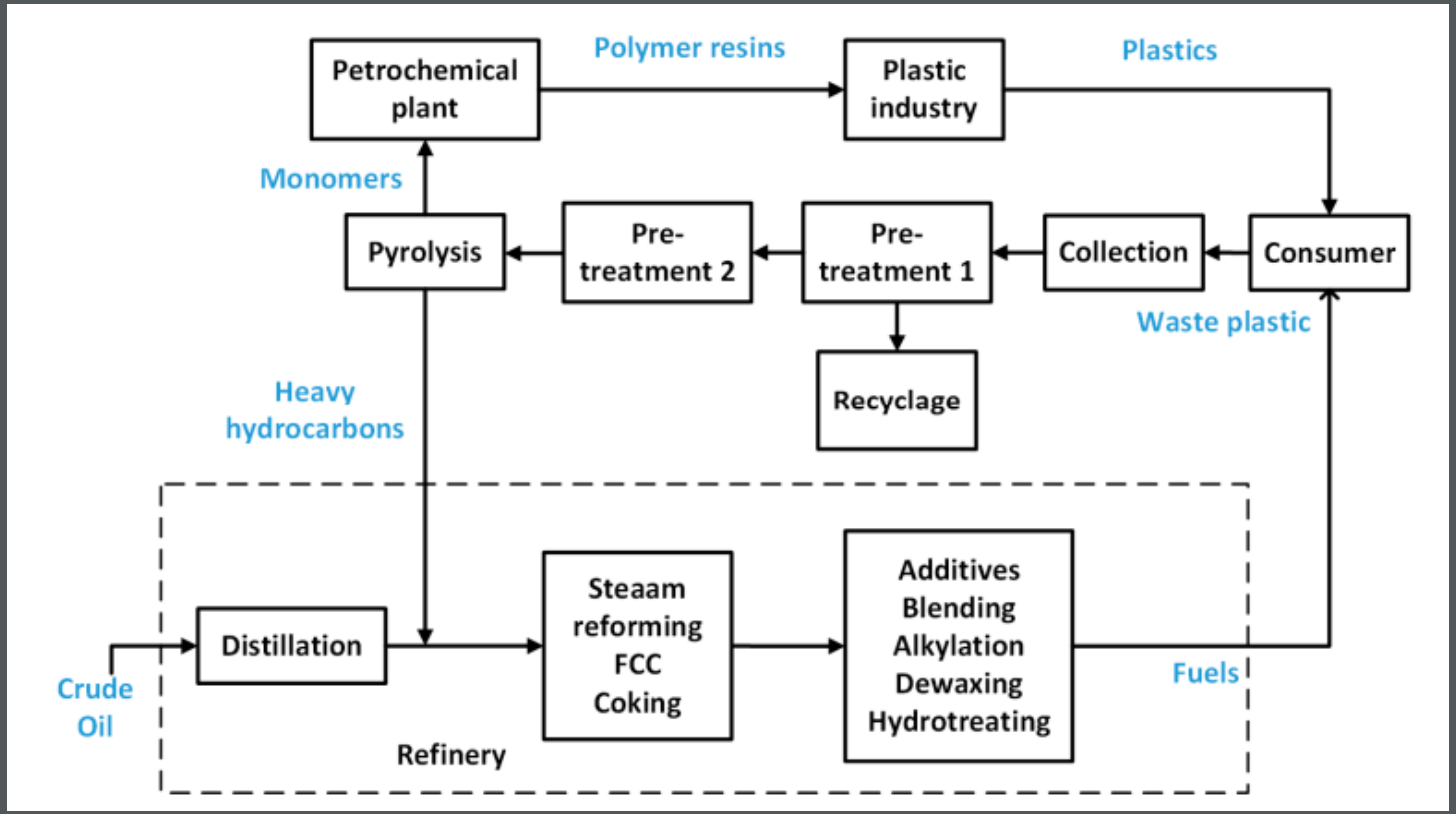
Comparison between crude and pyrolysis oil price's

615,55 $

•This $35 price difference positions our product as a cost-effective and sustainable option for potential customers.
•Current market trends indicate an increasing demand for pollution solutions, aligning with the sustainability aspect of our pyrolysis oil.

580 $

Proposing Pyrolysis Integration for Plastic Waste Management in Sonatrach's Oil Refinery



conclusion

- reduced petroleum use up to 40%, energy conservation, CO2 emission, resulting in less emission of landfill gases and reduced environmental damage.
- While there are challenges and limitations to the current tools and methods used for recovering plastic waste, such as the difficulty in recycling all types of plastic using current technology, pyrolysis technology still offers a promising solution for plastic waste management and environmental sustainability.