

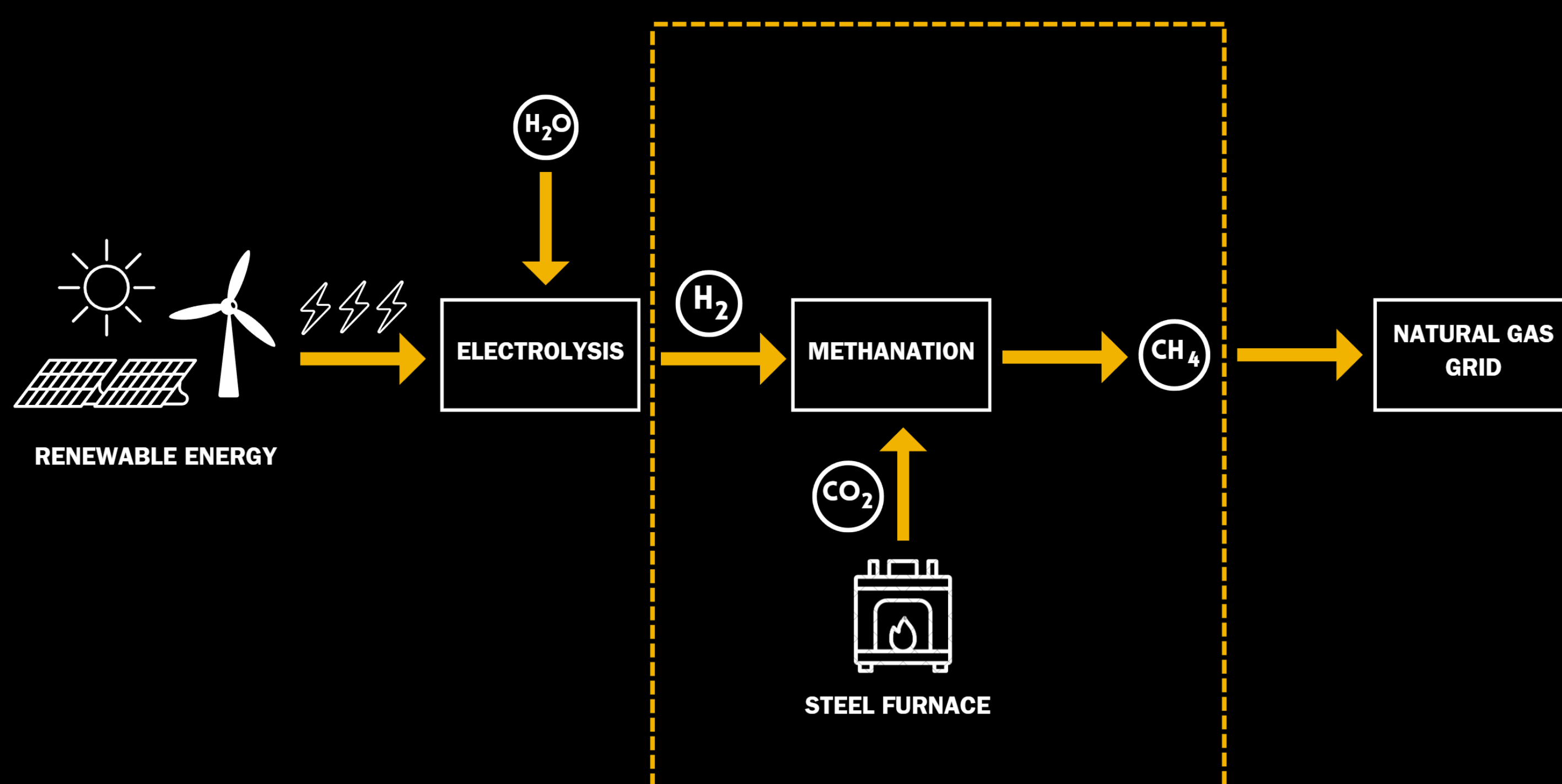
EXPO

engineering ▲ design

OBJECTIVES

- Design a Power-to-Gas plant using hydrogen from renewable energy
- Select a CO₂ source for methanation reaction
- Produce methane at 90-95% overall purity with 1-8% CO₂
- Utilize inherently safe design principles to minimize risk

DESIGN CONCEPT

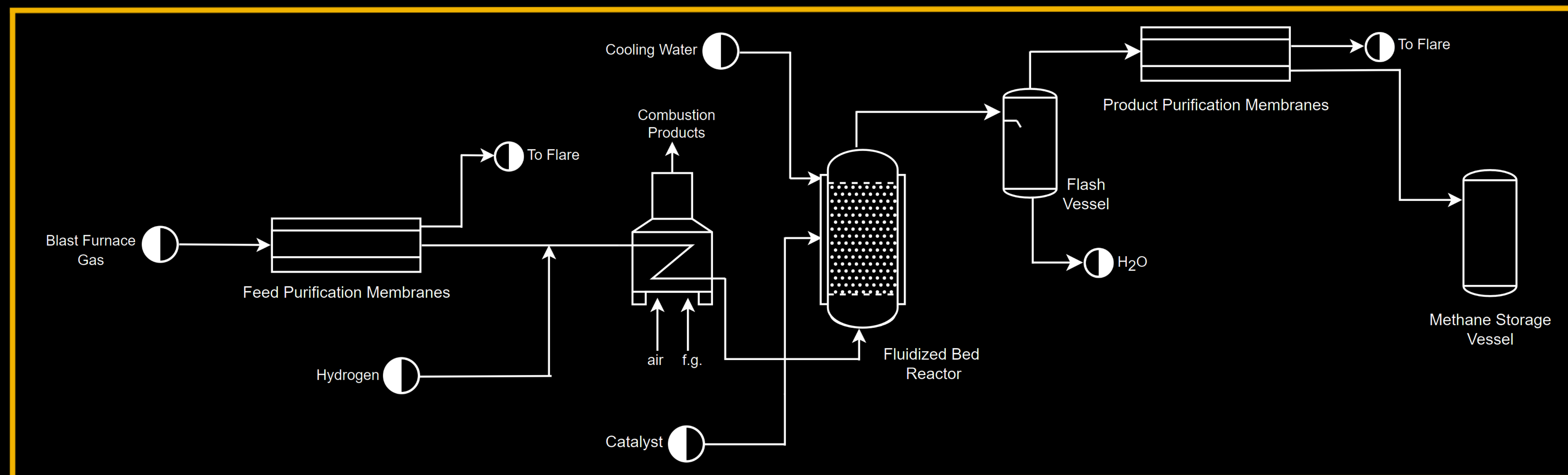


SELECTION OF CO₂ SOURCE

- Analyzed power, industrial, agricultural, biological sources
- Steel industry emits 1.89 tons of CO₂ per 1 ton of steel
- Assumed composition of 72% N₂ and 28% CO₂
- Free of contaminants

GREEN GAS: CONVERTING RENEWABLE ENERGY TO SYNTHETIC NATURAL GAS

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PROCESS OVERVIEW

- Feed purification membranes: UBE
- Product purification: 6FDA-TMDA, 6FDA-DAP
- Fluidized bed reactor
- Flash vessel to remove water

ENVIRONMENTAL IMPACT

- Use of atmospheric CO₂ for process feed
- Environmentally friendly separation methods

SAFETY

- Controls scheme, cooling jacket, and pressure relief valve implemented on reactor
- Failure rate of 0.0056 faults per year
- Minimization of flammable and toxic chemicals used
- HAZOP of reactor conducted

ECONOMICS

- Process is sensitive to market prices of methane and hydrogen
- Annual replacement of catalyst

FCI _L	\$4,540,000
COM _d	\$5,160,270
Revenue	\$879,237
Breakeven Revenue	\$6,330,995

CONCLUSION

- Final product of 17.5 kg/hr of 92% methane
- Not currently feasible
- Design scale up for increased flow rates
- Incorporate recycle stream
- Advancements in membrane technology