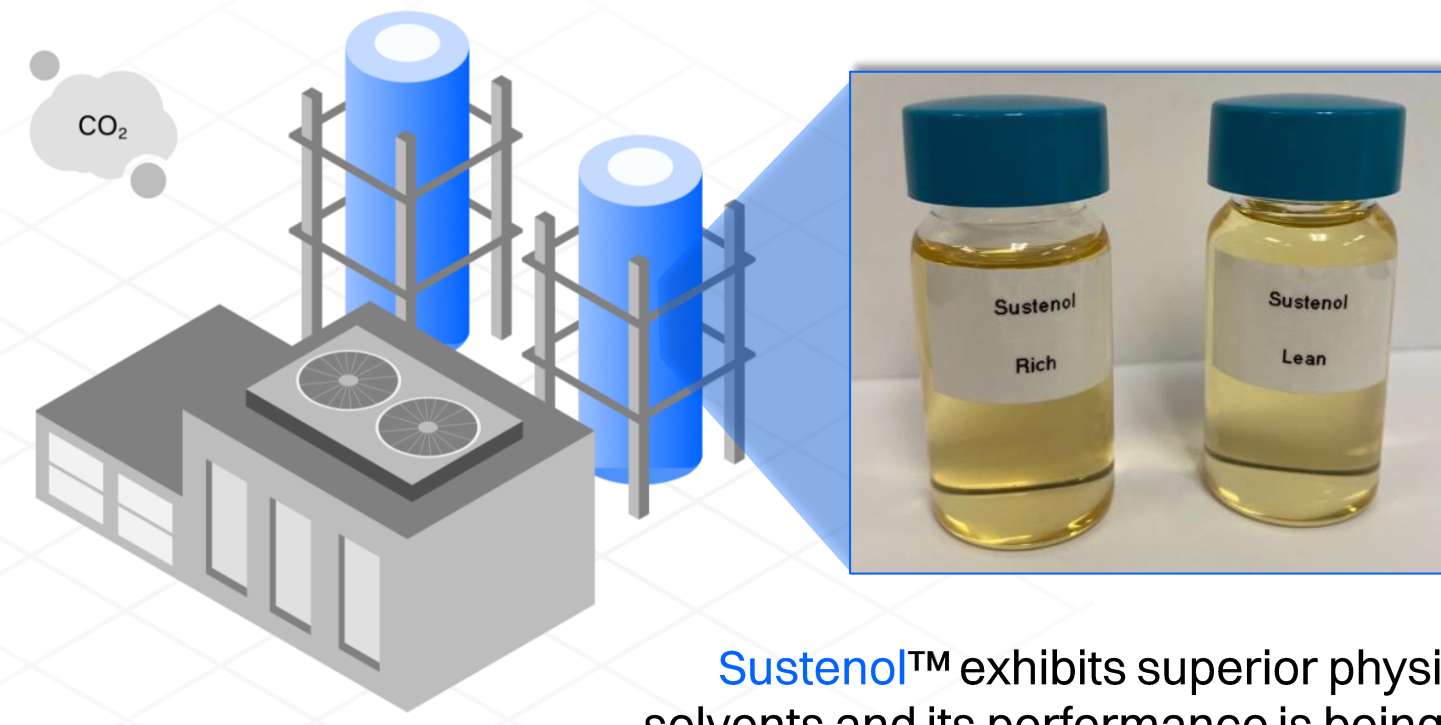


## Objective

### To develop and advance Sustenol™

a novel, water-lean, mixed-amine solvent, for NGCC point source CO<sub>2</sub> capture



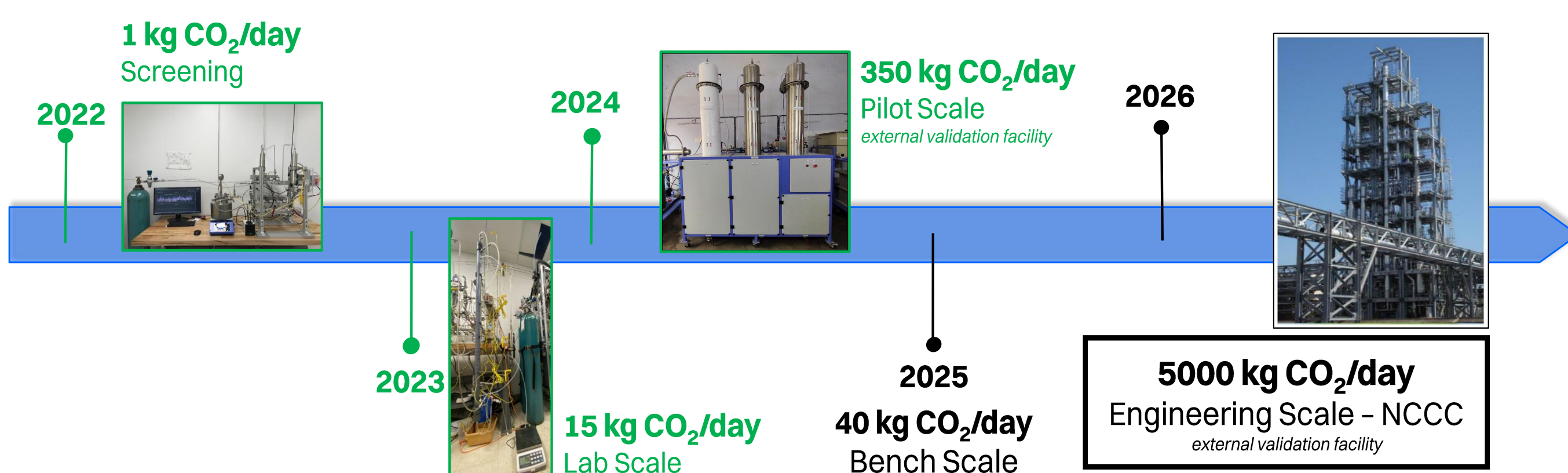
**>97%** CO<sub>2</sub> capture efficiency

**3x** higher reaction rate  
compared to 30 wt.% MEA (40°C)

**40%** lower capture cost  
compared to Cansolv®

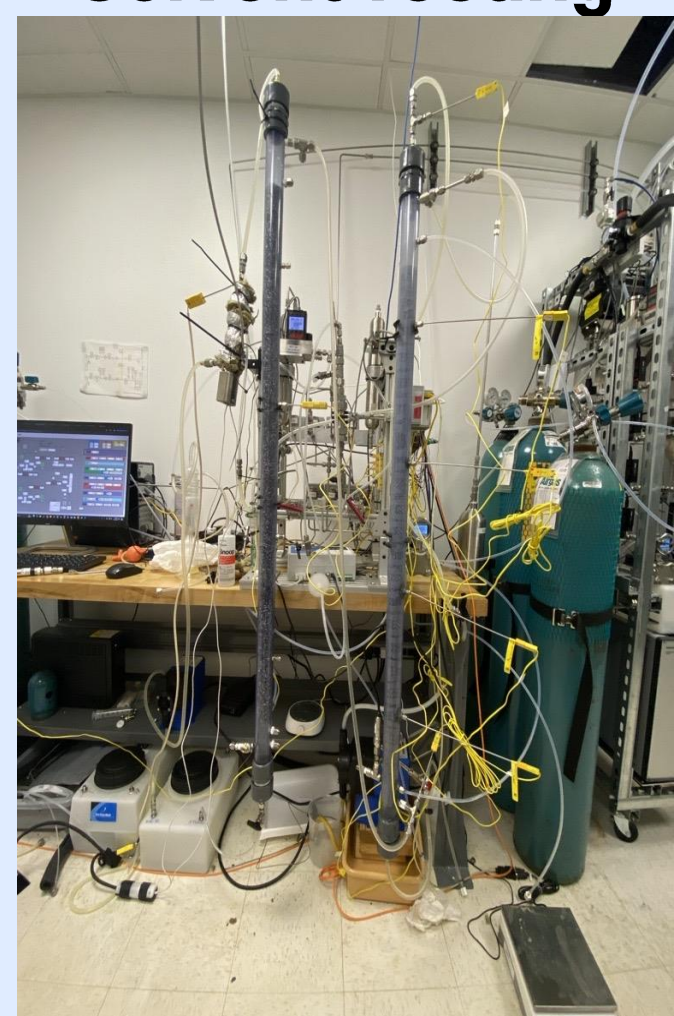
Sustenol™ exhibits superior physical/chemical properties that differentiate it from other solvents and its performance is being validated at various scales from lab to engineering scale

## Technology Roadmap

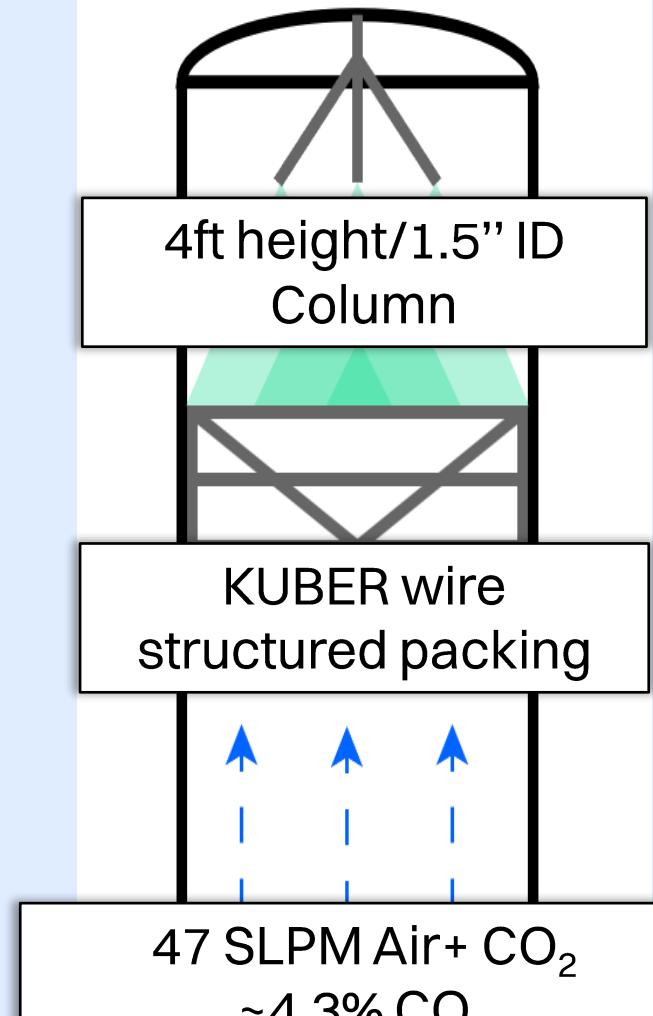
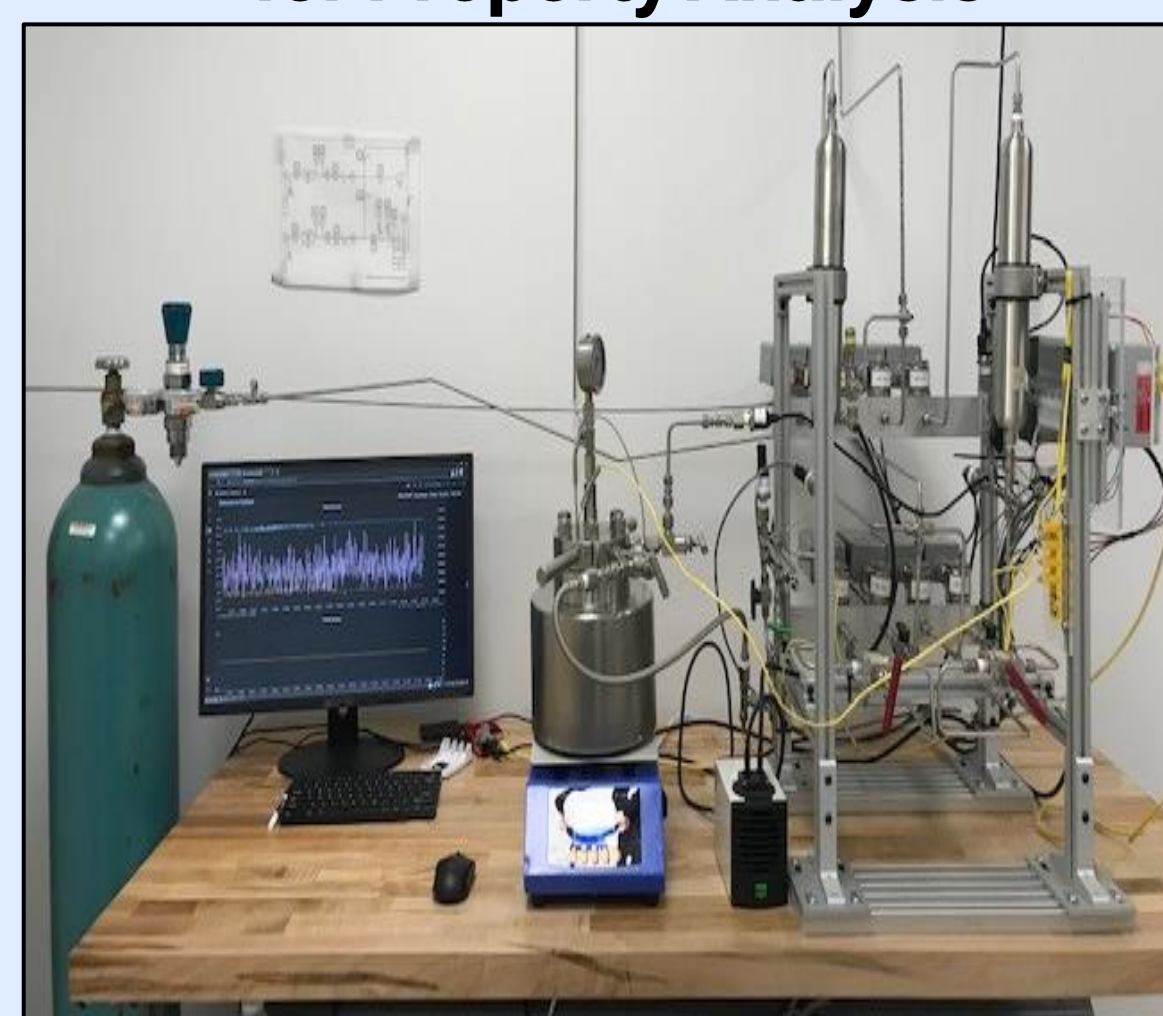


## Lab Scale Results

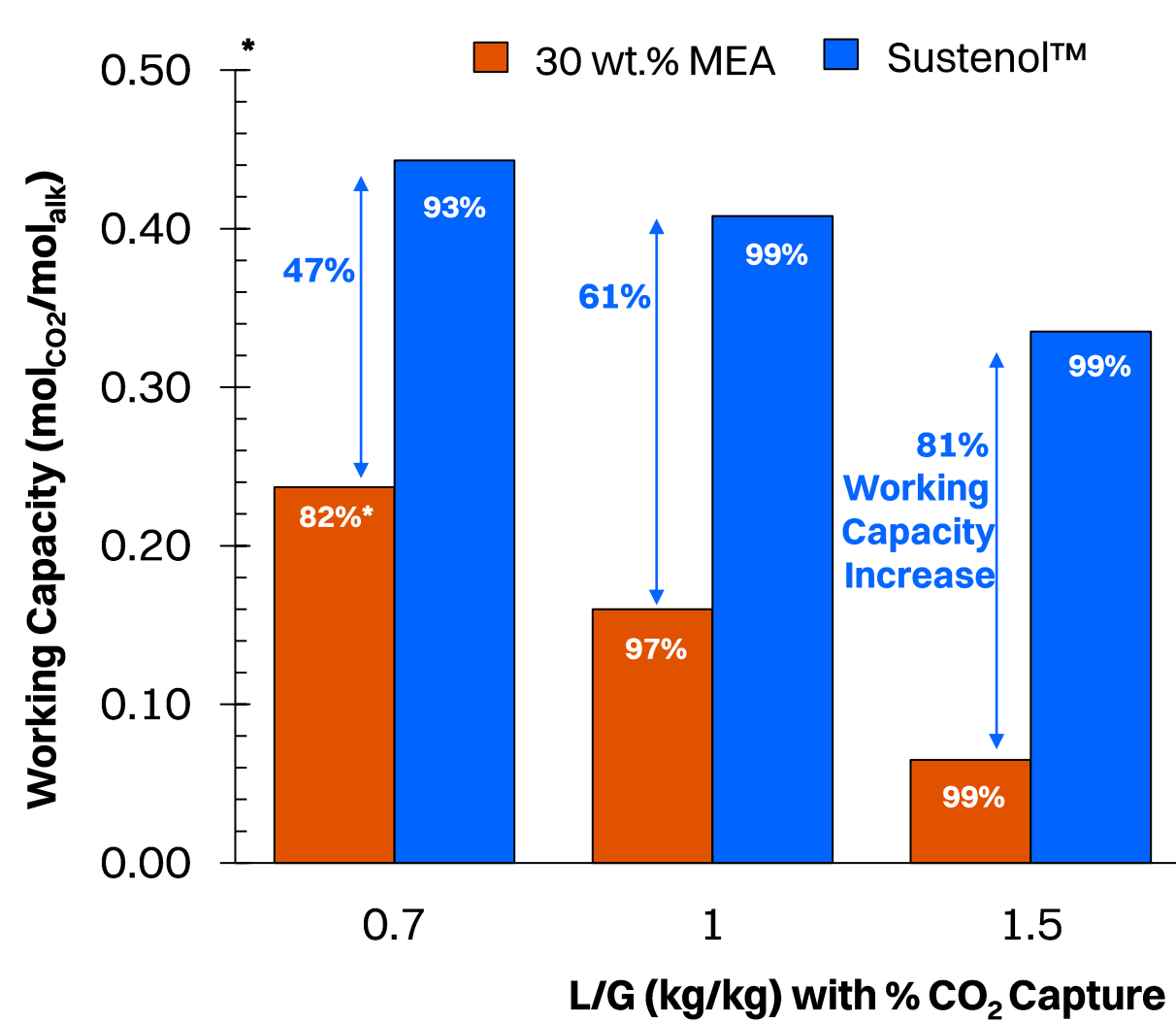
### Lab Scale Absorber Solvent Testing



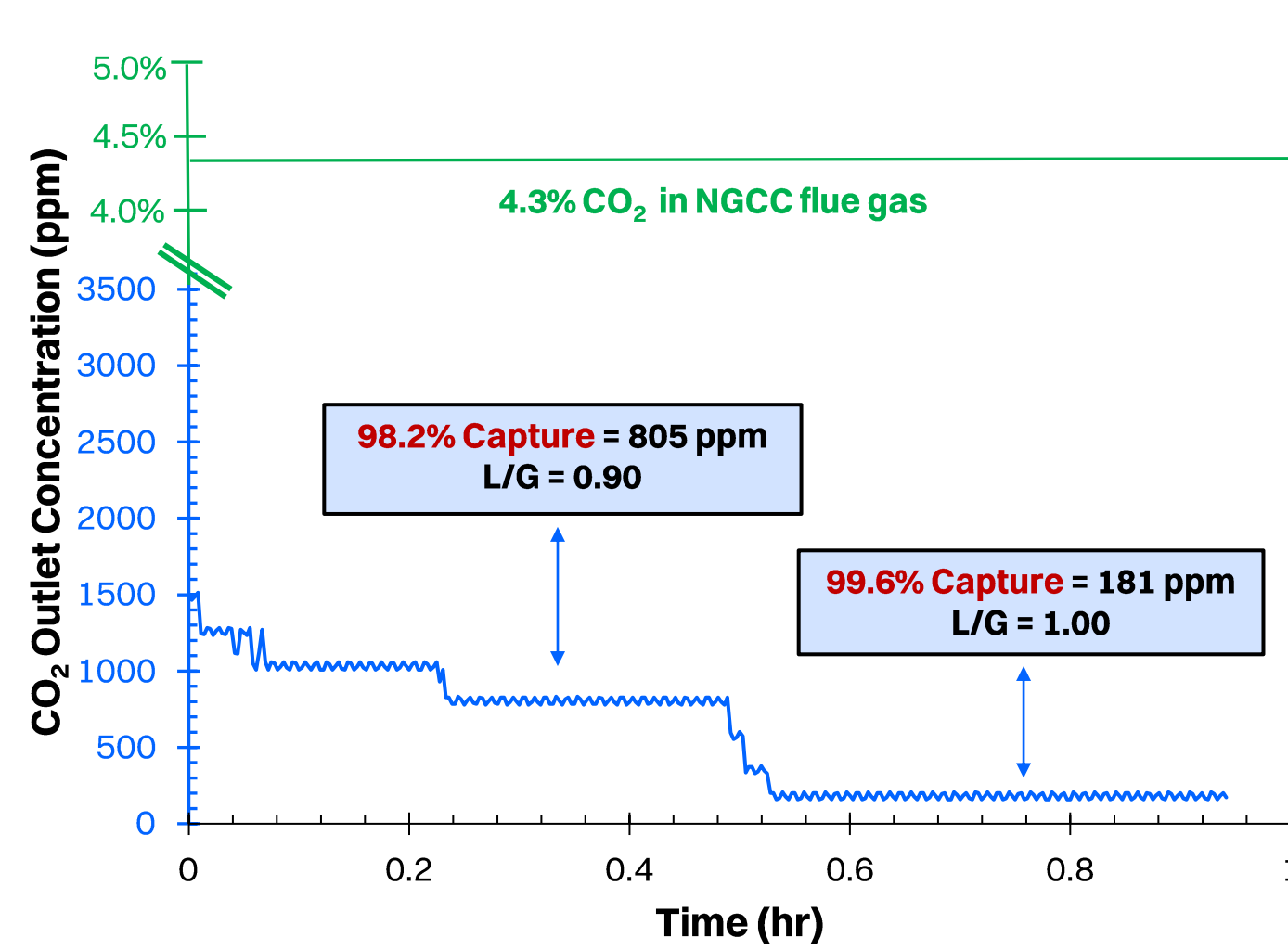
### Lab Scale Stirred Tank Reactor for Property Analysis



### Superior CO<sub>2</sub> Capture Efficiency + Working Capacity



### Deep CO<sub>2</sub> capture with low L/G ratios enables net zero removal



## Solvent Property Comparison

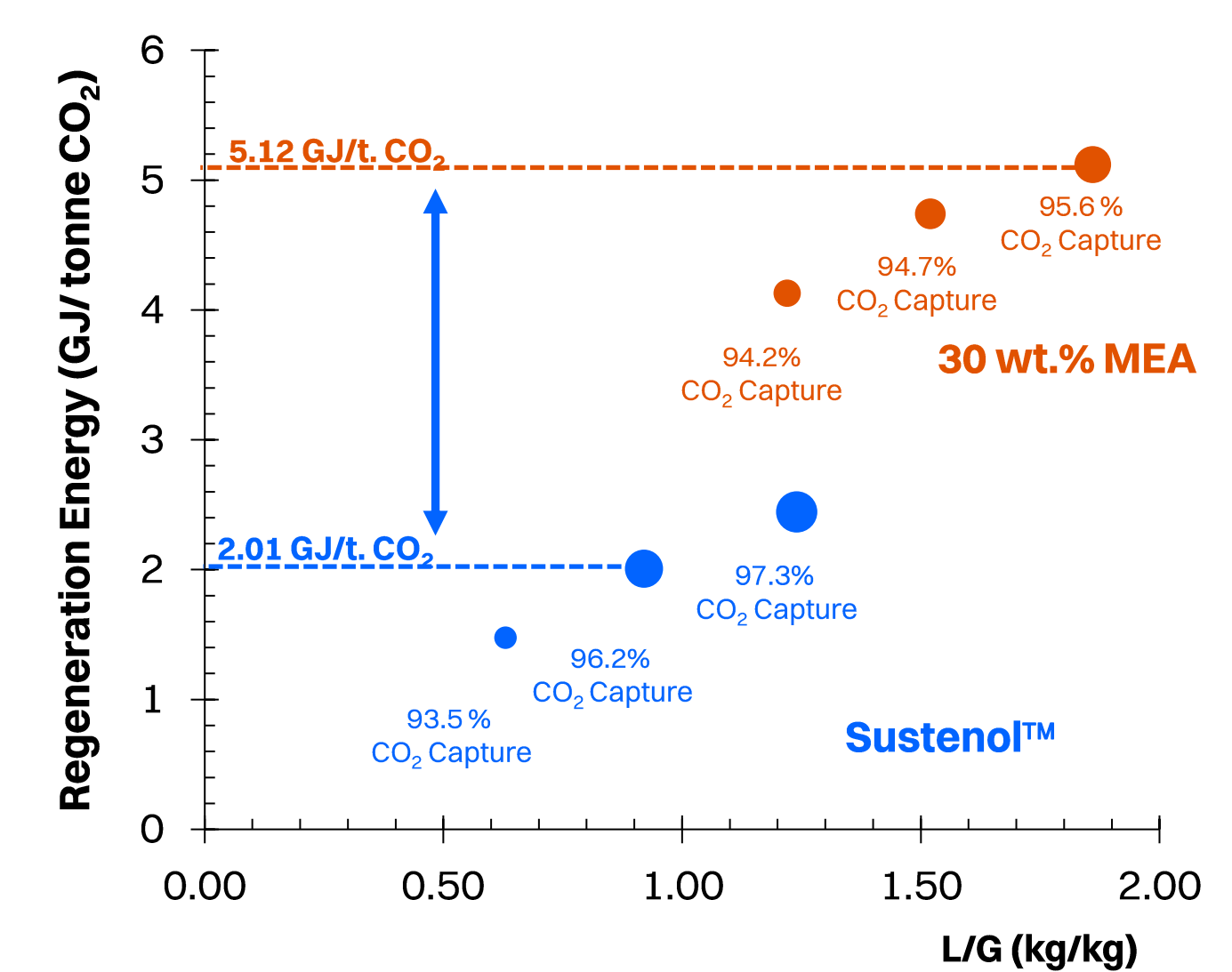
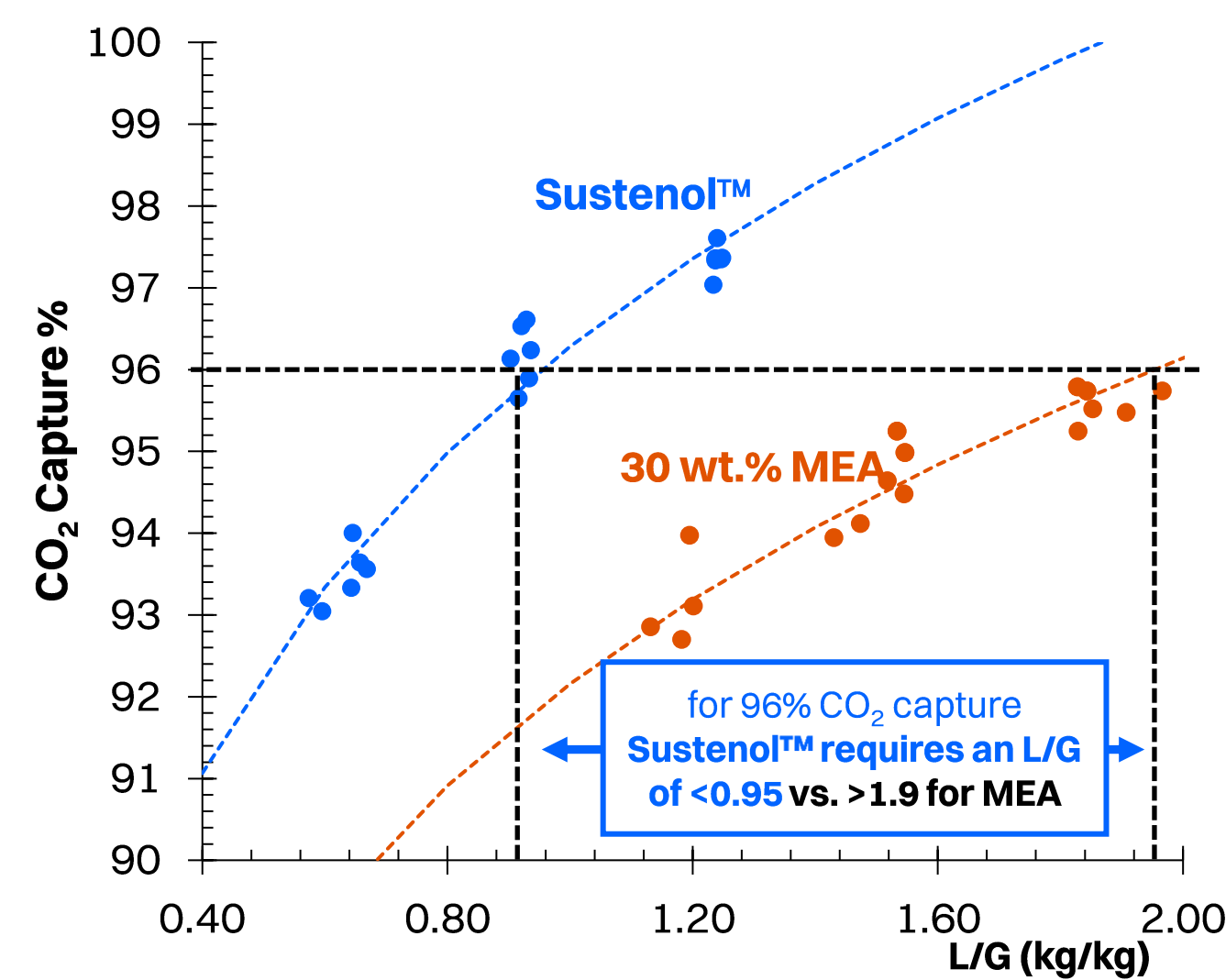
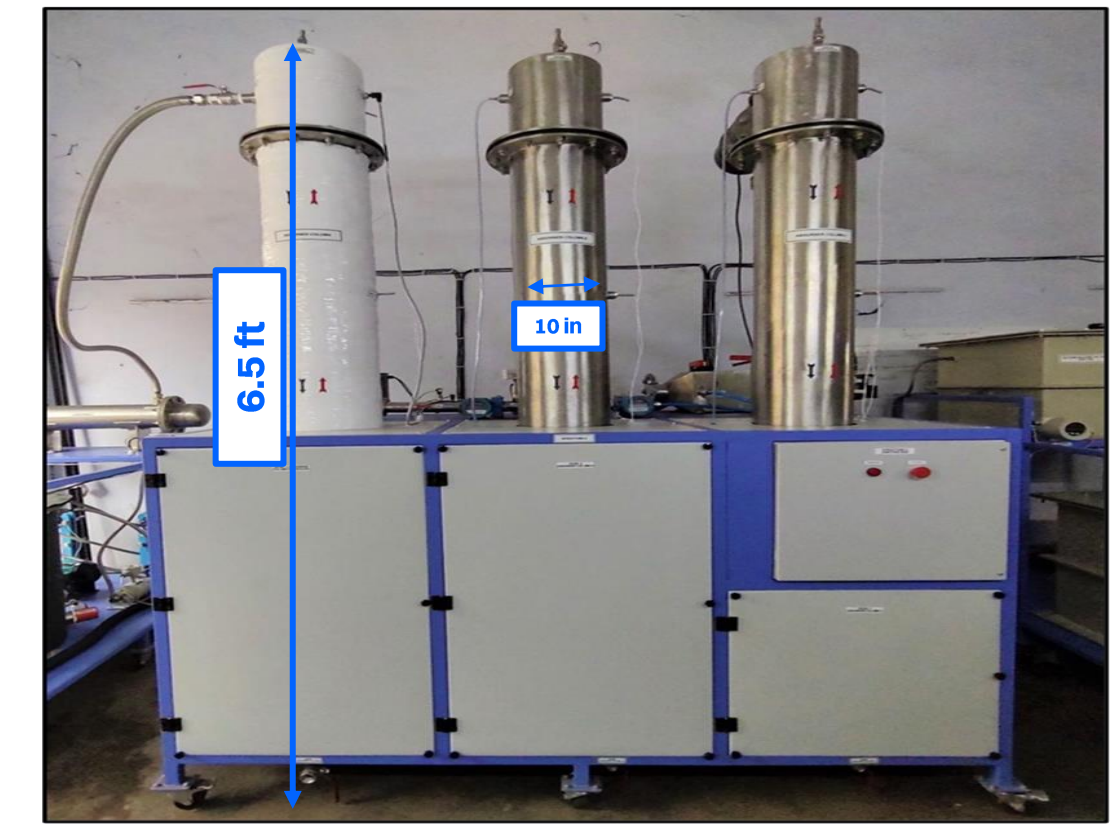
Parameter	30 wt.% MEA	Sustenol™	Change
Kinetic Rate (m <sup>3</sup> /kmol/s) (at 40°C)	14,000	43,000	<b>3X increase</b>
Surface Tension (mN/m) (at <0.6 mol <sub>CO2</sub> /mol <sub>alk</sub> loading)	64	40	<b>37% reduction</b>
Viscosity (cP) (at 40°C and <0.4 mol <sub>CO2</sub> /mol <sub>alk</sub> loading)	<5	<10	<b>2X increase</b>
Heat Capacity (kJ/kg.°C) (at 40°C)	3.88	3.30	<b>15% reduction</b>

## Pilot Scale Results

Conventional Absorber	
Packing Diameter	10 in
Packing Height	6.5 × 2 ft
L/G (kg/kg)	0.7-4
Gas flow	1000-4000 lpm
Liquid flow	3-10 lpm
H <sub>2</sub> O	5-7 mol%
CO <sub>2</sub>	4-5 mol%
N <sub>2</sub>	70-80 mol%
O <sub>2</sub>	8-12 mol%

### 1 t. CO<sub>2</sub>/day Scale

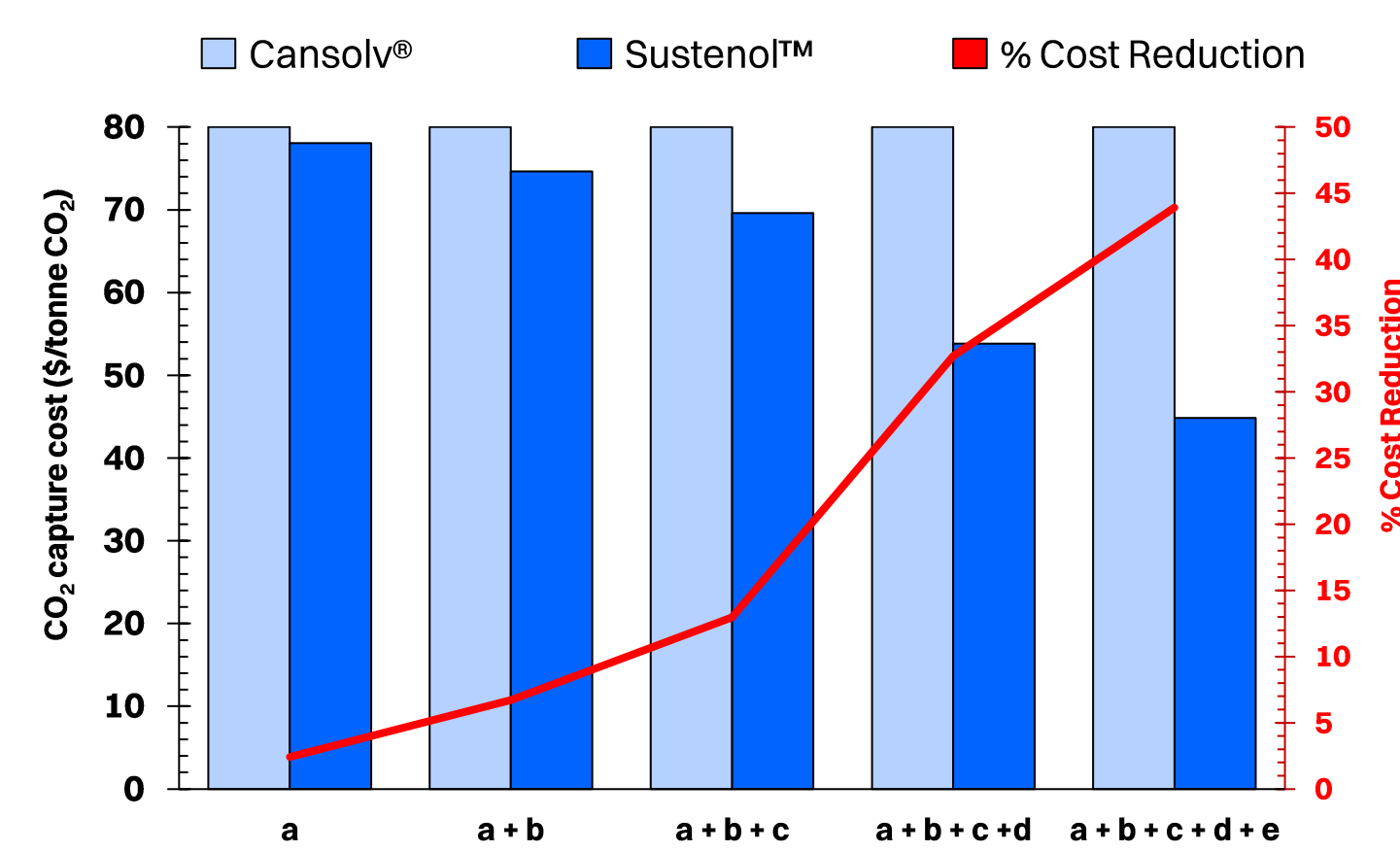
Stripper	
Packing Diameter	10 in
Packing Height	6.5 ft
Pressure	1-2 bar
Temperature	110-120°C
Pre-heater Duty	12 kW
Reboiler Duty	27 kW



**~50%** reduced solvent requirements at 96% CO<sub>2</sub> capture, vs. 30% MEA

**61%** reduction in regeneration energy at 96% CO<sub>2</sub> capture, vs. 30% MEA

## Techno-Economic Analysis

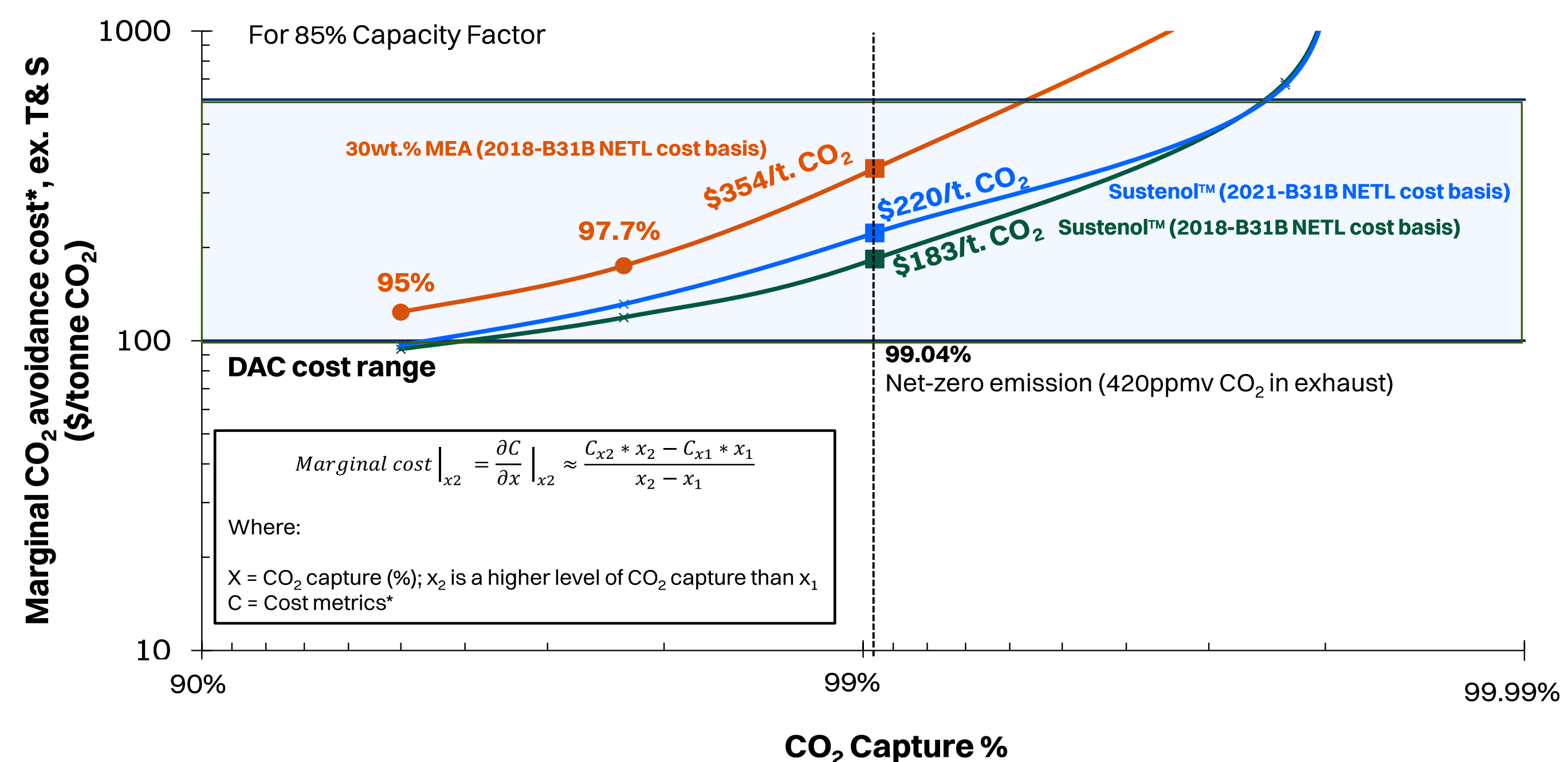


Strategy to reach <\$45/tonne. CO<sub>2</sub>

- a - 30% reduction in SRD
- b - 58% increase in regenerator pressure
- c - 31% increase in working capacity
- d - 50% reduction in absorber capital
- e - 37% reduction in solvent cost

\* Costing methodology and 30wt.% MEA costs from Du et al. 2021 (Int. J. Greenh. Gas Contr. 111 (2021) 103473)

### DAC vs. CCS marginal cost for net zero emissions



## Next Steps



### Testing at National Carbon Capture Center (NCCC)

- Located at Wilsonville, Alabama
- 0.5 MW Pilot Scale Test Unit
- Validate CO<sub>2</sub> capture performance for >97% CO<sub>2</sub> removal
- Confirm reboiler duty
- Determine optimum operating conditions
- Confirm solvent stability and low emissions

Solvent Stability + Emissions Testing by SINTEF Located at Trondheim, Norway

## Acknowledgement/ Partners

