

## Motivations

- Only 9% of waste plastics in the U.S. and 15% in Europe are recycled. The rest are sent to landfills or incinerated.
- Mechanical recycling is limited by mixed materials and contamination and waste plastics that are recycled are typically converted to less valuable products.

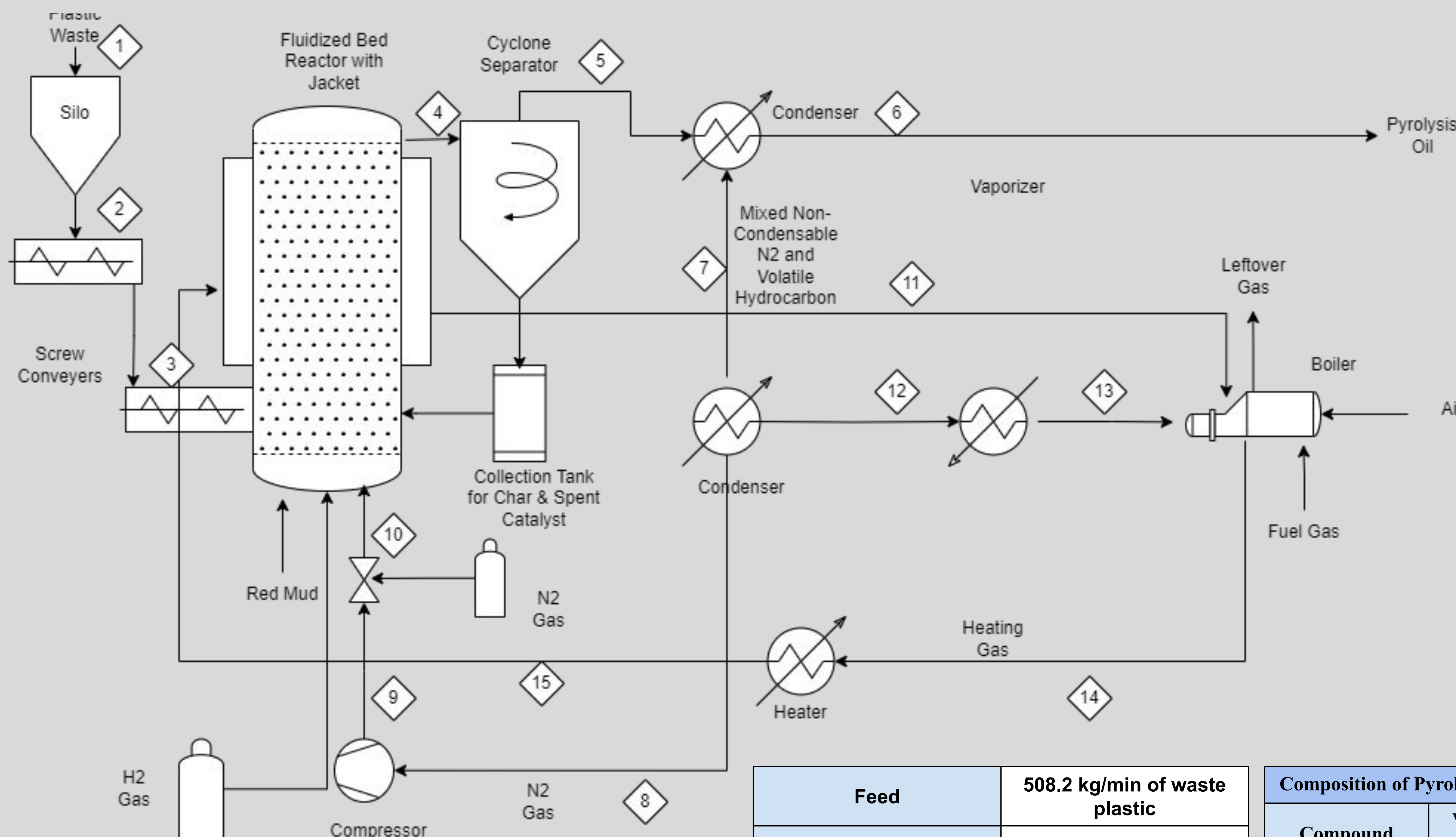
## Goals

- Design a profitable method for recycling waste plastic into pyrolysis oil with the use of a zeolite catalyst on a large scale.
- Produce pyrolysis oil that is comparable to crude oil that can be sold to a nearby oil refinery.

## Economics

- Capital costs include equipment, land and construction costs.
- Operating costs include utilities, operating labor, manufacturing.
- We plan to sell 1,167,858 barrels of oil per year and estimate a profit of \$29,000,000.

## Process Design



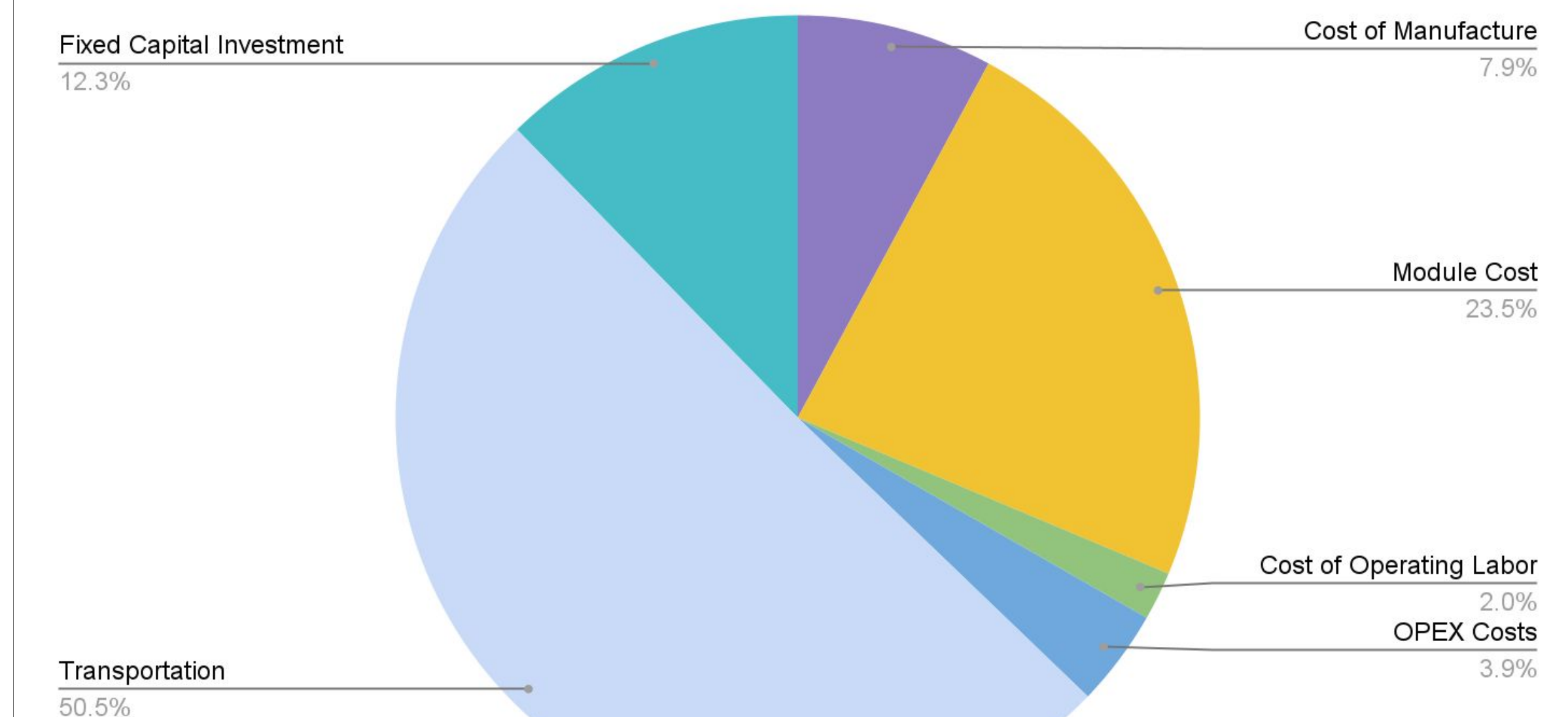
Polymer Type	Percentage in Feedstock Composition
High and Low Density Polyethylene (HDPE/LDPE)	46%
Polypropylene (PP)	20%
Polystyrene (PS)	20%
Polyethylene Terephthalate (PET)	5%
Polyvinyl Chloride (PVC)	<4%
Other Polymers	5%

<b>Feed</b>	508.2 kg/min of waste plastic
<b>Operating Conditions</b>	500 °C, 1 atm
<b>Desired Product</b>	289.67 kg/min of pyrolysis oil

Red Mud Catalyst Composition						
Fe <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	SiO <sub>2</sub>	CaO	Na <sub>2</sub> O	Others
36.5	23.8	13.5	8.5	5.3	1.8	10.6

Composition of Pyrolysis Oil	
Compound	Weight percent
Toluene	14.20
Dimethyl-heptene	4.10
Ethyl-benzene	19.00
Xylene	4.20
Styrene	42.30
α-Methyl-styrene	8.90
Methyl-naphthalene	7.30

Annual Costs	Dollar Value
Cost of Manufacture	\$3,120,427.16
Module Cost	\$9,300,000.00
Cost of Operating Labor	\$773,500.00
OPEX Costs	\$5,609,891.00
Transportation	\$20,029,655.17



## Conclusion

- 267,109,920 kg of plastic waste is recycled annually
  - 8% of the total generation of plastic waste in the Houston metro area.
- 152,252,654.4 kg/yr of pyrolysis oil is produced and it equivalent to 1,167,856.295 barrels/yr.
- Using industrial waste (red mud) as a catalyst has a positive impact on the environment.

## Acknowledgements

- Thank you to Dr. Linak and Dr. Bullard for supporting us through our senior design project.