NC STATE UNIVERSITY | DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING | EASTMAN

DESIGN OF A COMMERCIAL-SCALE PET PRODUCTION FACILITY

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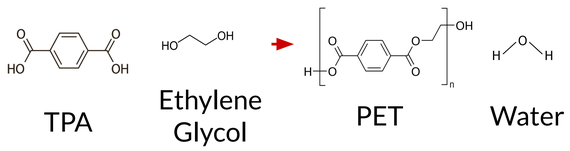
1. INTRODUCTION

Objective

Design a greenfield facility capable of producing **450,000 metric tons** of bottle and container grade polyethylene terephthalate (PET) per year, and perform an economic analysis to determine whether it is feasible to construct the plant.



Background

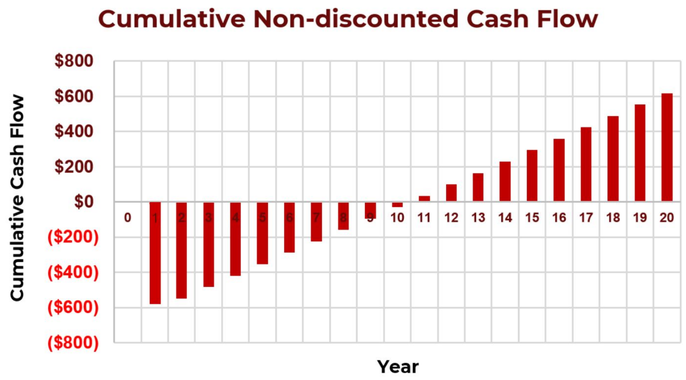
TPA and EG as raw materials for the production of PET ensuring an inherently safety manufacturing process that ensures positive environmental impact .

2. ECONOMIC ANALYSIS

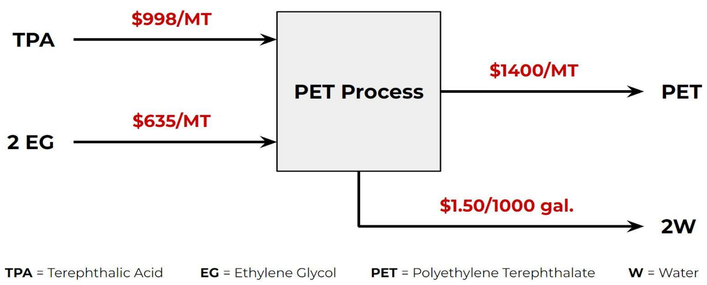
Market Overview

- 2023, the market stood at $48.43 billion
- Projected growth of 88.7% by 2030 to $91.37 billion

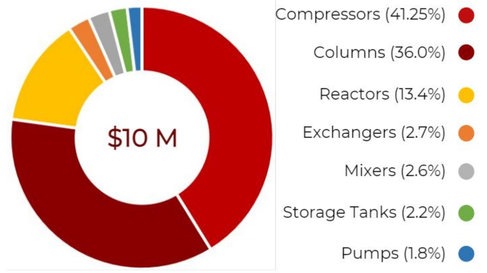
NPV: $93.2 million **IRR: 16%**



Due-Diligence

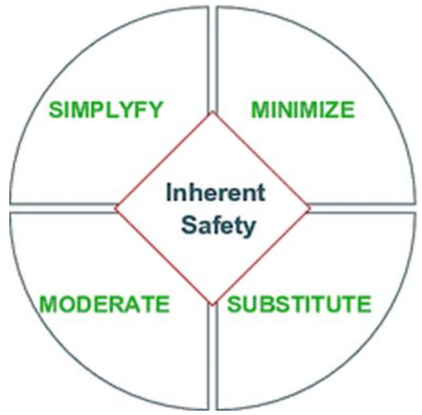


TPA = Terephthalic Acid **EG** = Ethylene Glycol **PET** = Polyethylene Terephthalate **W** = Water



3. PROCESS SAFETY

- Potential runaway reaction for esterification and polymerization reactions
- TPA considered as most hazardous substance to address
- Inherently safer design: moderate runaway reactions by introducing n-octadecane@MF resin microPCMs into reactors 1 and 3



5. ENVIRONMENTAL DESIGN

- One waste stream that comes out of tops of distillation column containing mostly water and BHET
- Superconducting high-gradient magnetic separation to prevent catalyst leakage
- rPET processes designed
  - Obtain reactants at cheaper cost
  - Provide more waste stream filtration
  - Recycle waste product

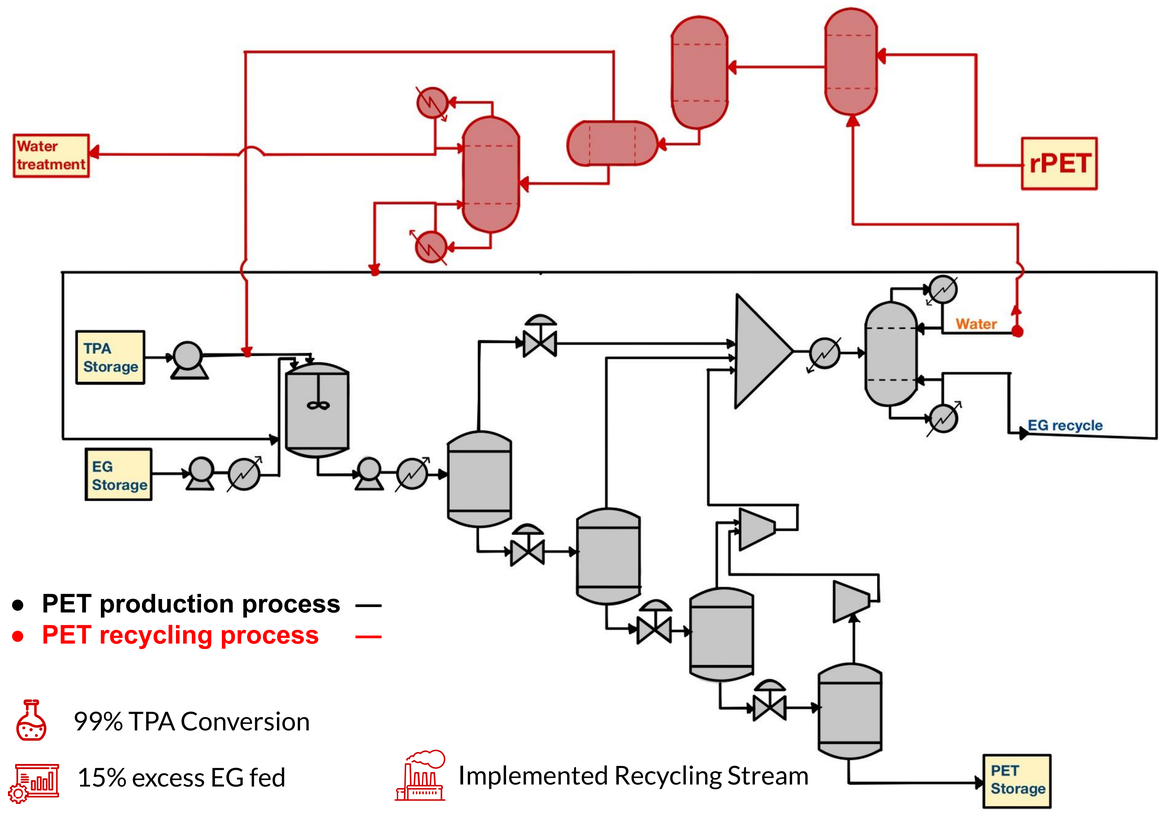
Environmental Considerations (CO_2 Output)

$$CO_{2,\,TOTAL} = PET_{OUT} - TPA_{IN} - EG_{IN} + EG_{OUT}$$

$$CO_{2,\,TOTAL} = PET_{OUT} - TPA_{IN} - EG_{IN}\ (Recycling)$$

- Without recycling EG
  - 1,650,000 metric tons of CO_2 per year
  - 209.3 metric tons of CO_2 per hour
- With EG recycle stream
  - 117,000 metric tons of CO_2 per year
  - 14.84 metric tons of CO_2 per hour

4. PROCESS DESIGN



6. CONCLUSION

***Recommendation**: The proposed greenfield facility is a **feasible** opportunity for Eastman*

- Cash flow positive after *nine years* of operation with an NPV of $93.2 million
- Future plans to implement recycle stream to promote sustainability and cost efficiency

7. ACKNOWLEDGEMENTS

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