
AVEVAWORLD

Precise Modeling Using Customization within APS

PATRICK VINCENT

Low-cost, low-carbon hydrogen & syngas using heat and globally abundant materials

OMC Thermochemistry

Founded 2021

COMPLETED WORK | SERIES A | PILOT | COMMERCIAL & GROWTH

$11 million in non-dilutive grants & PhD-led development | 6 mos | 18 mos

Britt Boughey
MBA, MS, PE

Kent Warren
PhD

Juan Inga
PhD, PE

Jayaveera Muthusamy
PhD

Patrick Vincent

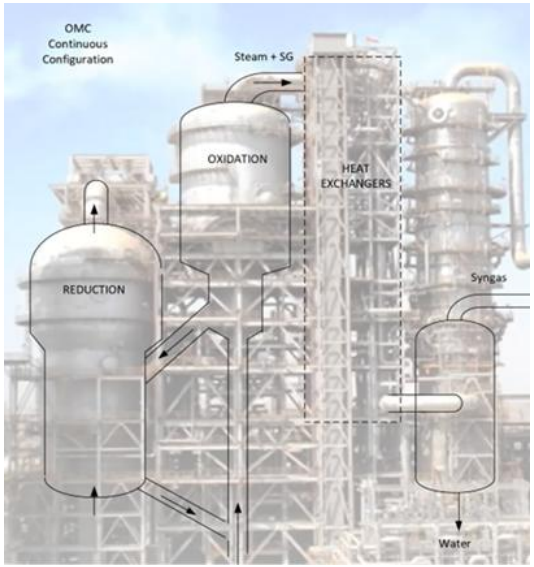
Liam Taylor

*assumes renewable electricity is used

Existing H_2 Production Technologies

	Legacy	Emerging	
	Steam Methane Reforming	Electrolysis	Autothermal Reforming
CO_2 Emissions	High	None*	Low
Energy Efficiency	60-70%	70-80%	60-70%
Cost	$	$$	$$$
Large-Scale	✓	Needs many small units	✓
Chemistry	$CH_4 + H_2O \rightarrow 3H_2 +$ 	$H_2O \rightarrow H_2 + ½\ O_2$	$CH_4 + ½O_2 + H_2O \rightarrow 3H_2 +$ 

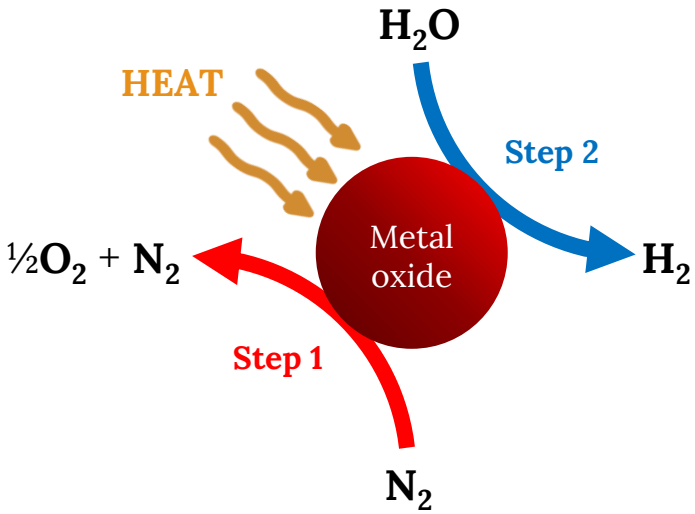
The OMC Oxygen Carrier Platform



FCC – Fluidized Catalytic Cracker

- Iron & aluminum
- Easily fluidizable, highly spherical powder
- Mechanically durable; highly resistant to poisons / fouling
- No unwanted side reactions for H2 / syngas production

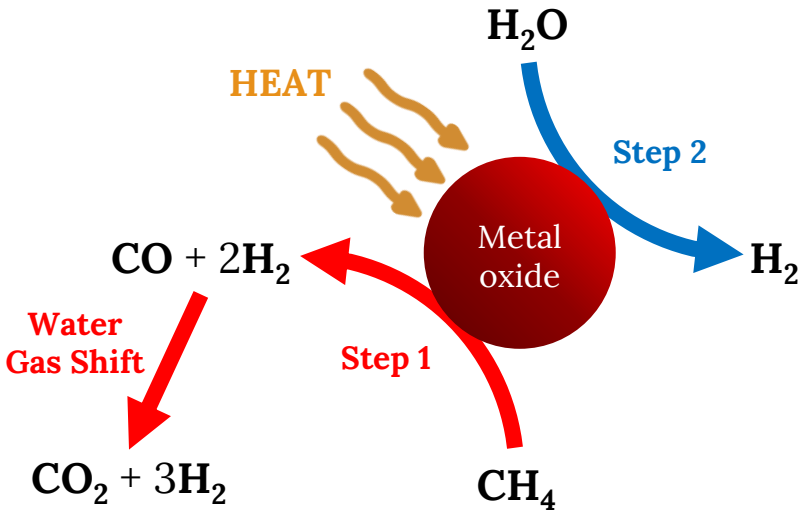
The OMC Process for Green H_2



	OMC
CO_2 Emissions	Low
Energy Efficiency	~90%
Cost	$
Large-Scale	✓ (via FCC format)

(Alternate Step 2) Feed steam and CO_2 to produce syngas ($CO + H_2$) for upgrading into low-carbon fuels

The OMC Process for Methane-Driven H_2

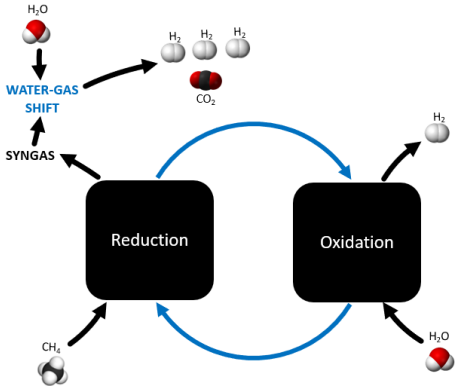


	OMC
CO_2 Emissions	Low
Energy Efficiency	~85%
Cost	$
Large-Scale	✓ (via FCC format)

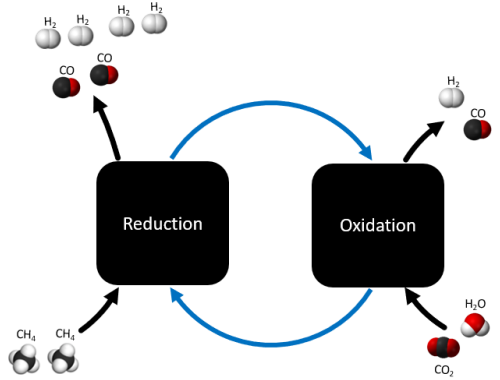
(Alternate Step 2) Feed steam and CO_2 to produce syngas ($CO + H_2$) for upgrading into low-carbon fuels

Simulation Cases

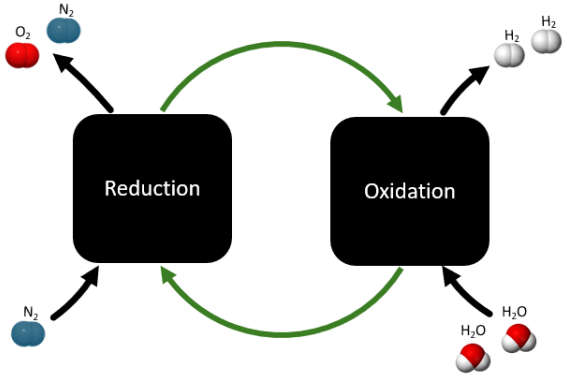
Hydrogen
Methane-Driven



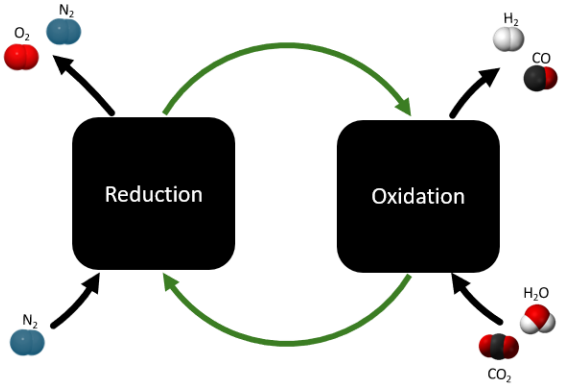
Syngas
Methane-Driven



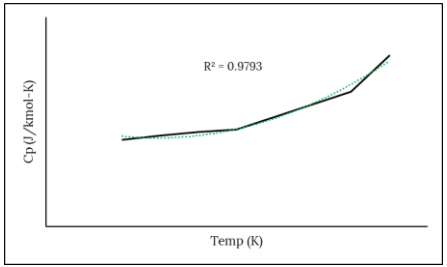
Green



Green



Modeling Proprietary Material Behavior



Solid Heat Capacity

Lab Data

Solids Circulation Rate

Reaction Enthalpy

MO = oxidized metal oxide
M = reduced metal oxide

Some equipment not shown

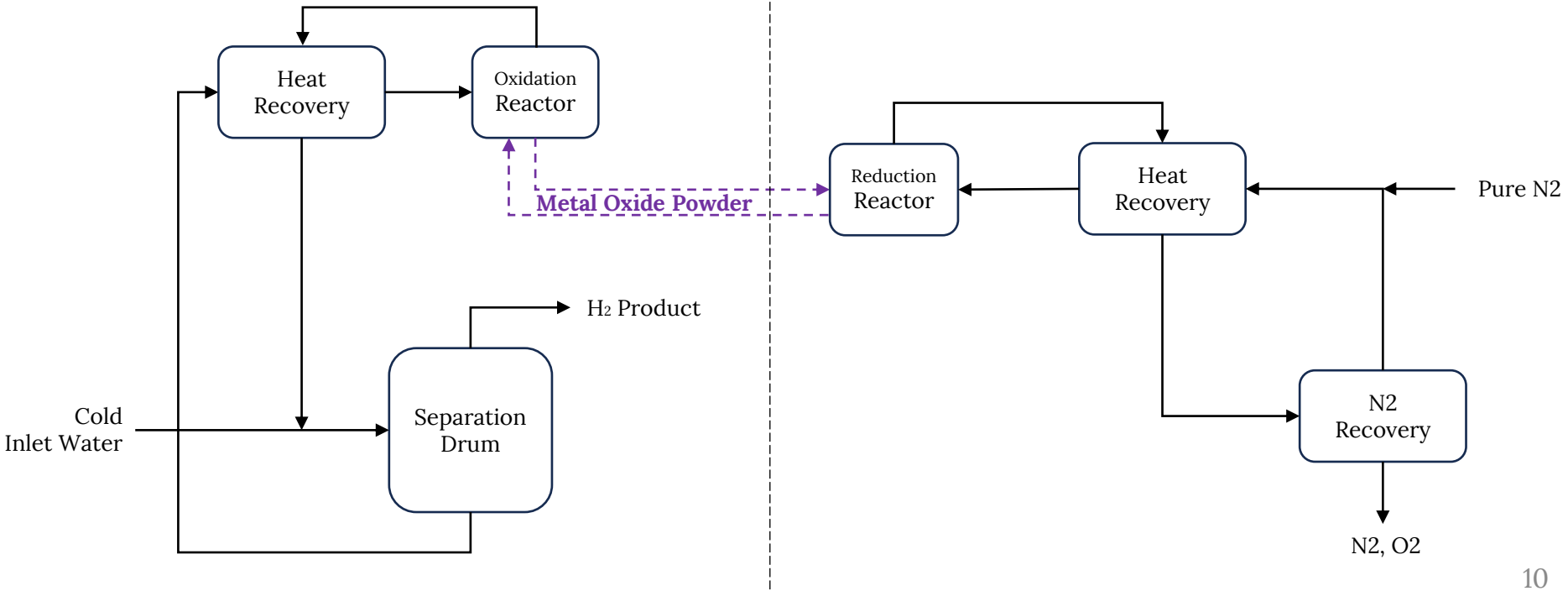
Mass Balances for Non-Stoichiometric Reactions

Real: $\boldsymbol{M} + H_2O \rightarrow \boldsymbol{MO} + H_2$

Simulation: $\boldsymbol{H_2O} \rightarrow \frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{O_2} + \boldsymbol{H_2}$

Real: $\boldsymbol{MO} \rightarrow \boldsymbol{M} + \frac{1}{2}\,O_2$

Simulation: $\frac{\boldsymbol{1}}{\boldsymbol{2}}\,\boldsymbol{O_2} \rightarrow \frac{\boldsymbol{1}}{\boldsymbol{2}}\,\boldsymbol{O_2}$



MO = oxidized metal oxide
M = reduced metal oxide

Some equipment not shown

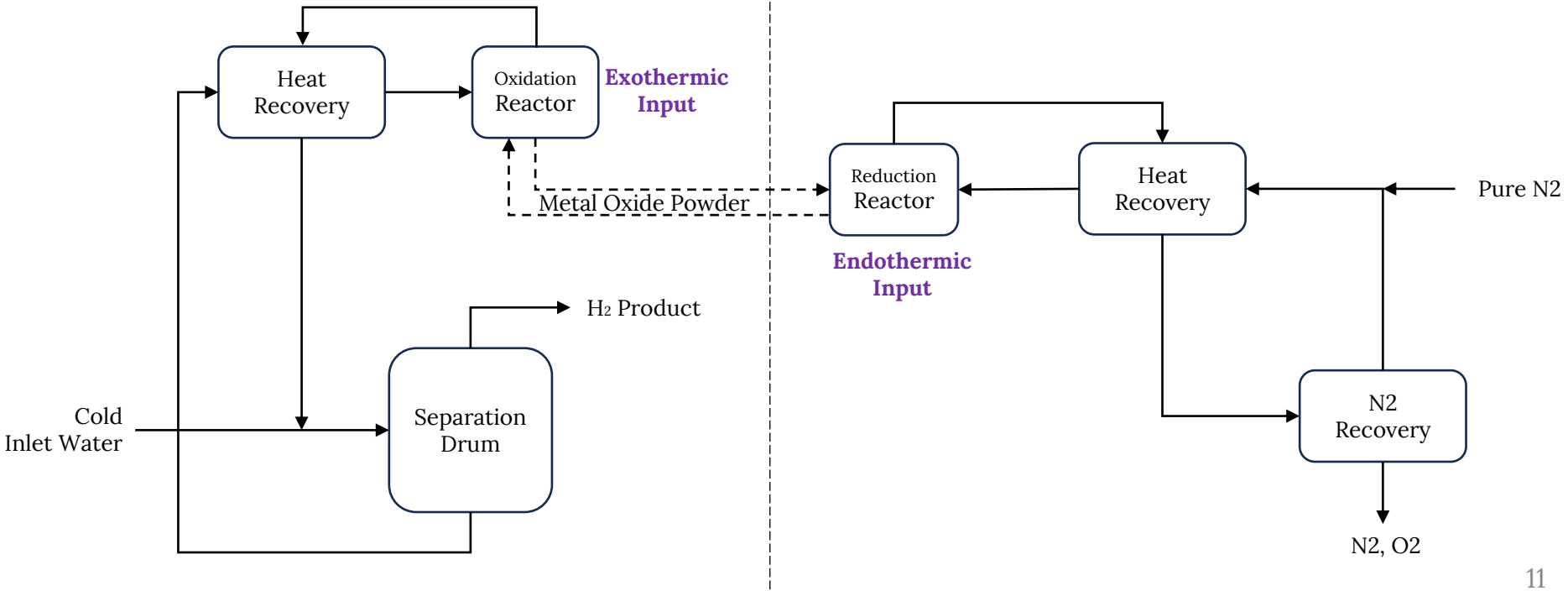
Heat Balances for Non-Stoichiometric Reactions

Reality: $\boldsymbol{M} + H_2O \rightarrow \boldsymbol{MO} + H_2$

Simulation: $H_2O \rightarrow \frac{1}{2}O_2 + H_2$

Reality: $\boldsymbol{MO} \rightarrow \boldsymbol{M} + \frac{1}{2}\ O_2$

Simulation: $\frac{1}{2}\ O_2 \rightarrow \frac{1}{2}\ O_2$



OIL, GAS, AND ENERGY | COLORADO, UNITED STATES

OMC Thermochemistry advances novel low-carbon hydrogen / syngas technology

Challenge

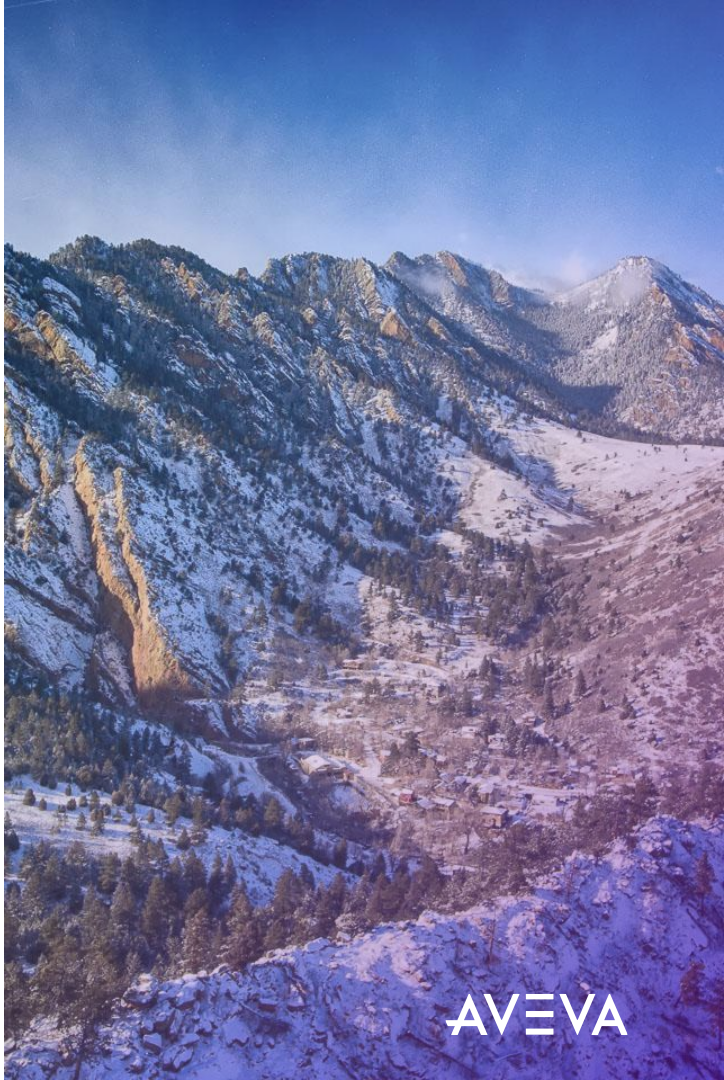
- Novel process requires customization of simulations to enable accurate modeling & technology development
  - Solids handling of proprietary iron aluminate “active material”
  - Non-stoichiometric reactions occurring between solid / gas phase
  - Custom first-principles enthalpy inputs

Solution

- Utilized flexibility of AVEVA™ Process Simulation (APS)™ to successfully model “Nth Plant” flowsheet
  - Unit economics
  - LCAs

Results

- **Rigorously modeled class-leading efficiency & unit economics of technology**
- **Quantified >90% life-cycle emissions reductions for low-carbon hydrogen**
- **Optimized exotherm heat recovery to capture ~10% energy efficiency improvement**

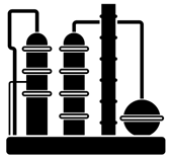


Next Steps


Series A


Pilot


Series B


Commercial Demonstration


Growth

OMC
Thermochemistry