Fourth Annual Conference on Carbon Capture & Sequestration

Developing Potential Paths Forward Based on the Knowledge, Science and Experience to Date

Capture and Separation - Sorbents 1

Energy Integrated CO_2 Capture

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Cansolv Technologies Inc.

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CTI Technology Enables You To:

- Meet “zero” emission requirements for all pollutants
- Earn CO_2 credits
- Position your company as “green”
- Evaluate new business opportunities from byproducts - e.g. EOR with CO_2
- Use inexpensive fuels
- Save capital and operating cost

Presentation Outline

- CANSOLV Process descriptions
  - Regenerable SO_2 capture
  - Amine solvent CO_2 capture
  - Wet DeNOx
  - Wet mercury capture
- DeSOx + CO_2 Capture
- Multipollutant + CO_2 Capture
- Cost comparisons to benchmark processes
- CO_2 Capture cost per tonne

Cansolv Technologies Inc.

- CTI founded in 1997 as management buyout of Union Carbide's CANSOLV® Regenerable SO_2 capture process.
- The SO_2 technology has been commercialized and new processes added for NOx, Hg, CO_2 and particulates.
- 24 people including 14 professionals.

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

CURRENT TRENDS

- Requirement to control all pollutants becoming reality
- CO_2 emissions must be reduced
- These trends favor integrated multipollutant control prior to CO_2 capture

MULTIPOLLUTANT CONTROL

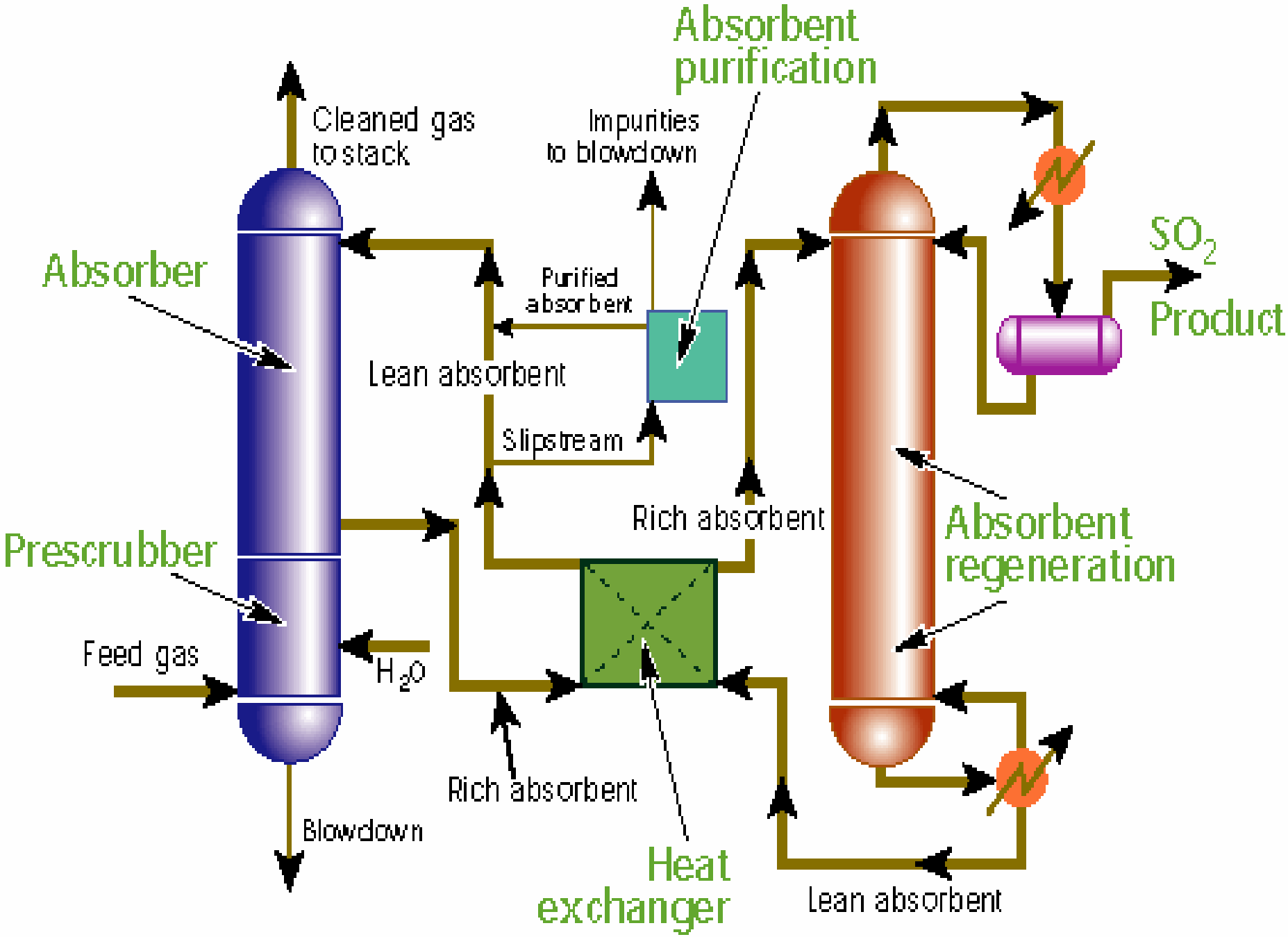
- CO_2 capture requires prior removal of SO_2
- Many jurisdictions now require DeNOx
- Mercury control is imminent
- Opacity requirements means particulate control
- CTI multipollutant control technology offers near zero emissions

THE COMPLETE SOLUTION

- Installation of complete multipollutant + CO_2 control in one tower with energy integration provides the lowest cost "zero" emissions
- CTI technology gives the option of installing emission control in stages

THE CANSOLV DeSOx PROCESS

- Regenerable solvent
- SO_2 removal to <25 ppm
- Can treat very high SO_2 levels economically
- A robust, safe, simple process

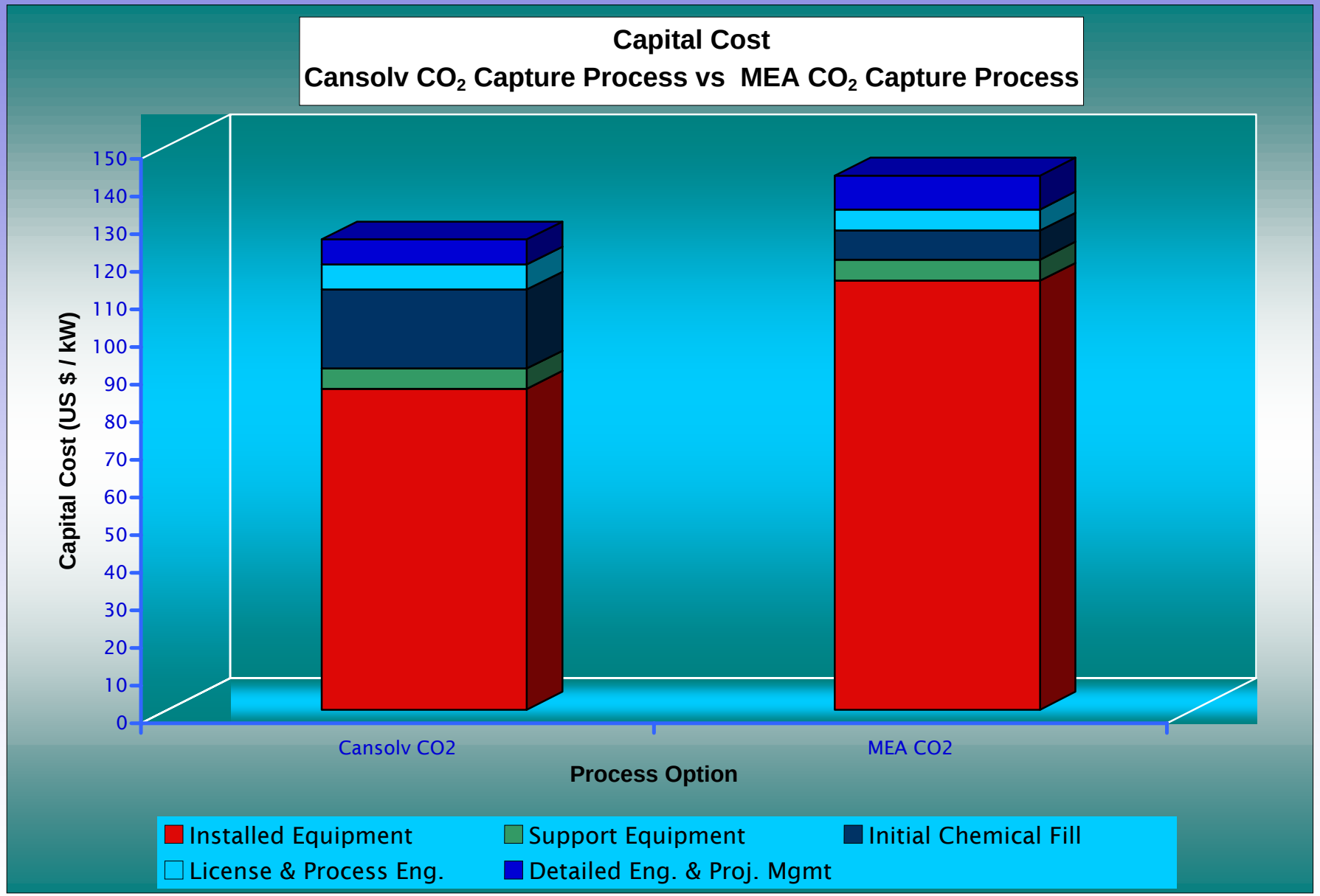

Absorbent purification
Cleaned gas to stack
Impurities to blowdown
Absorber
Purified absorbent
Lean absorbent
Slipstream
SO_2 Product
Rich absorbent
Absorbent regeneration
Prescrubber
Feed gas
H_2O
Rich absorbent
Blowdown
Heat exchanger
Lean absorbent

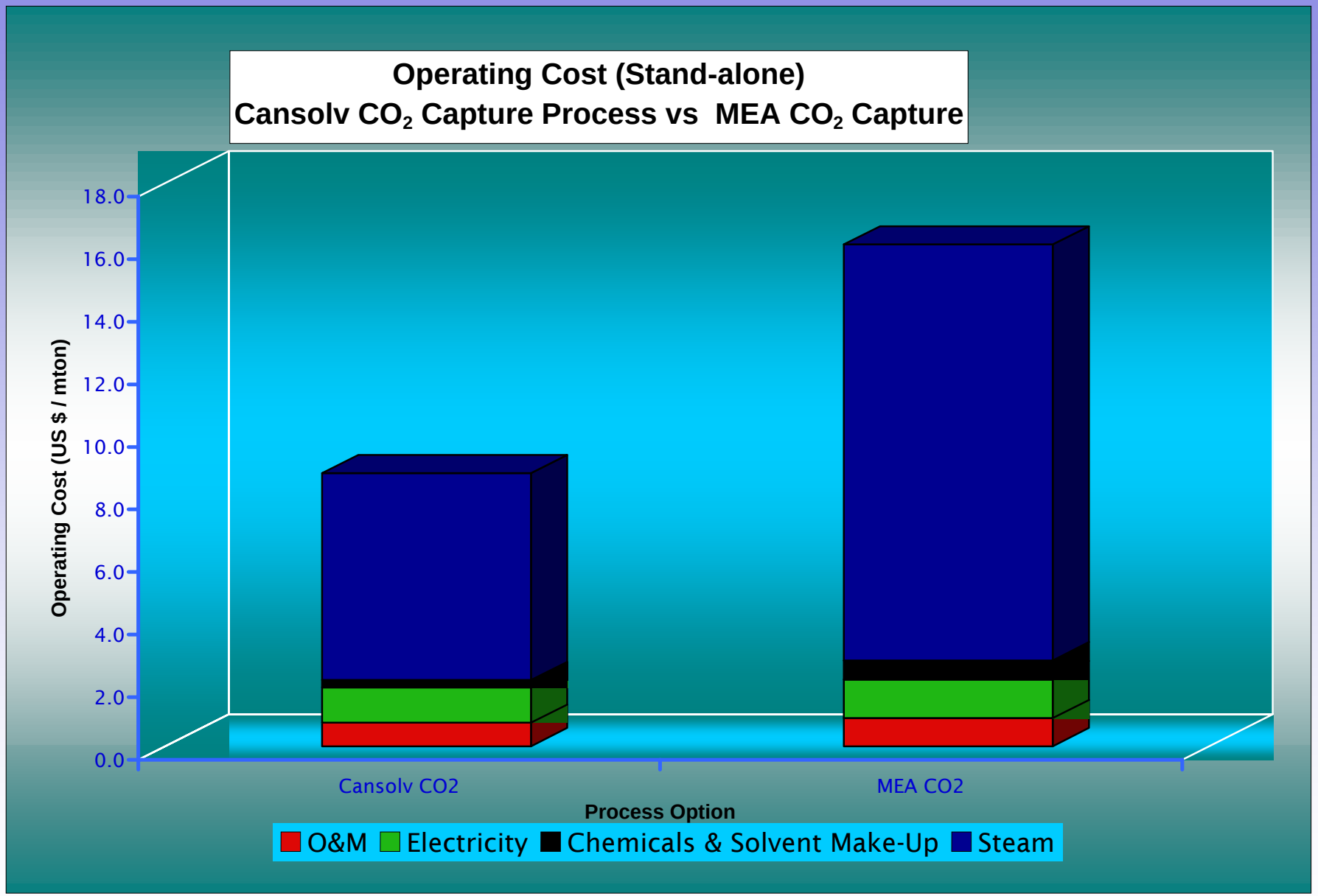
$DeSO_x$ COMMERCIAL UNITS

- 3 in operation since 2002
- 4 units in EPC
- Performance exceeding design
- Robust low maintenance operation

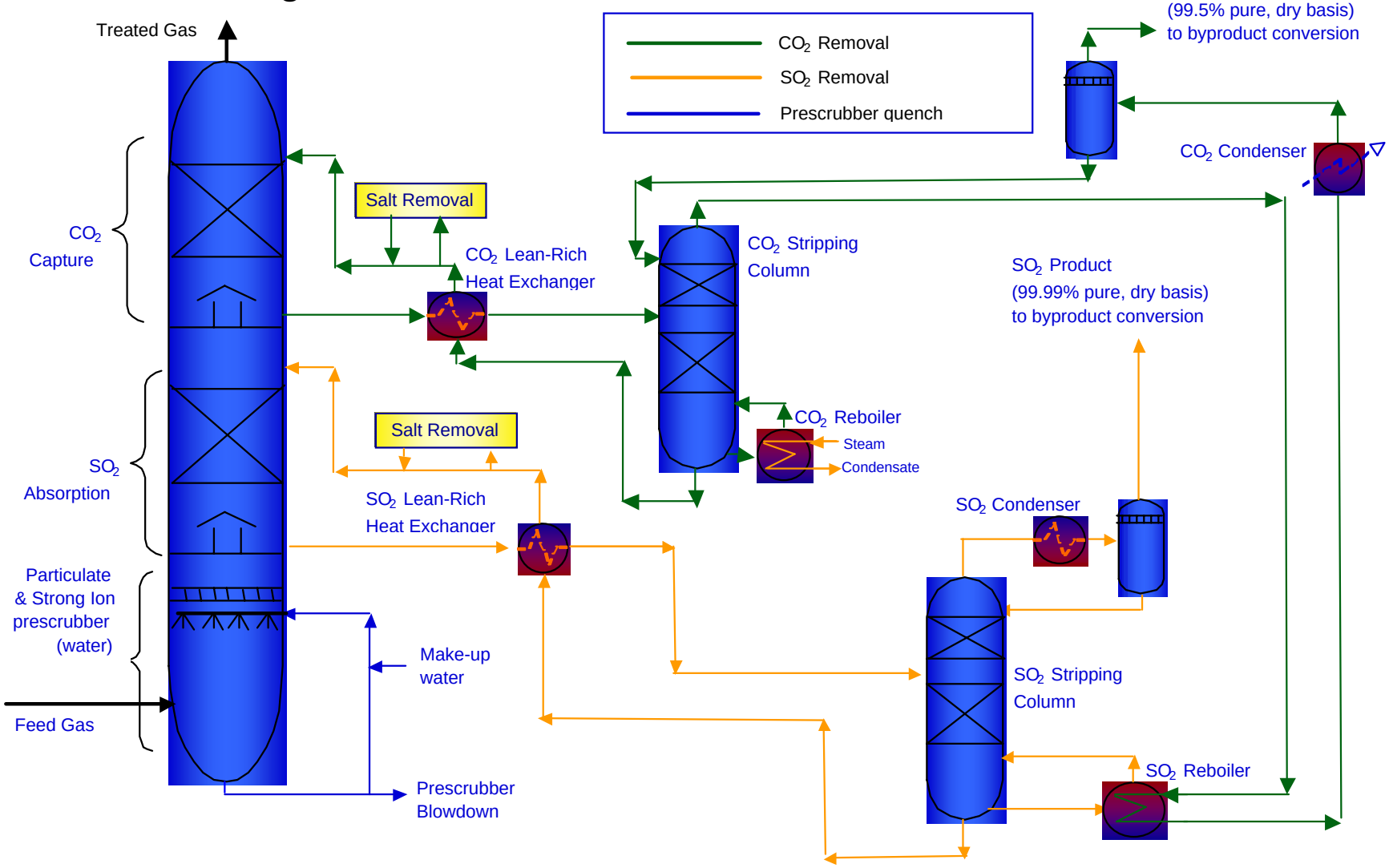
CO_2 CAPTURE PROCESS

- Amine solvent selected for low regeneration energy
- Solvent stable to oxidation
- Tolerant of some SO_2 with salt removal unit installed
- Piloted on both natural gas and coal firing boilers
- 70 TPD demo unit in negotiation


Capital Cost
Cansolv CO_2 Capture Process vs MEA CO_2 Capture Process
Capital Cost (US $ / kW)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Cansolv CO2
MEA CO2
Process Option
Installed Equipment
Support Equipment
Initial Chemical Fill
License & Process Eng.
Detailed Eng. & Proj. Mgmt


Operating Cost (Stand-alone)
Cansolv CO_2 Capture Process vs MEA CO_2 Capture
Operating Cost (US $ / mton)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Cansolv CO2
MEA CO2
Process Option
O&M
Electricity
Chemicals & Solvent Make-Up
Steam

CANSOLVØ Integrated SO_2-CO_2 Process

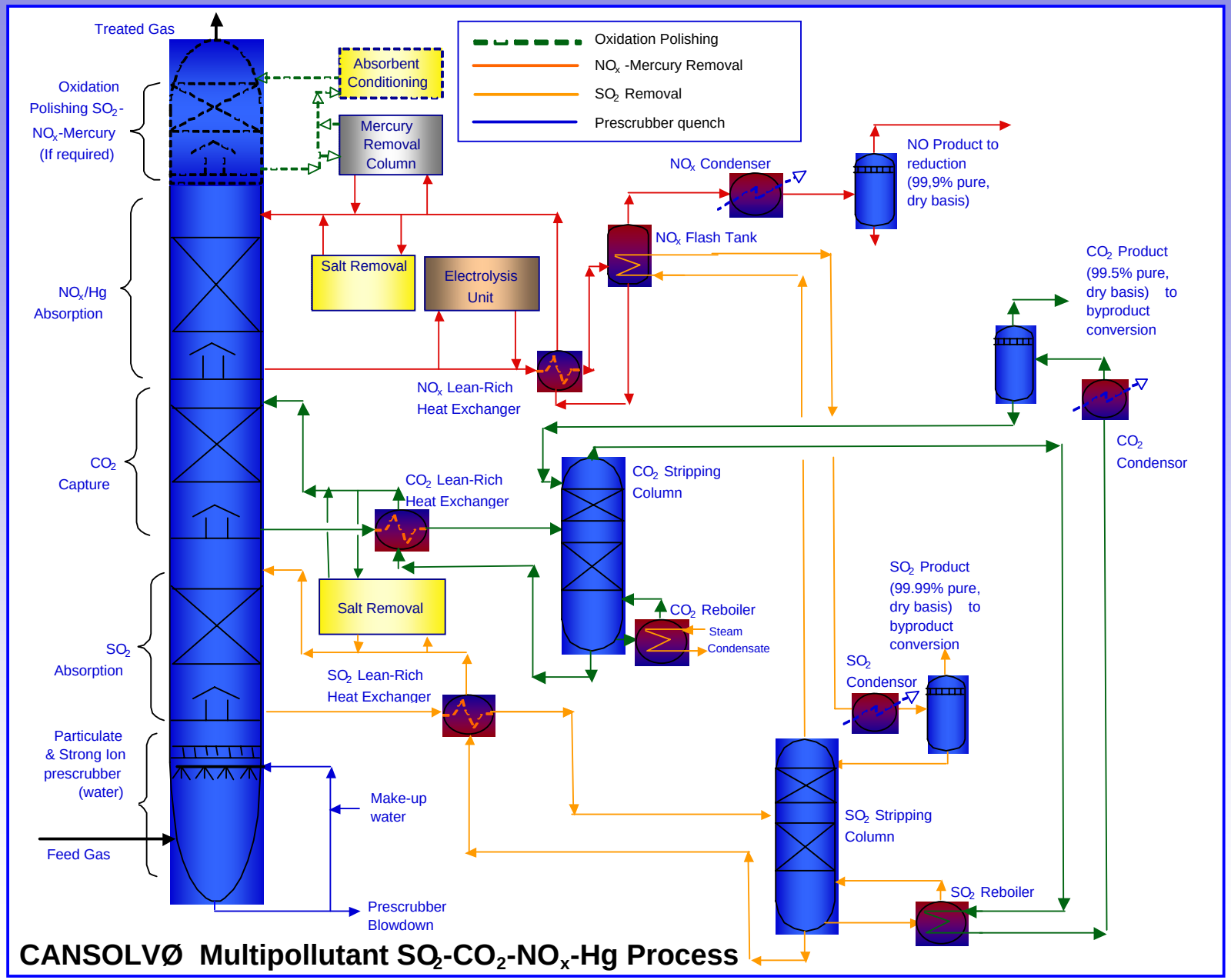


CANSOLV AquaNOx™ PROCESS

- Wet, regenerable DeNOx
- For gases with <50 ppm SO_2
- Polishes SO_x to nil & NO_x to <20 ppm in one step
- Low capital & operating cost
- Byproduct NOx incinerated in boiler

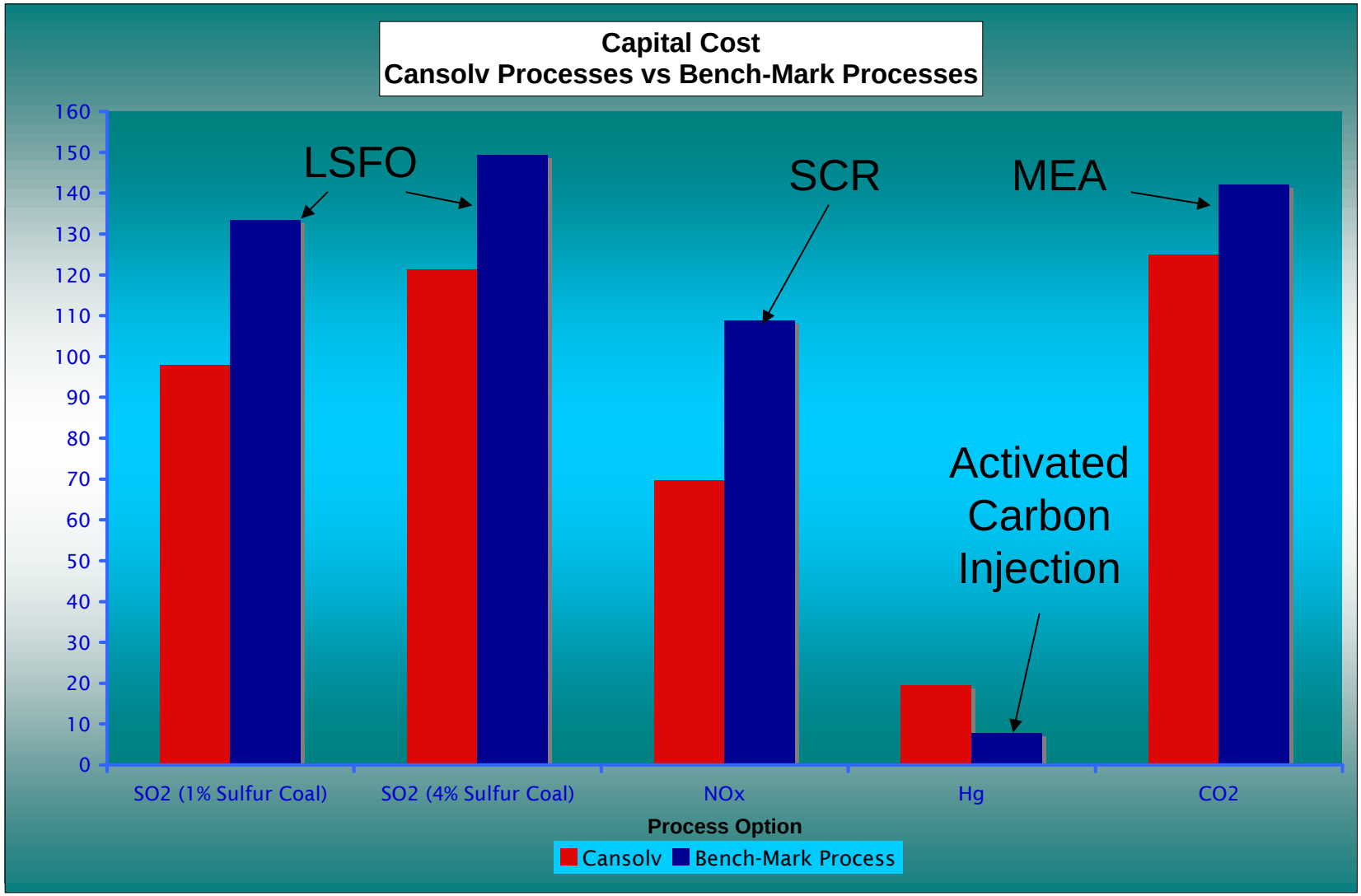
Hg CAPTURE

- Oxidized Hg captured in prescrubber
- Hg° scrubbed with an oxidizing solution after SOx and NOx capture
- Pilot test on coal fired flue gas gave undetectable total Hg in treated gas

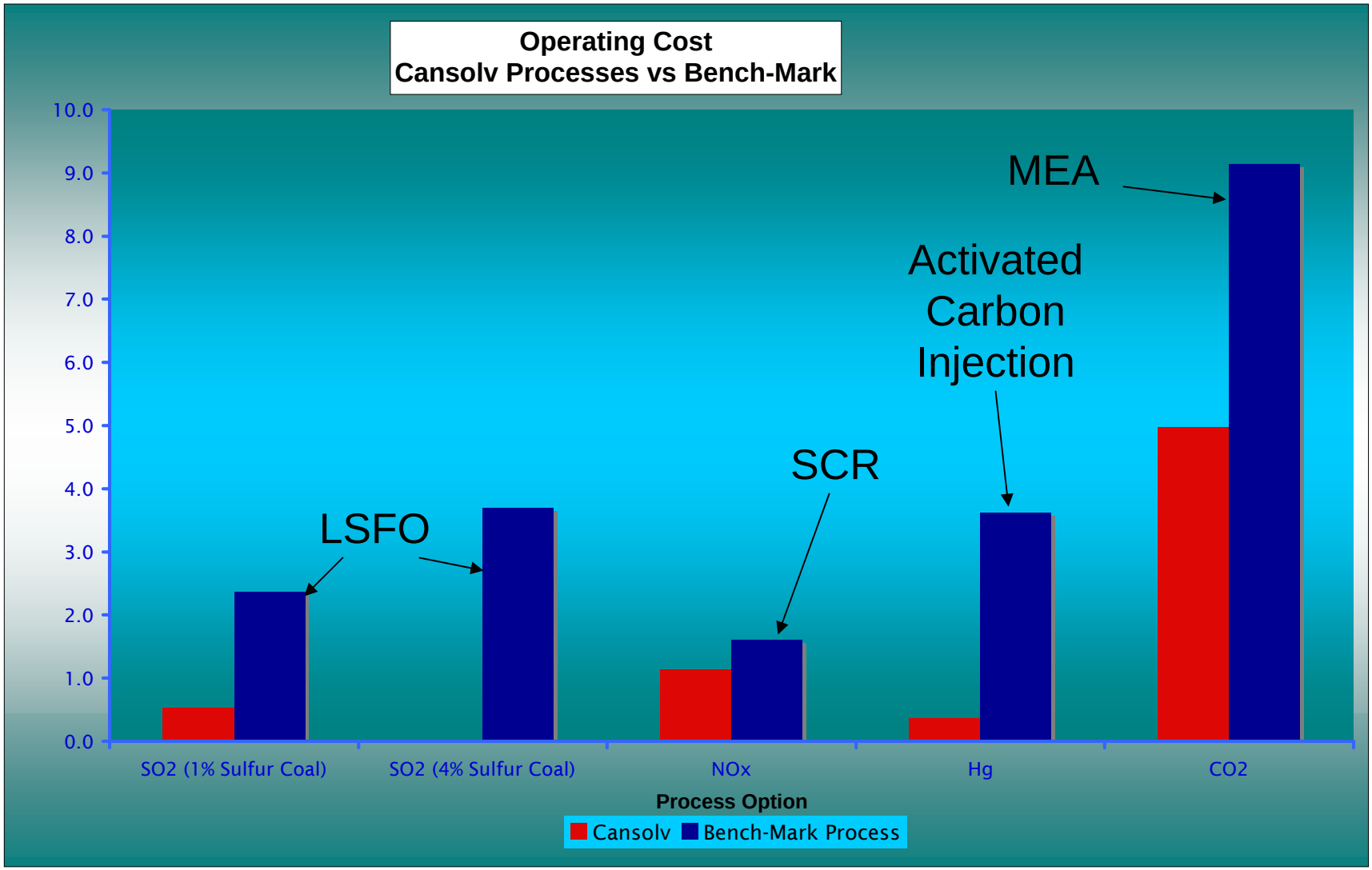


CANSOLVØ Multipollutant SO_2-CO_2-NO_x-Hg Process

Capital Cost of Cansolv vs. Bench-Mark Processes

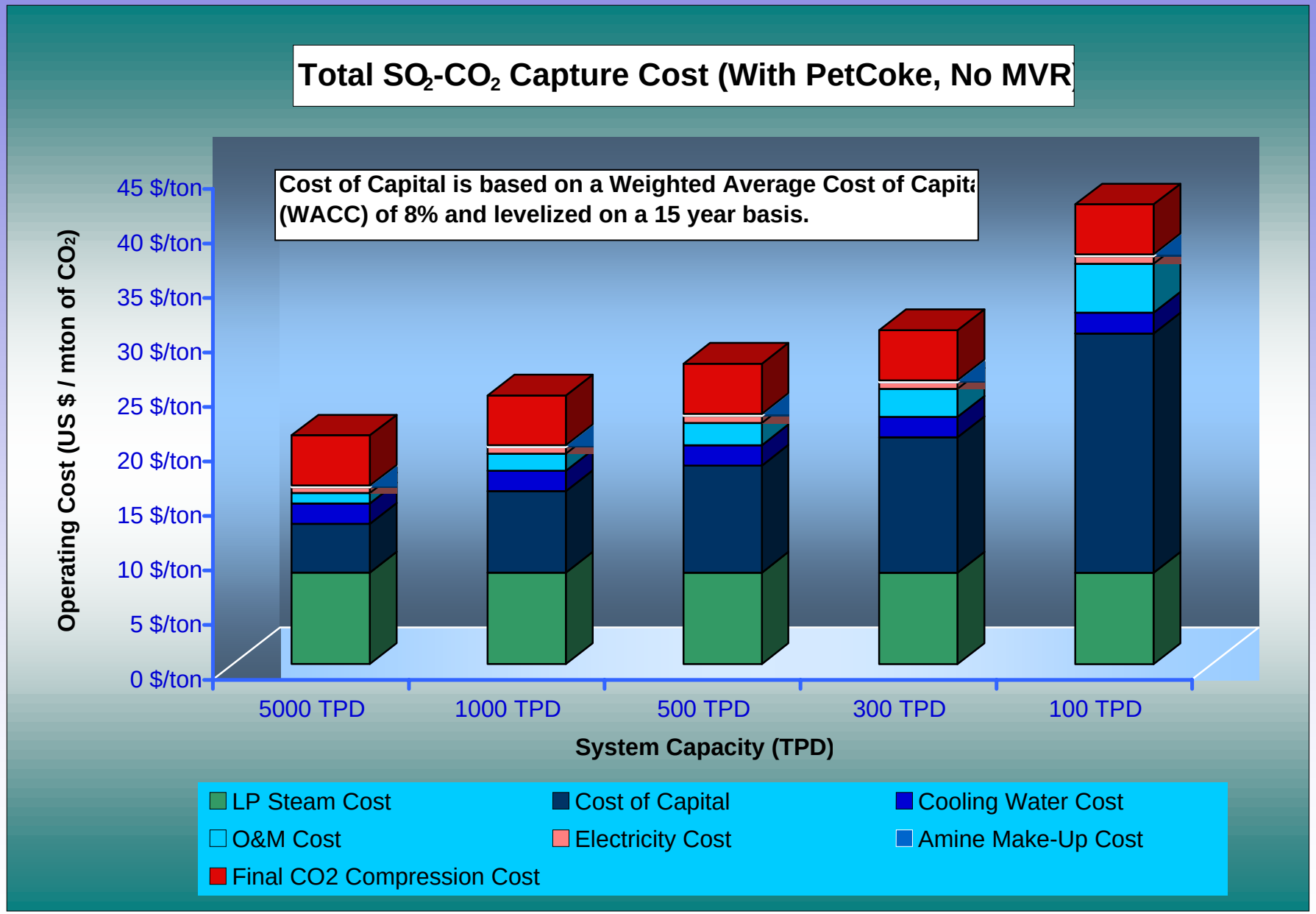


Operating Cost of Cansolv vs. Bench-Mark Processes



ENERGY REDUCTION

- One means of reducing the regeneration energy is with mechanical vapor recompression
- MVR of the stripper O/H stream allows it to provide heat to the reboiler
- The coefficient of performance can reach up to 12 for the SO_2 overhead
- Other energy reduction methods can also be applied


Total SO2-CO2 Capture Cost (With PetCoke, No MVR)
Cost of Capital is based on a Weighted Average Cost of Capital (WACC) of 8% and levelized on a 15 year basis.
Operating Cost (US $ / mton of CO2)
45 $/ton
40 $/ton
35 $/ton
30 $/ton
25 $/ton
20 $/ton
15 $/ton
10 $/ton
5 $/ton
0 $/ton
5000 TPD
1000 TPD
500 TPD
300 TPD
100 TPD
System Capacity (TPD)
LP Steam Cost
Cost of Capital
Cooling Water Cost
O&M Cost
Electricity Cost
Amine Make-Up Cost
Final CO2 Compression Cost

SUMMARY

- CTI's SO_2/CO_2 capture technology offers a major improvement in economics
- CTI's multipollutant technology enables the use of dirty fuels with "zero" pollution