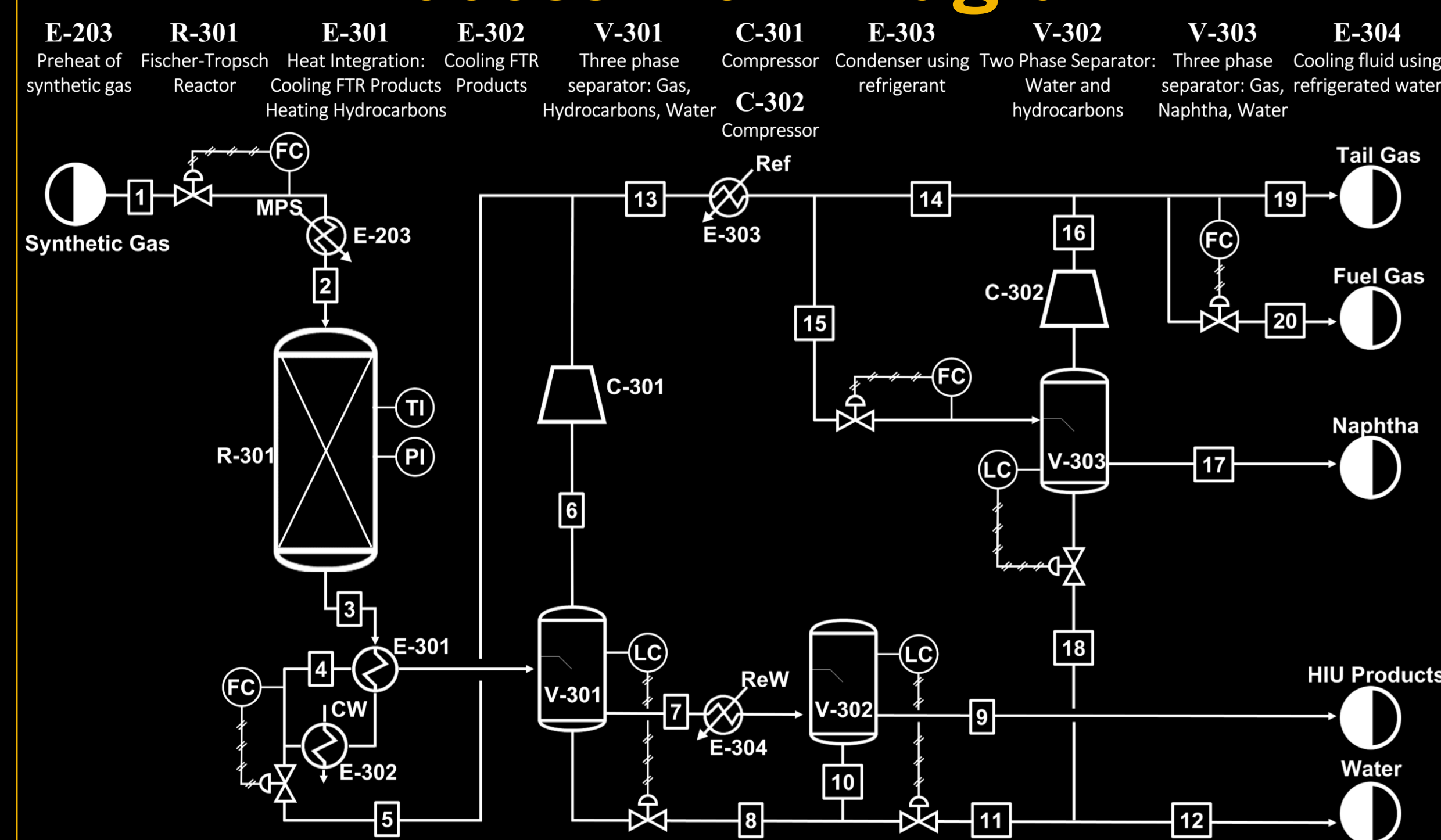


Project Objectives

- Convert stranded methane gas (CH_4) to petroleum products with a modular Gas-to-Liquid (GTL) plant
- Design a Fischer-Tropsch (F-T) reactor to convert syngas to long-chain hydrocarbons
- Design a separation process to separate the F-T products
- Analyze modular unit deployment routes
- Optimize product collection using trucks
- Calculate NPV of project with 8% minimum acceptable rate of return (discounted) and 80% utilization

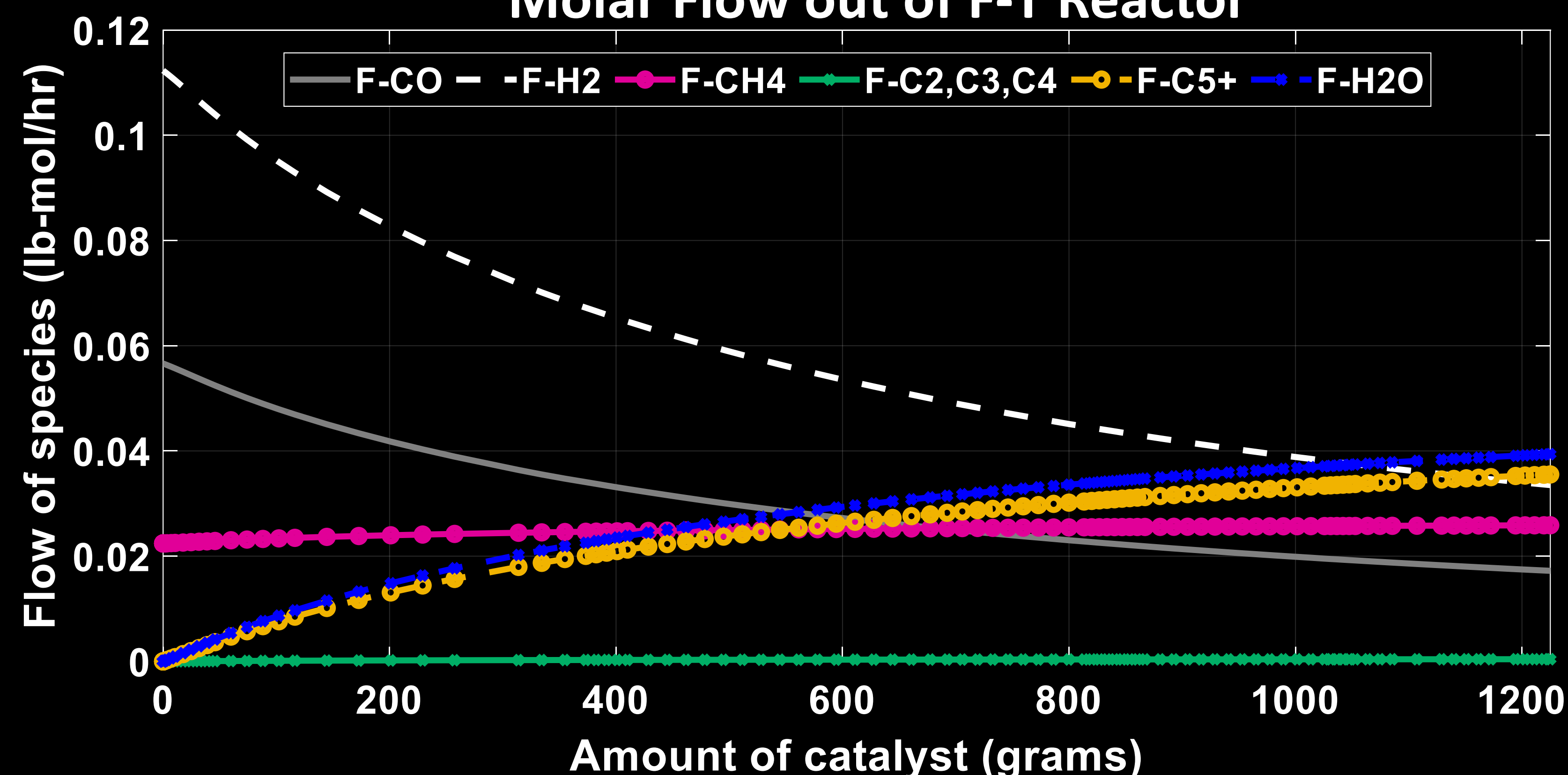
Process Flow Diagram



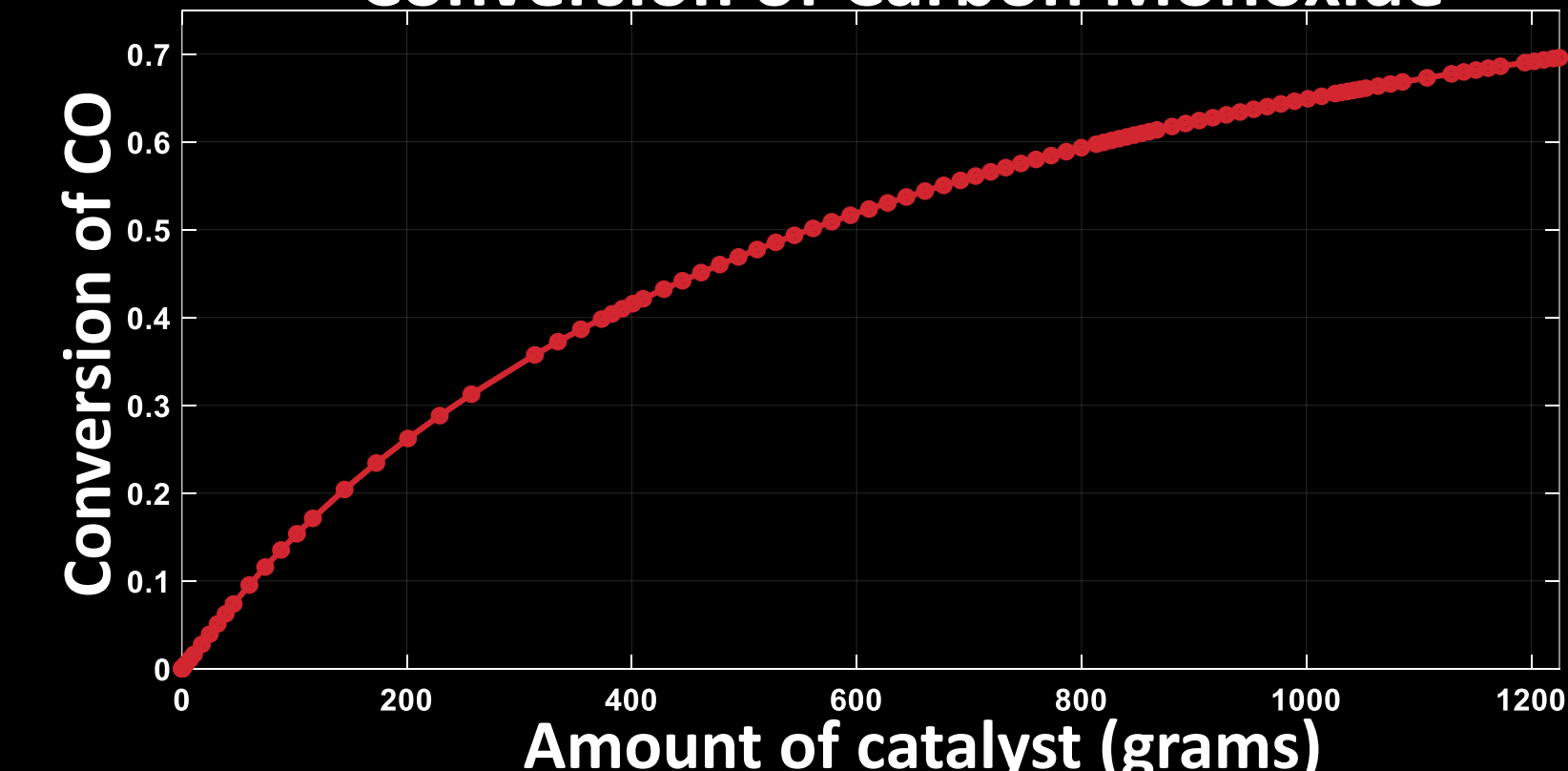
Process Design

- GTL plant composed of 3 modular units that are transported to isolated wellheads
- Syngas Unit converts CH_4 to synthetic gas comprised of CO and H_2
 - Steam Methane Reforming process simulated using AVEVA PROII
- F-T reactor and Separation Unit synthesizes $\text{C}_1 - \text{C}_{76}$ hydrocarbons and H_2O
 - Carbon chain elongation: $2\text{H}_2 + \text{CO} \leftrightarrow [-\text{CH}_2-] + \text{H}_2\text{O}$
 - F-T reactor simulated using MATLAB with given reaction kinetics
 - Separation of F-T products using 3 vessels
- Hydro-Isomerization Unit converts hydrocarbons to paraffin, naphtha, and diesel

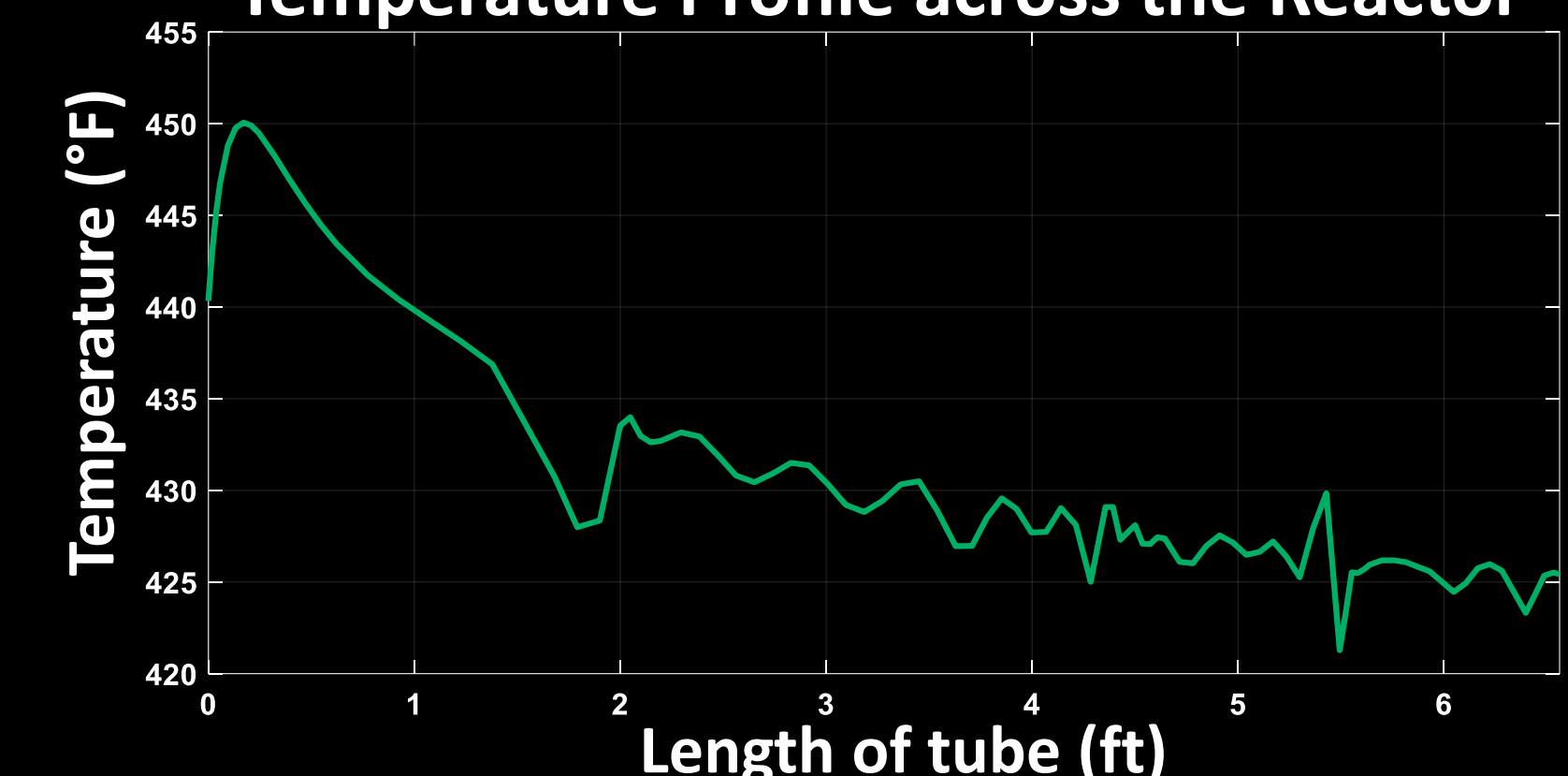
Molar Flow out of F-T Reactor



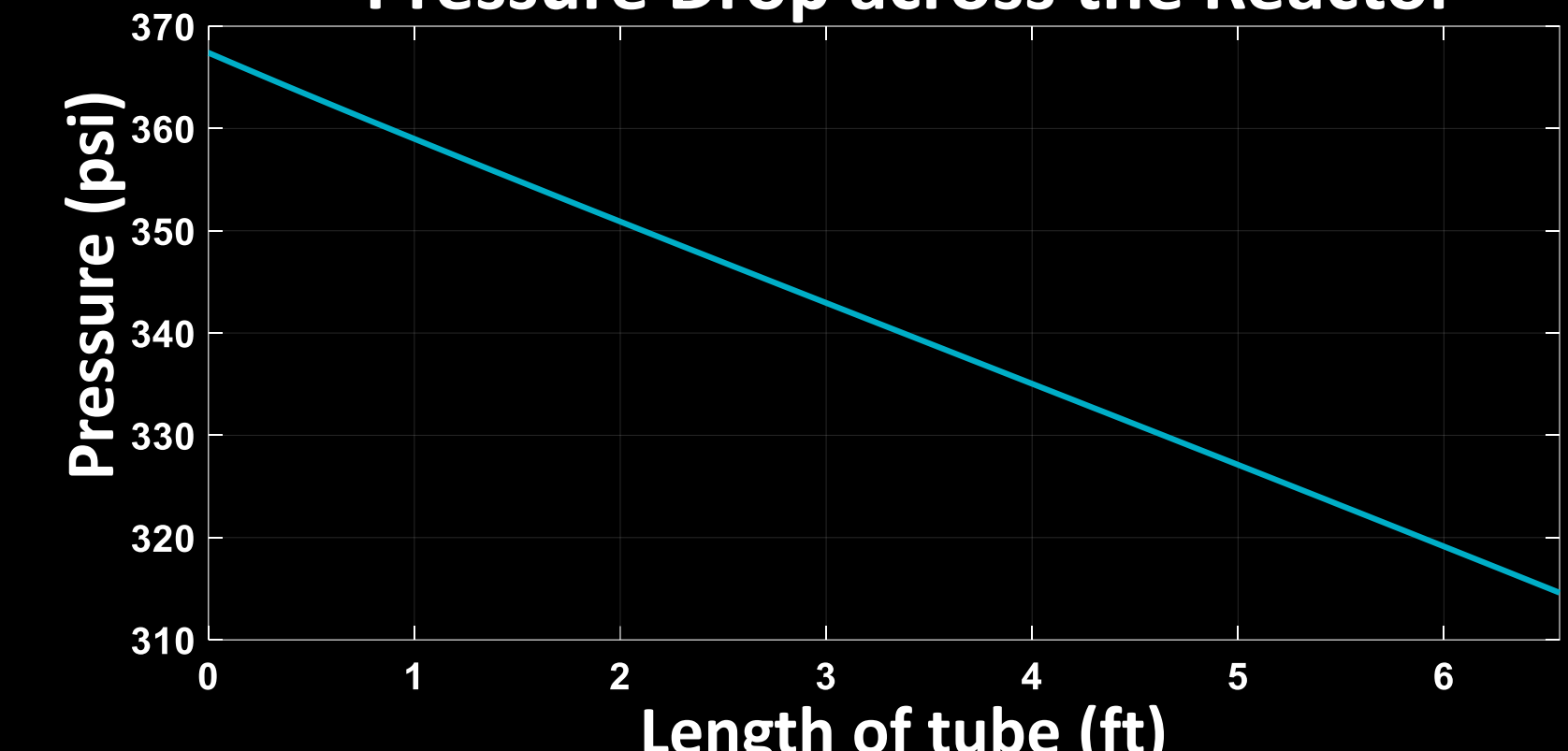
Conversion of Carbon Monoxide



Temperature Profile across the Reactor



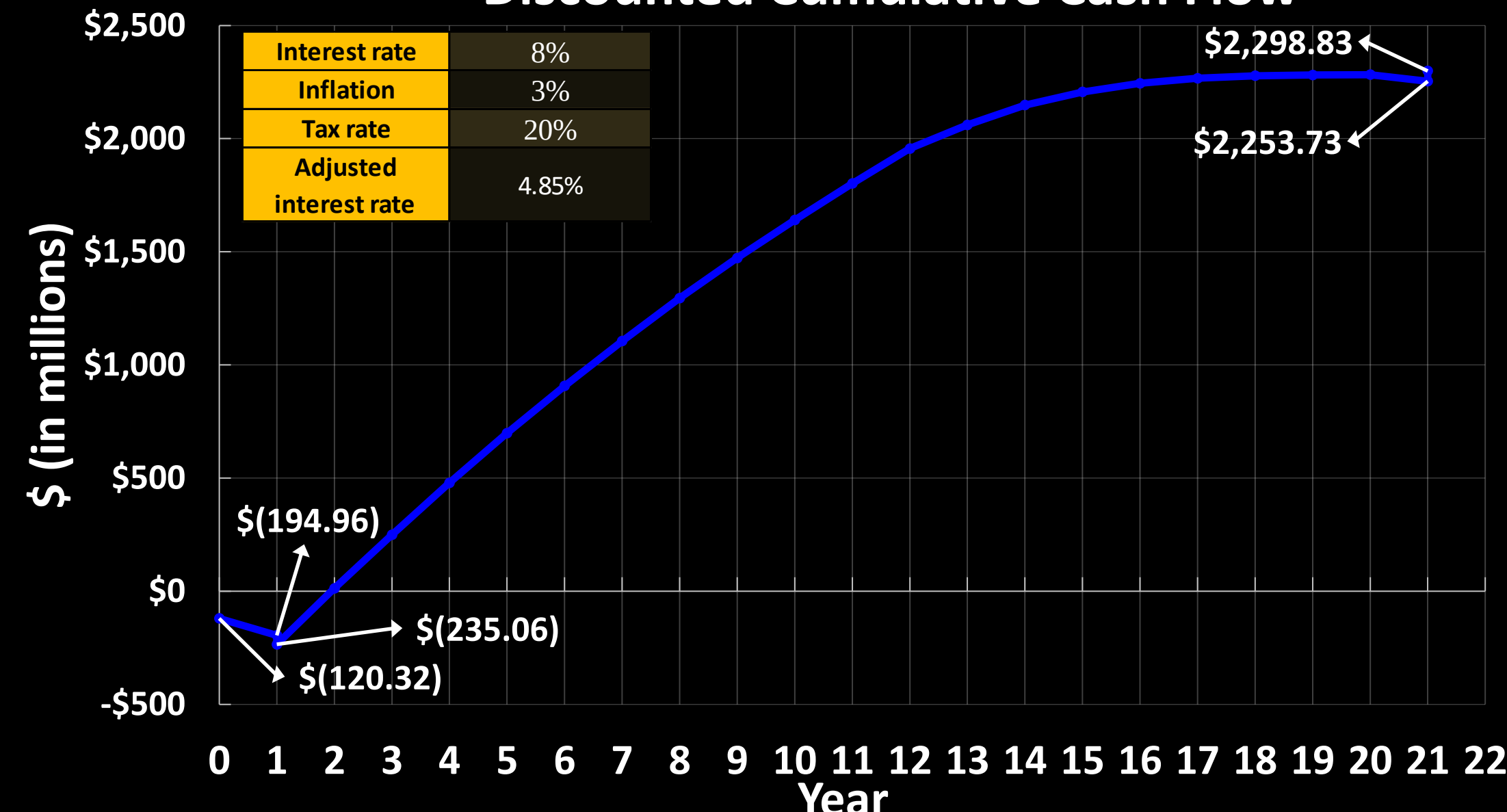
Pressure Drop across the Reactor



Economics

Year	Active Wells	Revenue
0	N/A	\$ -
1	N/A	\$ -
2	1F, 1H, 1C	\$ 377,837,900
3	1F, 1H, 1C	\$ 377,837,900
4	1F, 1H, 1C, 1G	\$ 384,241,930
5	1F, 1H, 1C, 1G, 2D, 1E	\$ 384,241,930
6	1F, 1H, 1C, 1G, 2D, 1E, 2A	\$ 384,241,930
7	1F, 1H, 1C, 1G, 2D, 1E, 2A, 1D	\$ 384,241,930
8	1F, 1H, 1C, 1G, 2D, 1E, 2A, 1D, 1A, 1B, 2F	\$ 384,241,930
9	1F, 1H, 1C, 1G, 2D, 2A, 1D, 1A, 1B, 2F, 2E	\$ 384,241,930
10	1F, 1G, 2D, 1D, 1A, 1B, 2F, 2E, 2B	\$ 384,241,930
11	1G, 1D, 1B, 2F, 2E, 2B, 2C	\$ 384,241,930
12	1G, 1D, 1B, 2F, 2E, 2B, 2C, 2A, 2H	\$ 384,241,930
13	1D, 1B, 2F, 2E, 2B, 2C, 2A, 2H	\$ 275,373,330
14	1D, 2E, 2B, 2C, 2A, 2H, 2G	\$ 243,353,180
15	2E, 2B, 2C, 2A, 2H, 2G	\$ 172,908,840
16	2E, 2B, 2C, 2H, 2G, 1A	\$ 121,676,590
17	2B, 2C, 2H, 2G, 1A	\$ 76,848,370
18	2B, 2C, 2H, 2G, 1A	\$ 44,828,220
19	2G, 1A	\$ 19,212,090
20	2G, 1E	\$ 12,808,060
21	1E	\$ 6,404,030

Discounted Cumulative Cash Flow



- Fixed Capital Investment: \$200.53 million
- Working Capital: \$40.11 million
- Salvage: \$4.99 million
- Seven-year straight line depreciation: \$28.65 million
- Unit transport cost: \$22.31 million
- Product transport cost: \$80.02 million
- NPV: \$2.30 billion

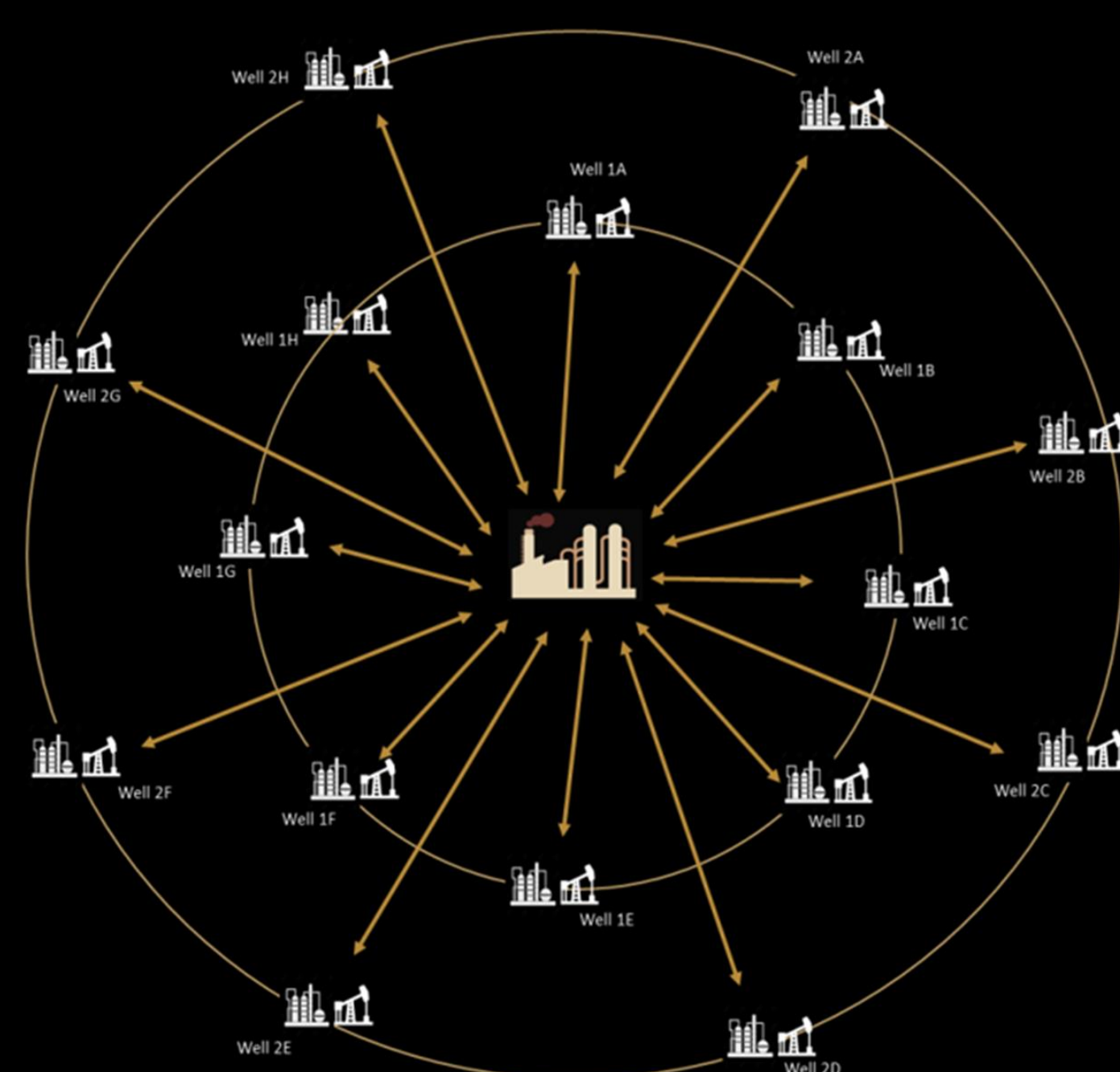
Safety

- Follow OSHA, NIOSH, and EPA standards and regulations to minimize and mitigate plant hazards
- Inherent safety designs reduce process complexity

Conclusion

- Sustainable and profitable project
- 500 MSCF/day and 2,500 MSCF/day contains 1 and 3 reactors, respectively, to process CH_4 feed rates
- 500 MSCF/day units produce 80.50 bbl/day of naphtha and 176.60 bbl/day of diesel
- 2,500 MSCF/day units produce 402.48 bbl/day of naphtha and 883.02 bbl/day of diesel

Associated Gas Well ID	Initial Associated Gas Production MSCF/day	Distance from Central Plant Miles
1A	4,494	62.0
1B	2,989	21.0
1C	8,365	17.0
1D	7,447	73.4
1E	3,290	6.2
1F	14,737	91.0
1G	11,155	59.0
1H	7,081	89.3
2A	9,182	85.8
2B	12,258	84.7
2C	8,742	2.4
2D	3,840	42.0
2E	7,939	98.8
2F	2,874	13.0
2G	6,076	87.0
2H	6,468	36.0



- 35% decrease of methane production for wells after first two years of operation
- Two-year startup
- Twenty-year operating lifetime
- Fifty 500 MSCF/day and two 2,500 MSCF/day units utilized