

DISTILLATION DIAGNOSTICS

The forgotten child of the energy transition



**16th STS-AIChE
Southwest Process Technology Conference
Houston, Texas
September 22-23, 2025
University of Houston**

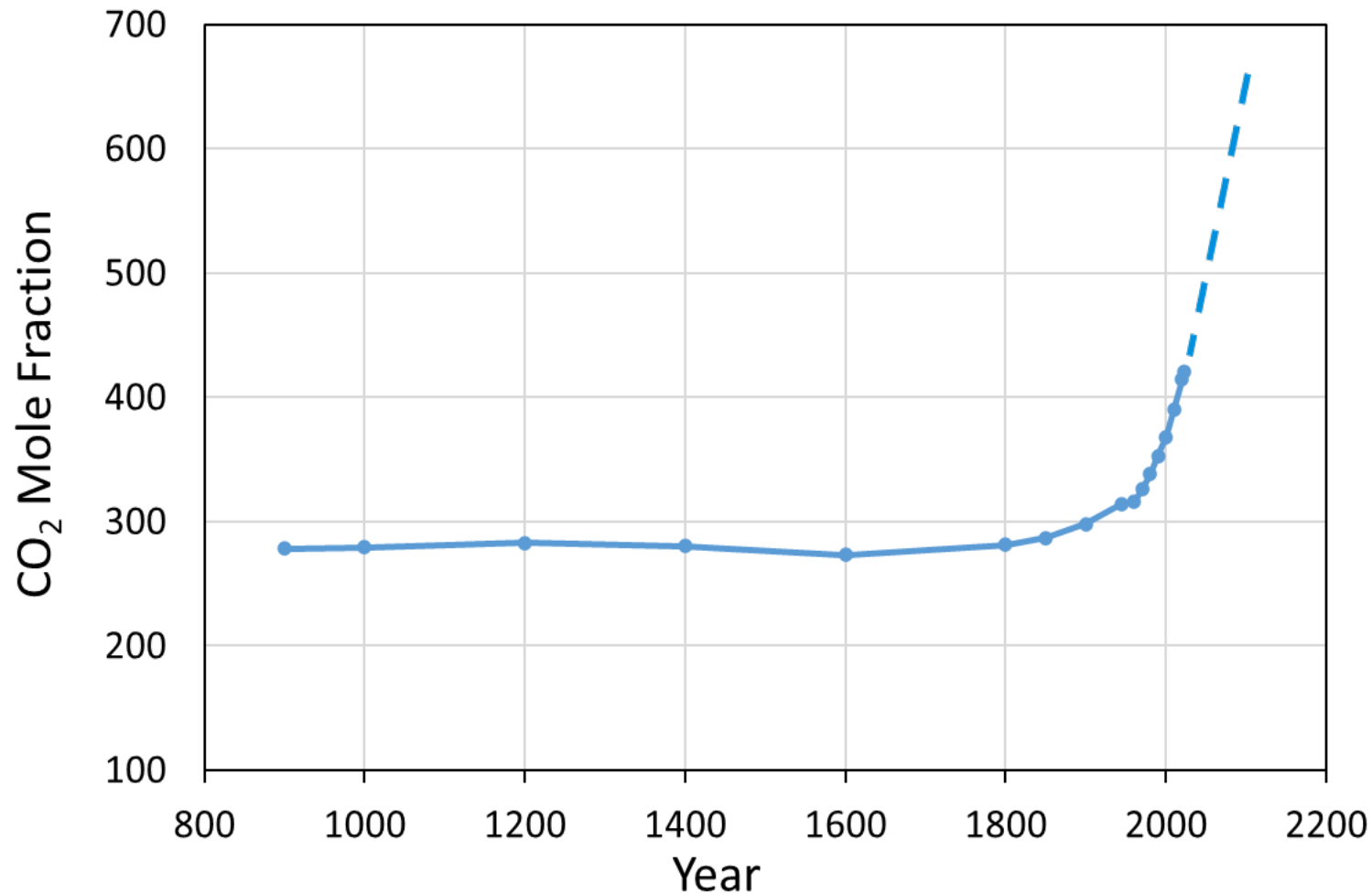
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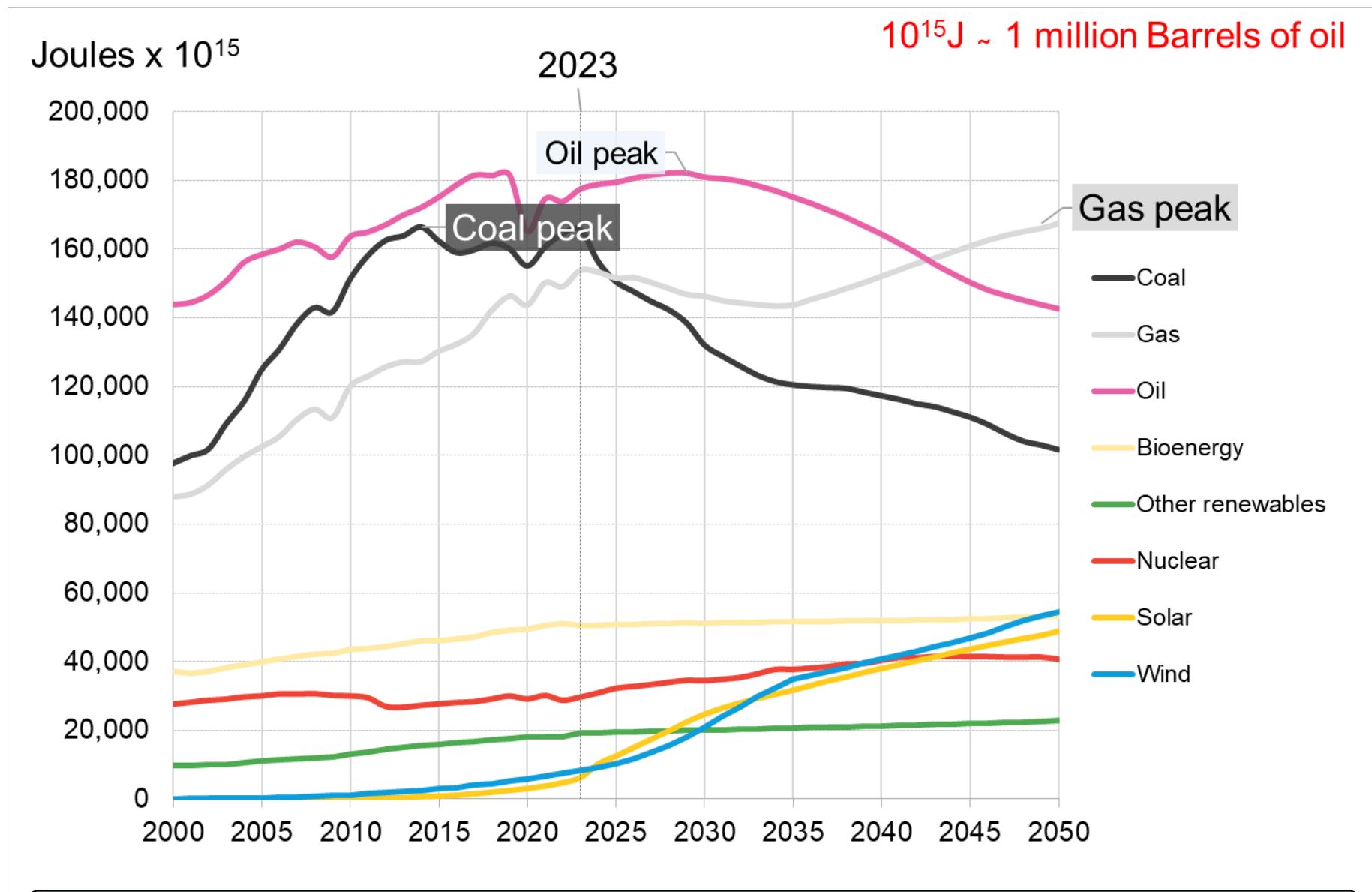
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Atmospheric CO₂ Trends



Data: “Earth Systems Research Laboratories”, August 2022 supplemented by Scripps Institution of Oceanography, NOAA Global Monitoring Laboratory, UC San Diego. Dashed line is the authors’ projection

Fossil Fuels Continue to Dominate for Decades



Data: Bloomberg New energy Outlook 2024

For Millenia.....



Glucose $\longrightarrow$ Hydrocarbons

In 70-80 years we have reversed this process

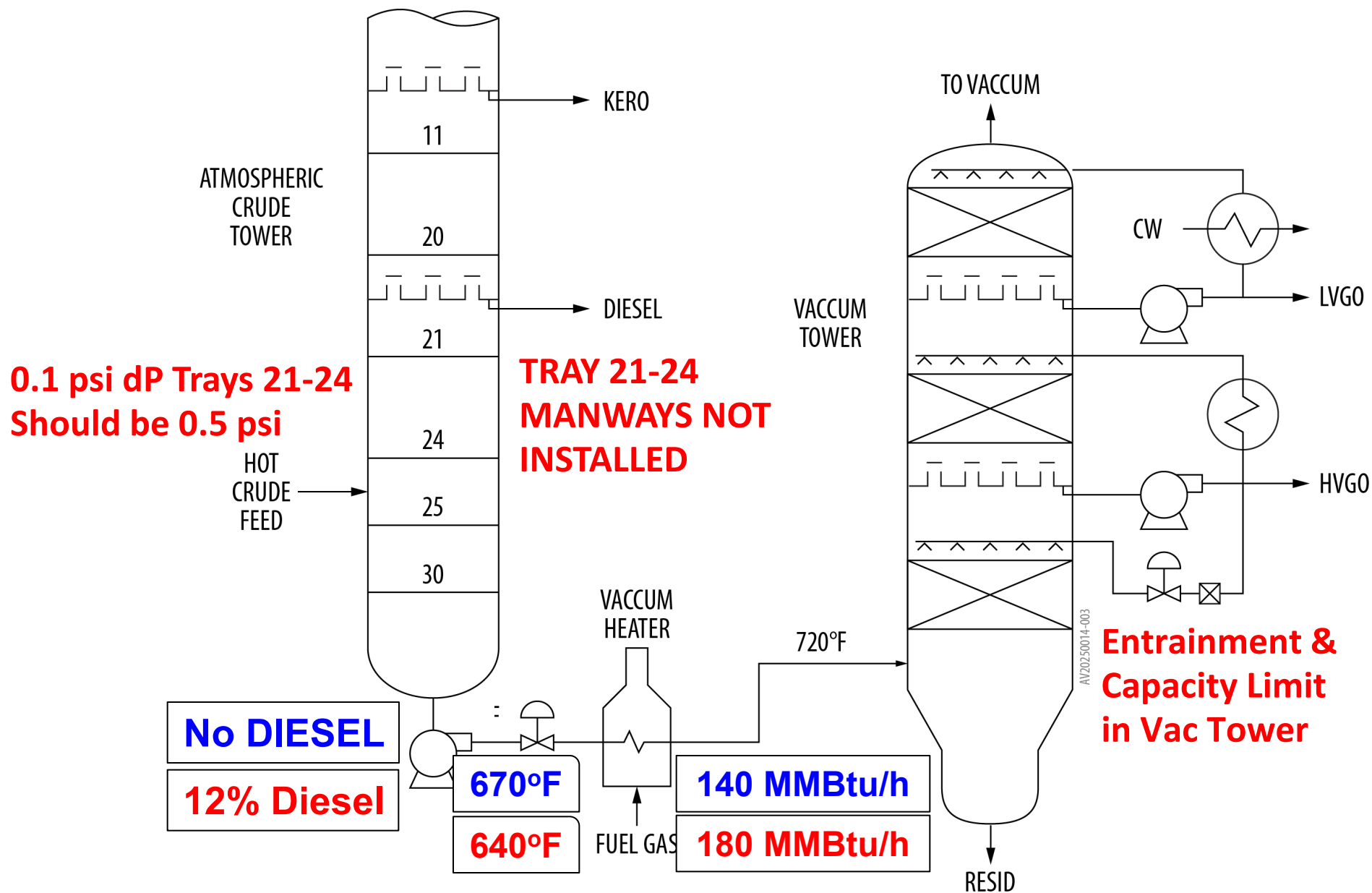
What Can You and I Do TODAY to Reduce CO₂ Emissions?

- **Wind, solar, hydro, geothermal, tides**
- **Renewables: ethanol, reprocessing oils**
- **Carbon capture**
- **Hydrogen generation**
- **Others**

One Technology is forgotten

- **Troubleshooting, diagnosing and solving plant problems**
- **Unlike many other technologies, this technology saves money**

Can Inspection & Good Measurement Slash Carbon Footprint?



How Did the Refinery Solve the Problem?

~~Repair trays 21-24 per Lieberman's recommendation
(re-install tray 21 - 24 manways)?~~



New 200 MM Btu/h Heater?

Carbon Footprint Impact

- For 4 years, 40 MM Btu/h == Footprint of 5264 cars
- A 200 MM Btu/h vacuum heater: tons of steel, nickel, and chrome, immense carbon footprint.
- Concrete for the foundation of the new heater weighs tons, has a high carbon footprint.
- Transportation of the heater to the site adds to the carbon footprint

Tale of Two Purification Vacuum Stills

Early 1990's: BX-Type Packing, major supplier, same bed heights

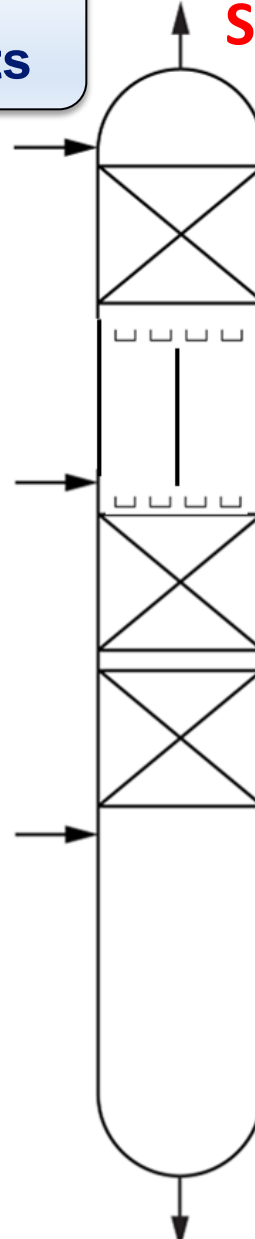
Design 50 Stages

2001 Gamma scans:
internals in correct place, no
fouling, no flooding, good
distribution

2015 World expert:

- Lots of issues
- High velocity in pipe
- Best & latest packing
- New distributors
- Add 4th bed

STILL X **UNSUITABLE FOR
PRODUCT PURIFICATION**



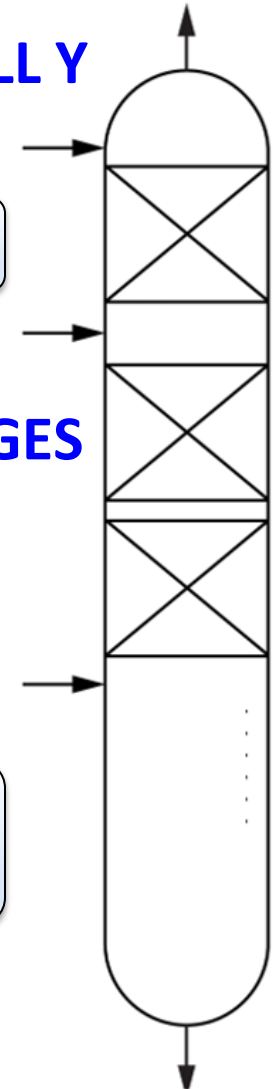
Early 2000's tests:

> 40 STAGES

11 STAGES

Tests repeated
2015, same result

STILL Y



Is there a Better way to Diagnose the Problem?

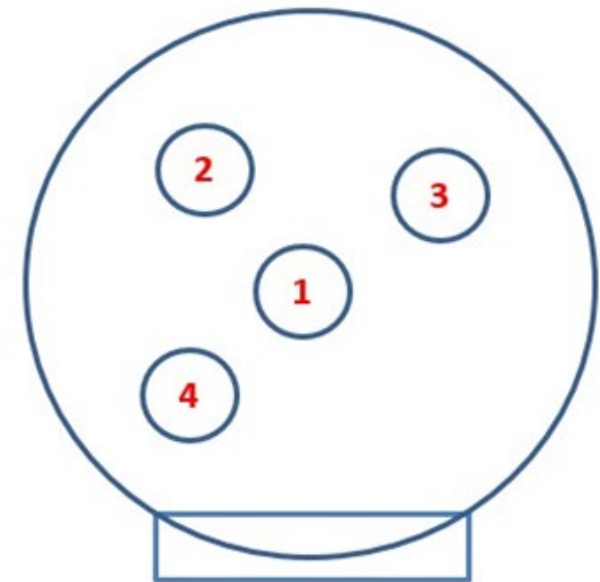
Late 2015: Talks with a long-serving operator. His recollections

- Initially both X & Y had the same separation efficiencies
- Late 1990's, separation of X degraded
- Efforts to recover performance were unsuccessful
- At the time the column unknowingly distilled organic chlorides
- Two other columns were damaged by these chlorides

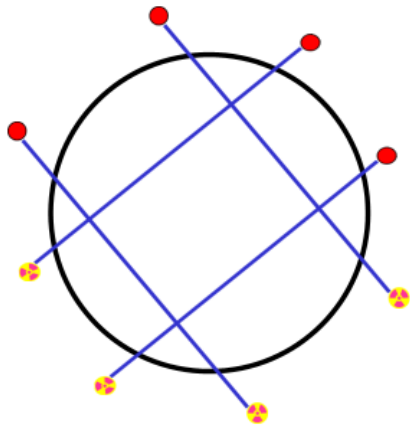
In-Situ Bucket & Stopwatch Distribution Tests

Time to fill a 5 gallons bucket:

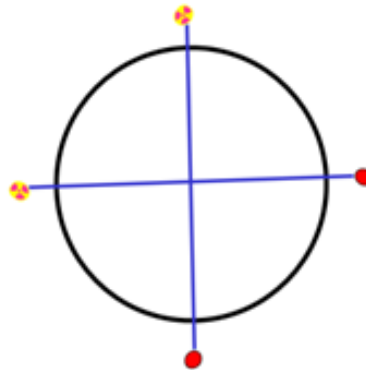
- 1 67 sec**
- 2 150 secs**
- 3 130 secs**
- 4 185 secs**



Did the Gamma Scans Lie?



Grid scan, normal



Plus scan, normally
used for ID < 2 ft



Towers are 5 ft ID, but + scan used due to surrounding structures

Only one problem...+ scans do not see center to side maldistribution...Bucket & watch tests do.

Solution, Takeaways, Carbon Footprint

SOLUTION: New packings, unchanged distributors

Reaching out to operators leads to correct diagnoses that reduce carbon footprint

One good measurement is worth more than 1000 expert opinions.

*No need to Buy a New Column with high carbon footprint
Correct Diagnostics can Bring a Rejected Column back to its Glory*

Simple Optimization of Sour Water Strippers

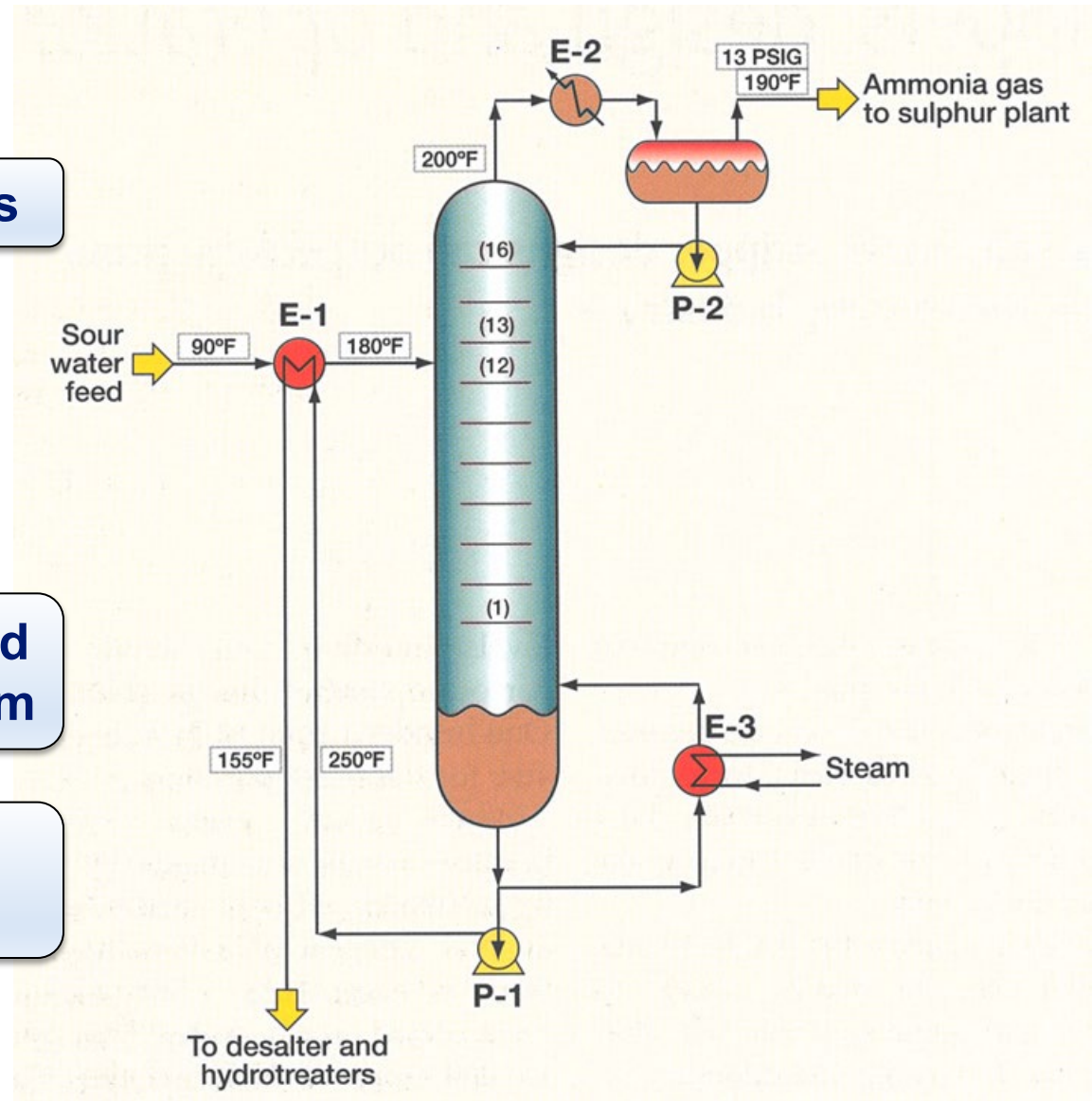
Stripping Rates

Usually 1.3-1.4 lb STM/BBL BTMs

Lieberman was raising feed rate by 30%, keeping STM/BTM constant

Operators: high steam rate would overload sulfur plant downstream

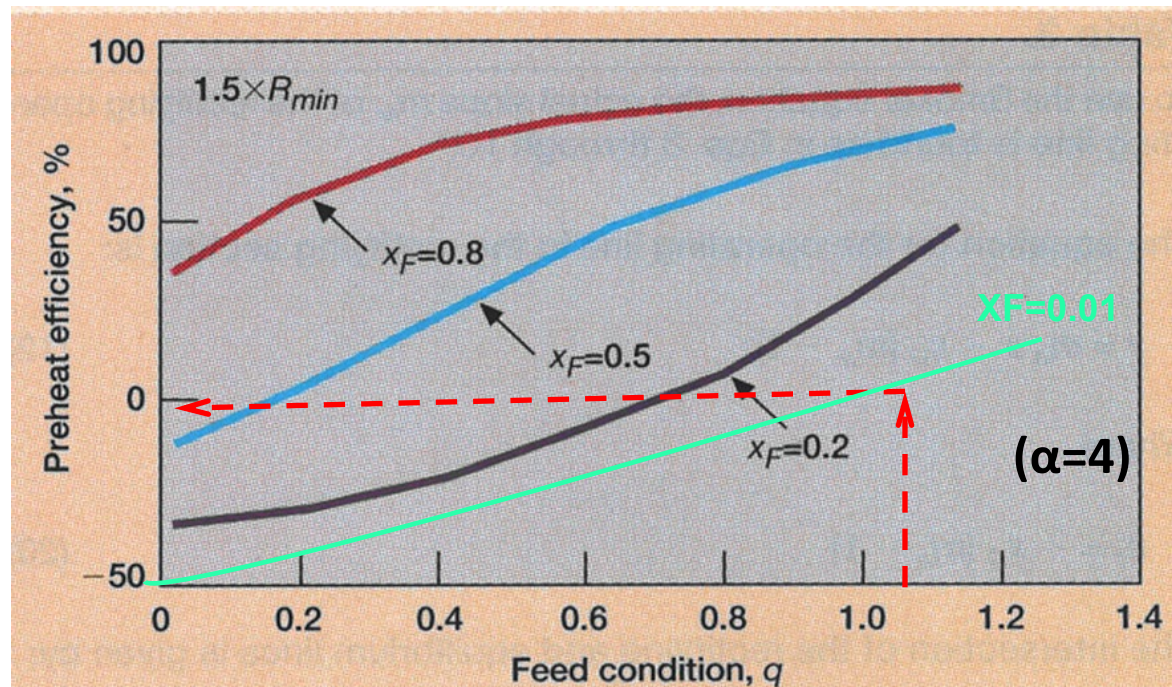
Steam does not overload sulfur plants. Hydrocarbons (HC's) do.



Cut STM, send HC's to BTM where they are recovered

Sour Water Heater Preheat Optimization

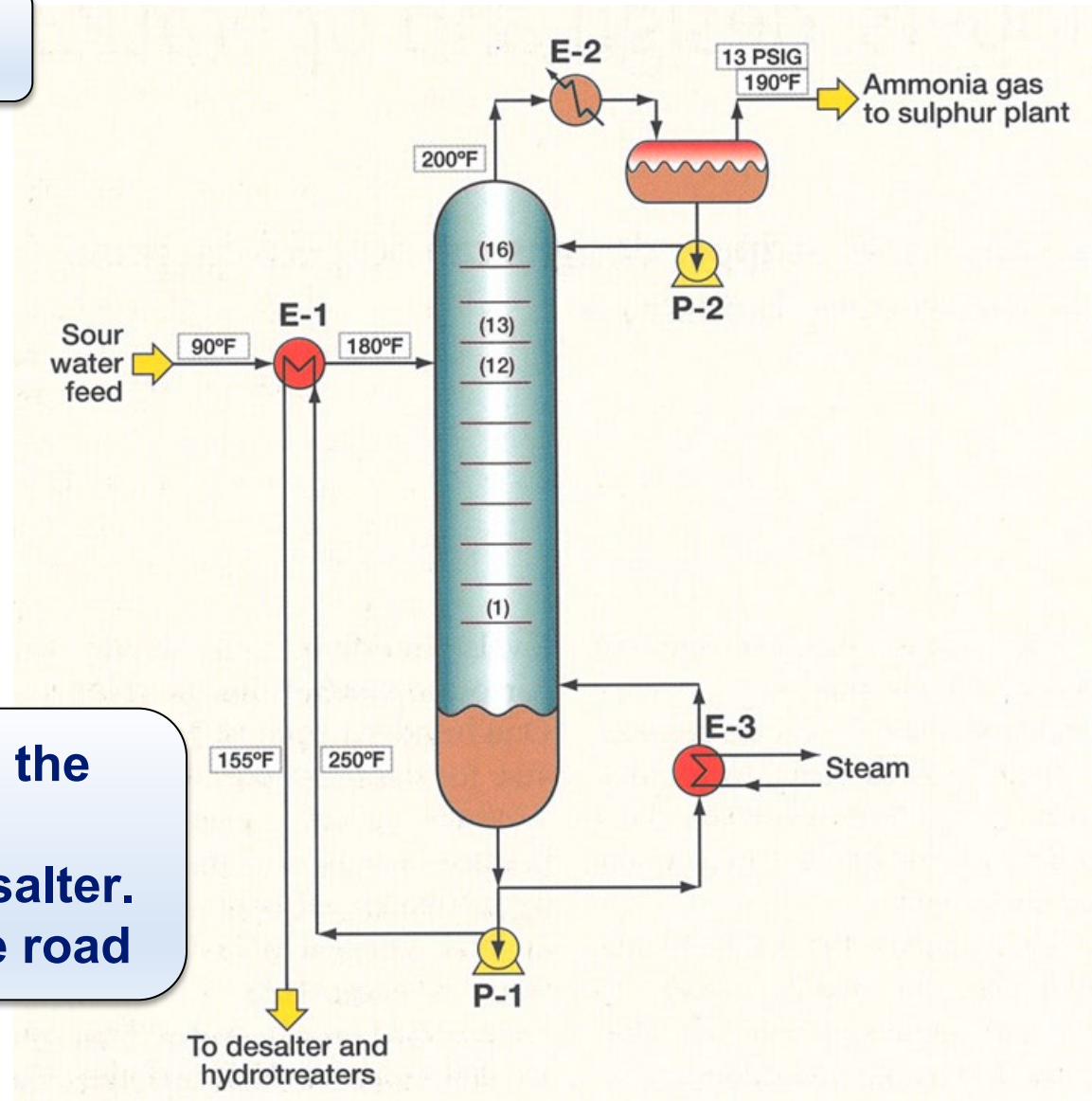
Liebert Preheat Efficiency = Reduction in reboiler duty/increase in preheat duty



(from Liebert, T., Hydrocarbon Processing, p.37, October 1993. Reprinted with permission.

Green and dashed red curves added by the authors)

Btms temp rose 100°F, same as the desalter temp.
Saved steam to reheat at the desalter.
Steam saving ~ 2400 cars off the road



Simple Optimization of Sour Water Strippers (SWS)

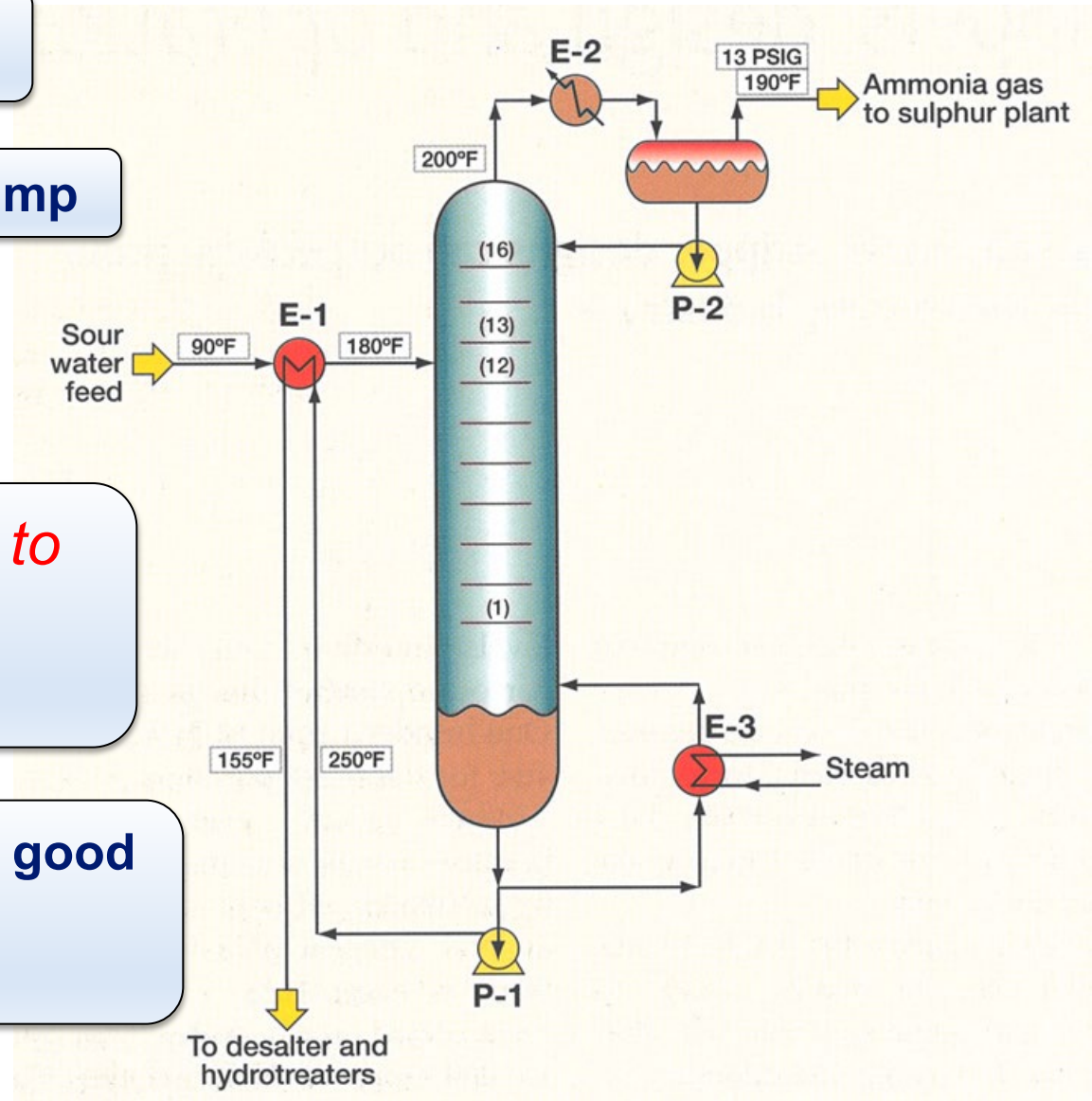
Preheater Removal

Eliminates condenser, drum, pump

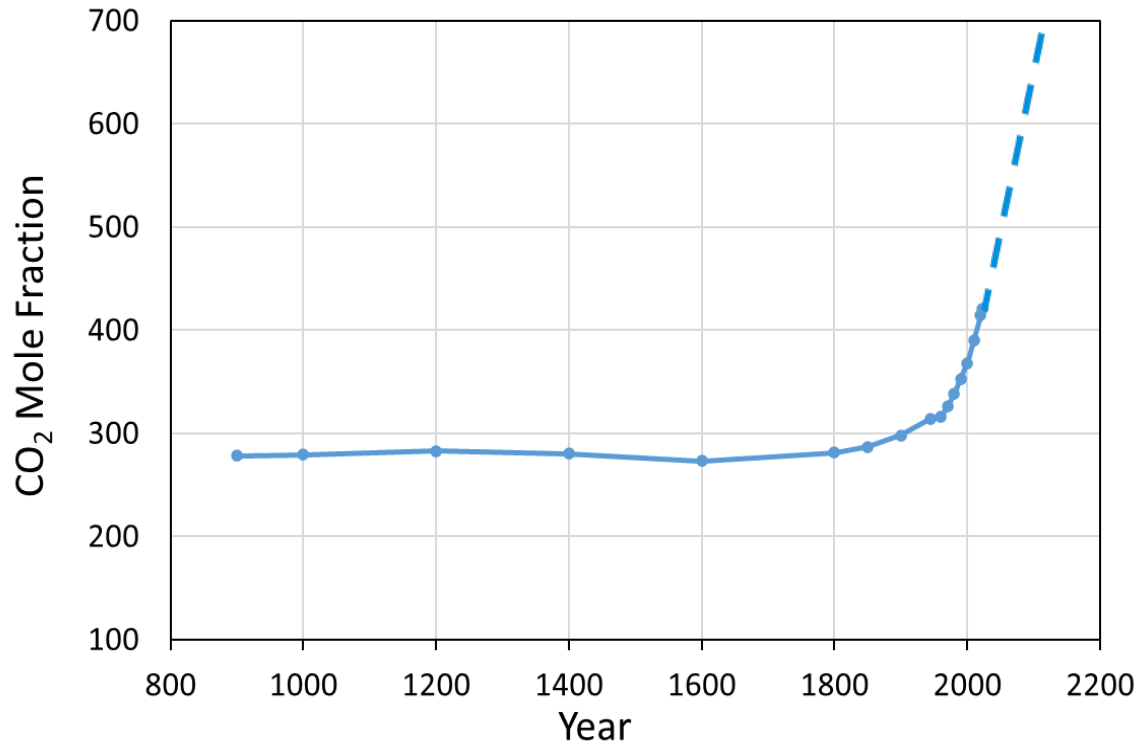
Preheater corrosion, tube leaks, fouling eliminated

Watchout: tray damage due to shock condensation in feed zone upon feed step-up

Prevention: Heavy duty design, good feed rate control, good SU/SD procedures, operator training



What Can We Do?



Not worry about it?

Give Up?

Diagnose problems and solve them

The Future is Still in Our Hands

Questions?



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