



### **1. Motivation and Goals**

 Replace the fuel for an ethane cracker to lower emissions by 90%. Design a hydrogen plant to produce 1,800 MT  $H_2$ /day.

# 2. Initial Research

• 4 Hydrogen Production Methods • Steam Methane Reforming (SMR) • Autothermal Reforming (ATR) • Alkaline Electrolysis (AEL) • Permeable Membrane Electrolysis (PEM) Production Method Capability • SMR can meet goals • ATR can meet goals • AEL and PEM cannot reach 1,800 MT/day • Why Choose SMR Method? • Costing, Research, and Capability! **Technoeconomic Analysis** \$3,900,000,000 \$3,710,000,000 \$4,000,000,000 \$3,000,000,000 \$2,000,000,000 \$728,000,000 \$749,000,000 \$1,000,000,000

ATR

SMR

PEM

AEL

# Large Scale, Low Emission **Production of Hydrogen Fuel** lan Goodall, James Kelley, Colin Thieken, Abi Willette, and Noah Williams

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#### 4. Economics \$523,427,109.00 Effective Revenue **Carbon Credit Analysis** \$441,646,224.65 Operating **Expenses Non-Discounted** \$81,780,884.34 Cash Flow \$1,404,190,948. Capital Cost 96 NPV \$118,200,740.03 **Discount Rate** \$/MT 2.74% / 1.74% Rate of Return (Disc/Non) Sensitivity Analysis of Key Metrics Decrease Increase **Natural Gas Price** Change (-25% / 50%) **Capital Cost Change** (-20% / 30%)

Electricity Price Change (-25% / 50%) Water Price Change (-25% / 50%) \$ 100,000.0 \$ (200,000.00) \$ (300,000.00) \$ (100,000.00)

Change in NPV (\$/1000)

## **5.** Conclusions

- Achieved >90% CCUS and 1,805 MT  $H_2$ /day.
- Negative Net Present Value.
- Profitability would increase with a higher carbon credit.

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