

# Production of Synthetic Fuel From Sewage Sludge

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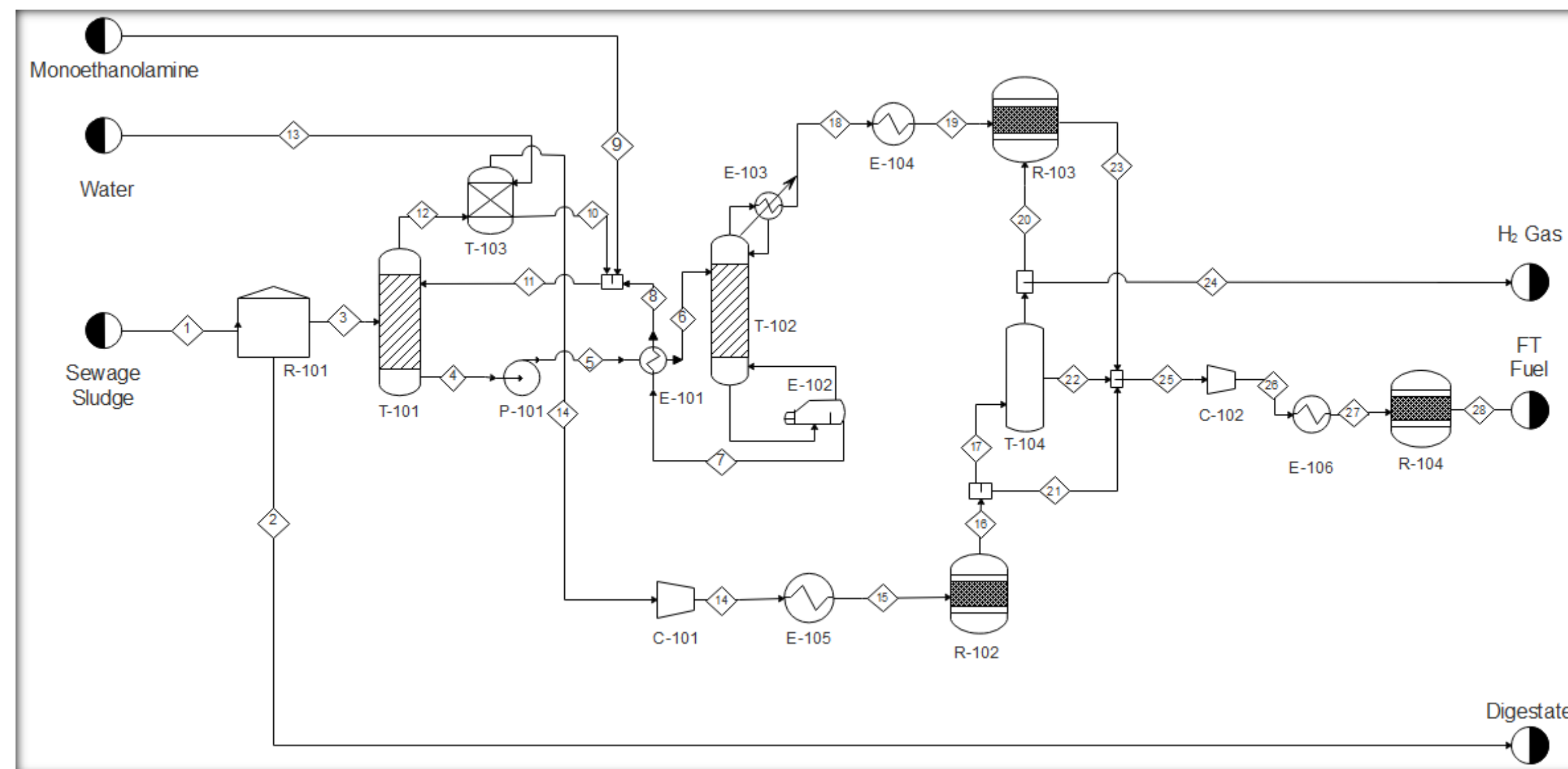
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## Abstract

This is a process for the production of synthetic fuel from sewage sludge via anaerobic digestion and using a CO<sub>2</sub> capture plant. After the sludge is initially digested, the product, biogas, is fed into the CO<sub>2</sub> plant where MEA is used to absorb CO<sub>2</sub> which then goes on to a steam reformer, pressure swing adsorber, and reverse water gas shifter to produce syngas. The syngas is then fed to a reactor where it undergoes Fischer-Tropsch synthesis to produce liquid hydrocarbon fuel. This study is being performed to display a possible environmentally-friendly alternative to mining and fracking.



## Process Flow Diagram



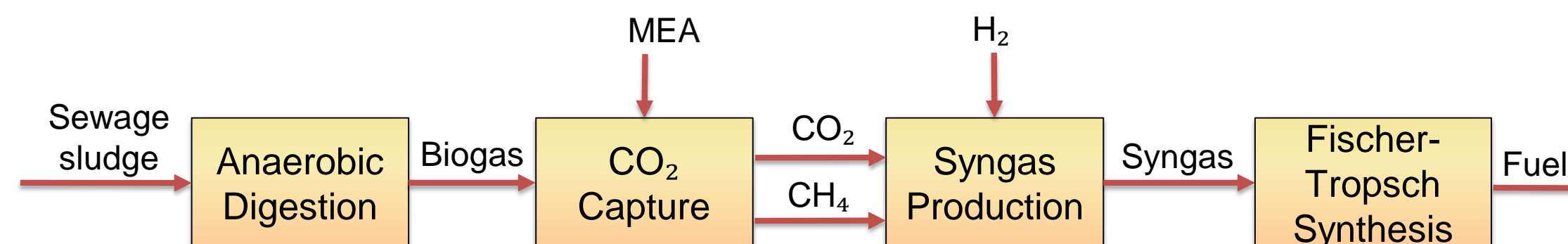
## Equipment Number

## Equipment Name

R-101	Anaerobic Digestion Plant
T-101	Absorption Tower
P-101	Pump
E-101	Heat Exchanger
T-102	Stripper
E-102	Kettle Reboiler
T-103	Scrubber Tower
C-101 to C-102	Compressors
E-103	CO <sub>2</sub> Condenser
R-102	RWGS Reactor
E-104 to E-106	Heater
T-104	PSA Unit
R-103	Steam Reformer
R-104	FT Reactor

## Process Specifications

- Stream 1: 11,000 kg/hr, 10 °C, 1.1 bar
- R-101: 35 °C, 1.1 bar,  $\theta = 15$  days
- T-101: 5 packed trays
- T-102: 10 packed trays
- 43 kg/hr hydrocarbon produced.
- Most H<sub>2</sub>O is recycled



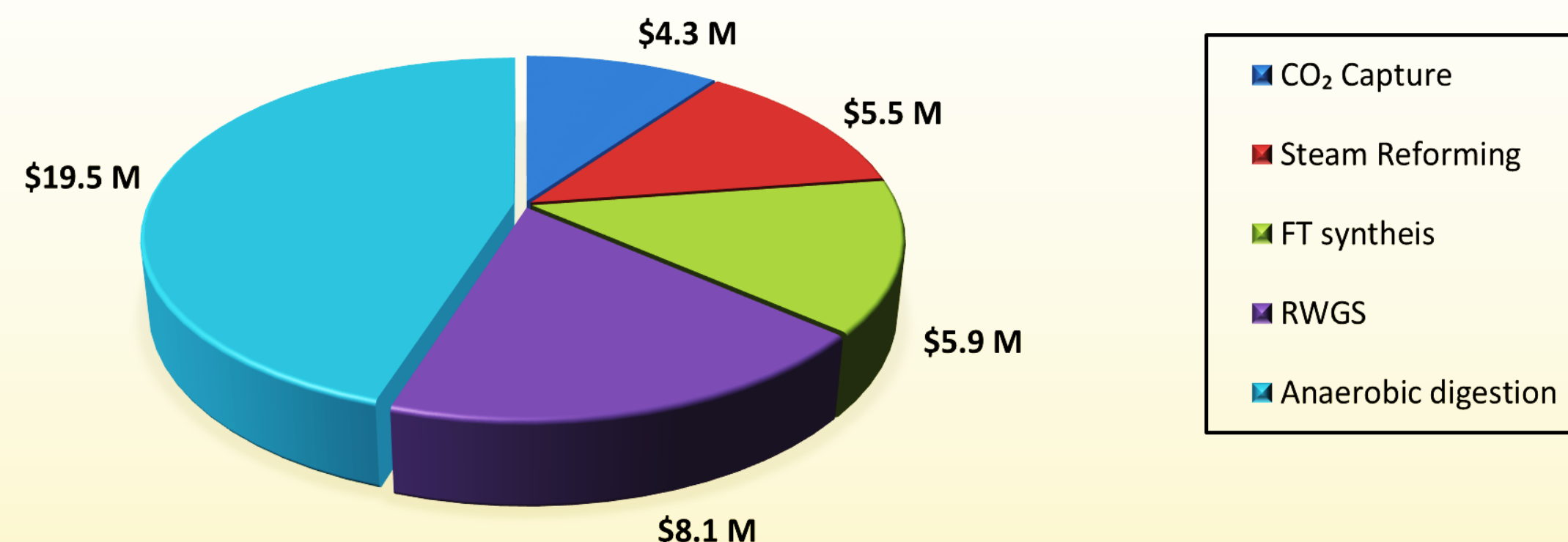
## Why sewage sludge?

- Novelty of process, using waste to produce usable fuel.
- Only listed use of sewage sludge by EPA is as fertilizer.
- Sewage sludge is already digested by anaerobic bacteria as part of the treatment process.
- Utilizes CH<sub>4</sub> and CO<sub>2</sub> off-gas, already produced in sewage treatment process.

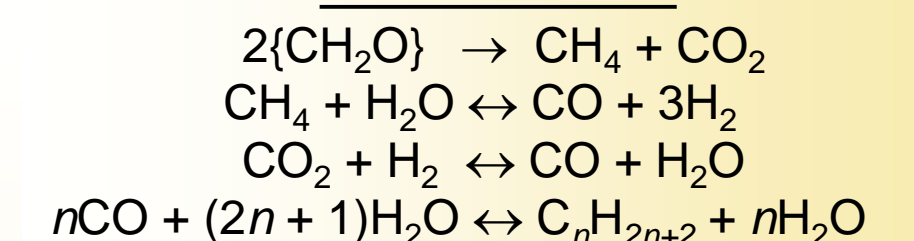
## Current Work

- Operational Costing
- PF&ID
- Optimization of CO<sub>2</sub> plant (hybrid)
- PSA unit

## ESTIMATE TOTAL CAPITAL INVESTMENT BASED ON PROCESS



## Reactions



## Assumptions

- Anaerobic digestion operated under mesophilic conditions.
- H<sub>2</sub>S NH<sub>3</sub> occur in only small trace amounts and therefore are neglected.
- Single-pass CO conversion in FT Synthesis.
- ENRTL-RK method used to model the process in Aspen Plus.
- Government subsidies and by-product revenues are excluded from the economic analysis.

## Acknowledgements

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