



The Case for micro & Fast Gas Chromatography: A Market Overview or Chromatography? Not Dead Yet!

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Companies compete... So do technologies

- *Near Infrared*
- *Mass Spectrometry*
- *Raman*
- *Tunable Diode Lasers*
- *Virtual Analyzers and even...*
- *The “Optical GC”*
- *... have all sought to displace
Chromatography.*



Why drive towards the demise of chromatography?

- “The entourage” as PV^2 coined
 - Gases
 - Solvents
 - Time
 - Complexity...



Taking the Chromatograph from the real analytical chemist is like taking the hammer from the real carpenter.

Customers need & want the answers.....

- ***“The entourage” PV² coined***
 - ***Gases***
 - ***Solvents***
 - ***Time***
 - ***Complexity...***

Not the hassles associated with analytical chemistry and... chromatography.



*And the hammer analogy isn't bad.
Message: use the right tool!*



Chromatography is intuitively understandable...

Elements of the Chromatograph

- ***Carrier***
- ***Sample Valve***
- ***Columns***
- ***Detector***
- ***Data System***

Elements of the Processing Plant

- ***Pumps***
- ***Valves***
- ***Columns***
- ***Sensors***
- ***Control System***

“Hmmm, I have those in the plant! It’s like a distillation column, just smaller! What’s complicated?”

And yet... we hear all about

- *microGC*
- *FastGC*
- *UPLC*
- *And all kinds of efforts to reduce the entourage!*

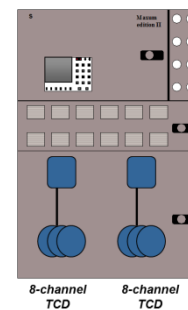
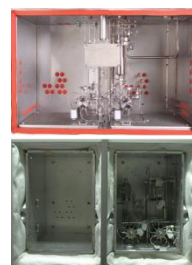
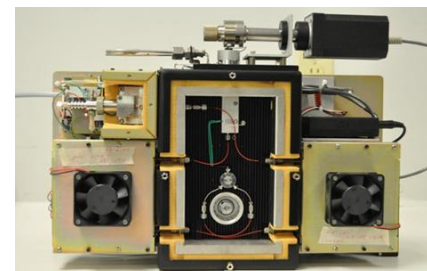
A worthy endeavor!

Threads of Continuity

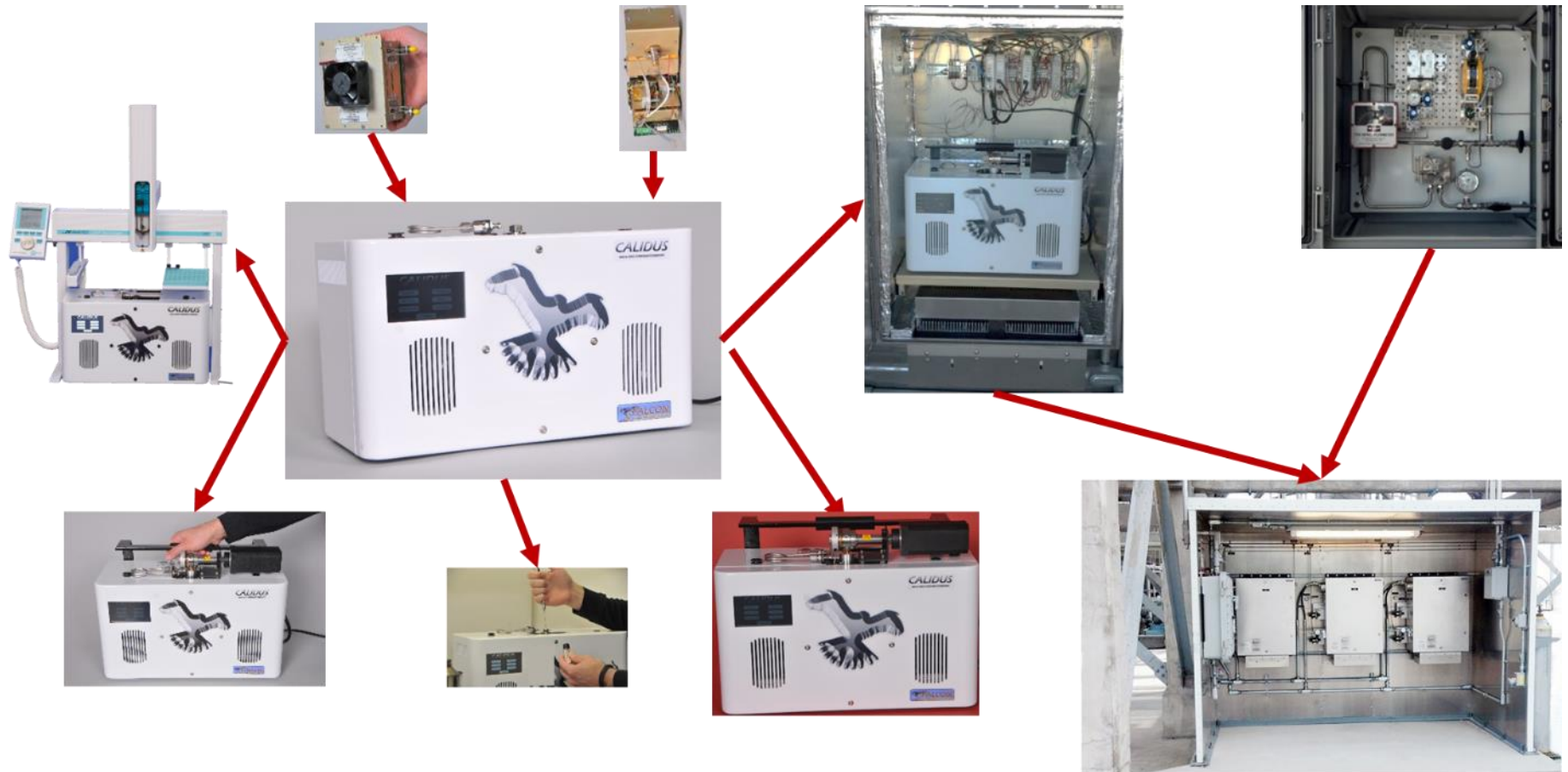
- *The need to solve users' requirements*
 - *At the top, make the necessary measurement*
 - *Reliably*
 - *In the hands of the end user*
- *And... downsize the entourage!*

MODULARITY

Some Images of Modularity (not to scale)



Modules Make Instruments Instruments Make Analyzers Analyzers Make System Solutions... One Solution



IFPAC, Year 2000 - Las Vegas

- *Question by Dr. Frank Schweighardt, Air Products,*

“Will there even be a gas chromatograph in 2020?”

- *Answer by Rajko Puzic, ExxonMobil,*

“Will humans be using materials made from hydrocarbons?”



Thus, Gas Chromatography is important!

Year in, year out... 20,000 to 30,000 GCs sold

- **Process Gas Chromatographs**

- ~ 5000 per year... more or less
- ~55% to Hydrocarbon Processing industries
- ~\$200 million for instruments only
- SI accounts for much more possibly up to \$0.8 - \$1 billion

- **Laboratory Gas Chromatographs**

- ~25,000 per year... more or less
- ~40% to Hydrocarbon Processing industries
- ~\$2 billion
- ~ 60% for routine testing and with accessories... ???

.....It's a BIG market!



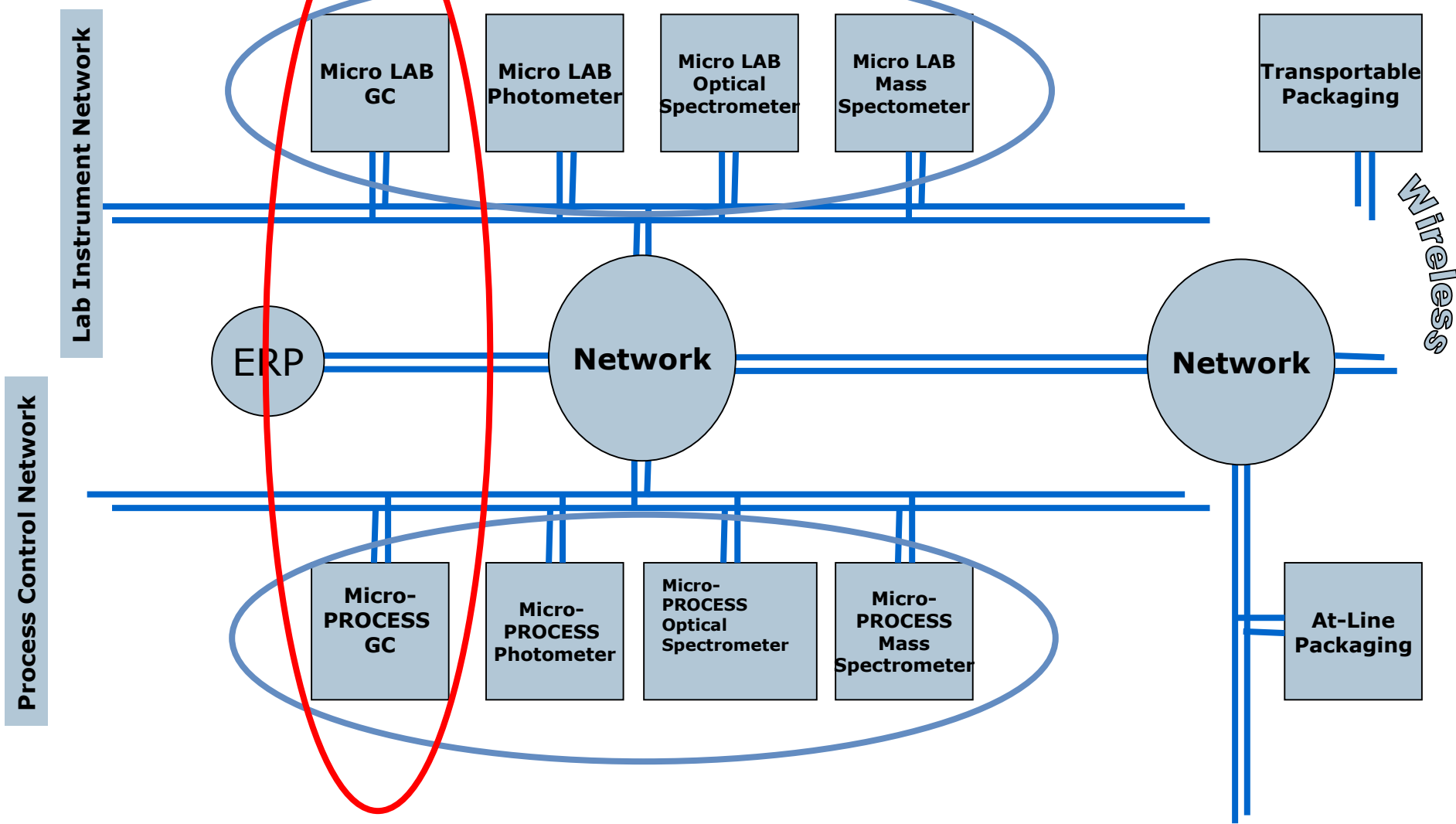
And why not? It is useful in a BIG way!

- ***For many analyses involving hydrocarbons***
 - ***Quantitative sampling***
 - ***Separation and then***
 - ***Detection***

... is difficult to beat
- ***And extremely cost effective!***

New Thinking...CONVERGENCE!

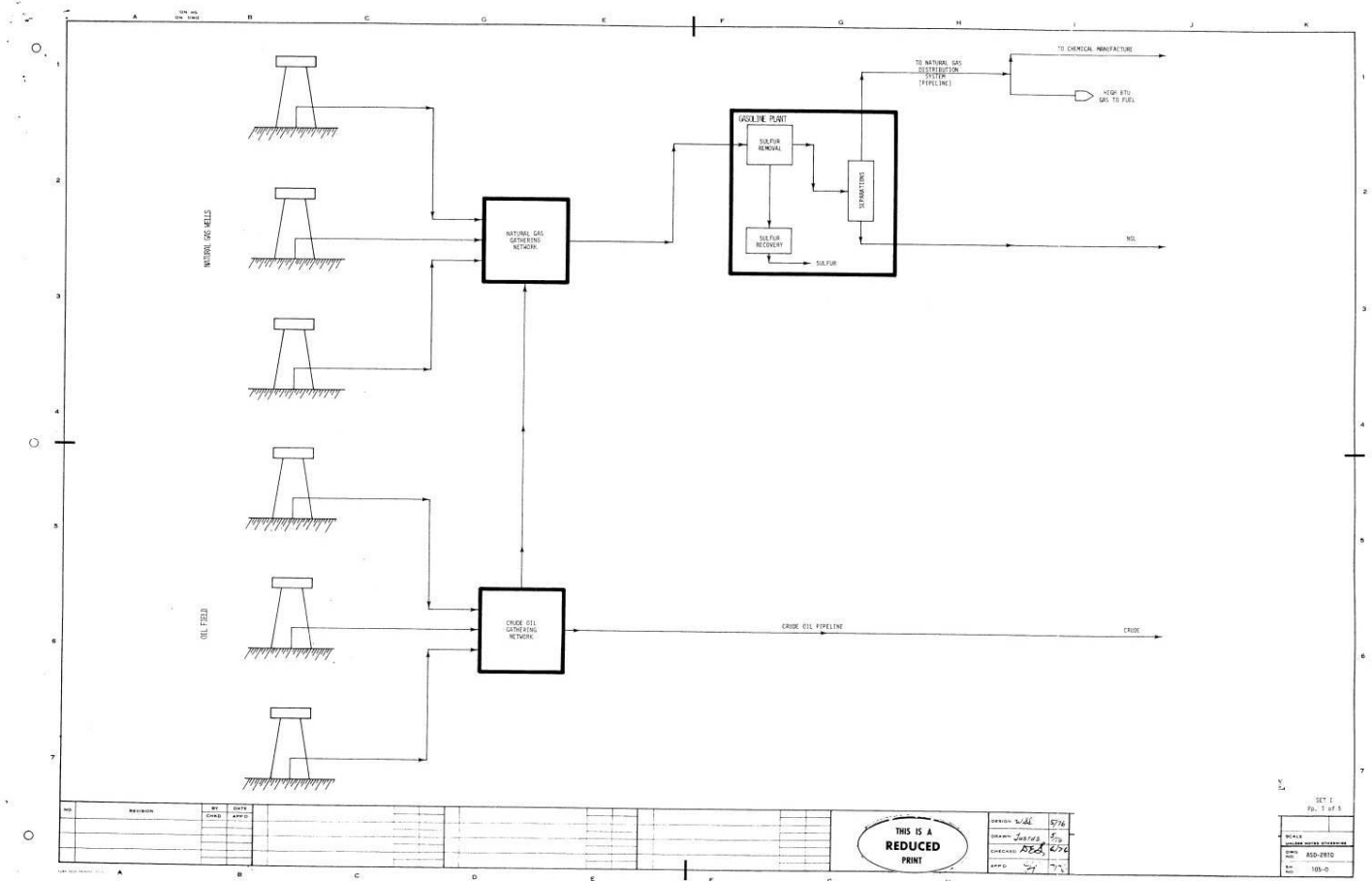
Old School



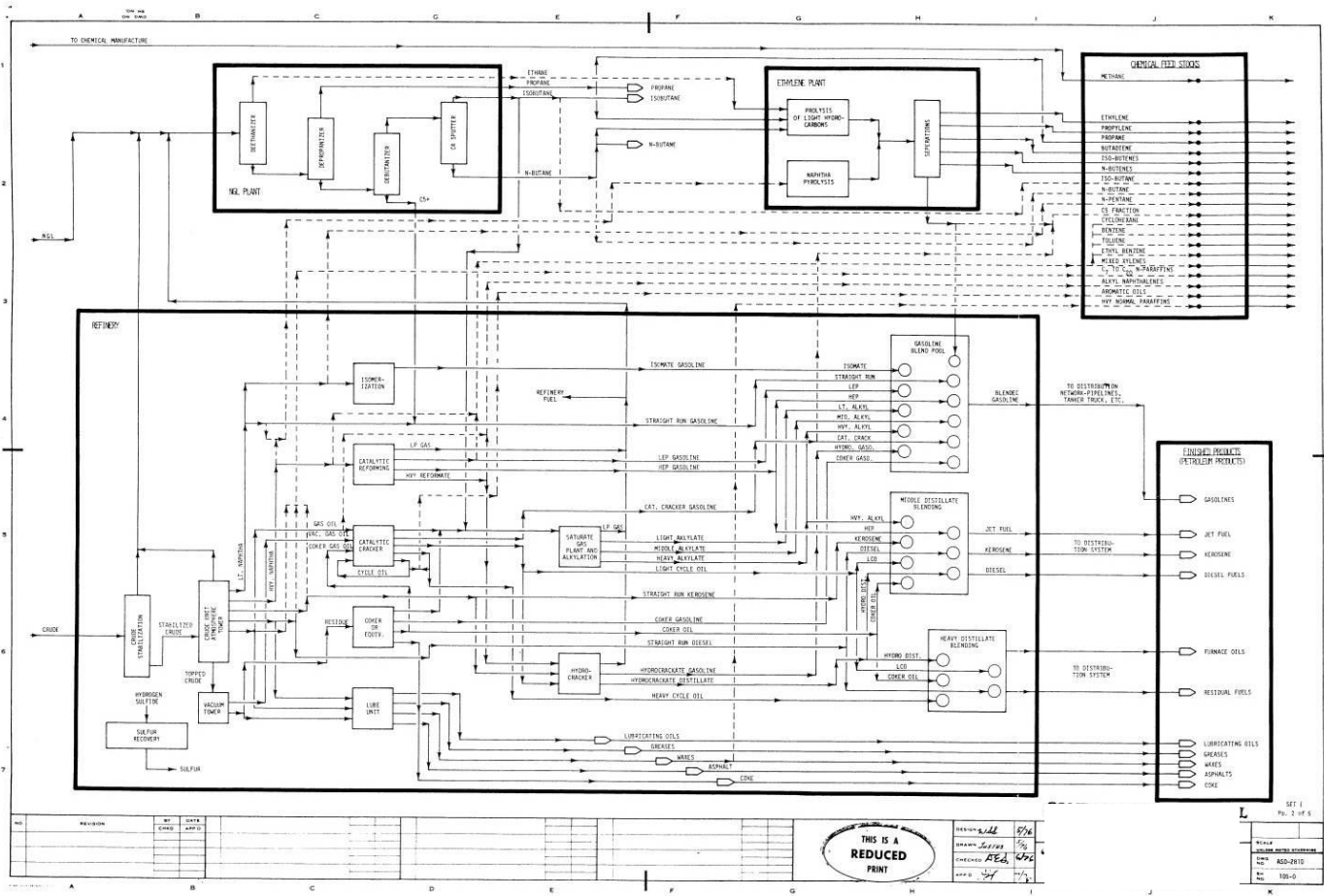
Fast and micro GC Applications (refinery/petrochemical processes & upstream)

- ***Air components hydrogen, oxygen, nitrogen, CO, CO₂***
- ***Low boiling hydrocarbons methane - butane***
 - ***Refinery gas BTU***
 - ***Ethylene purity & BTEX are examples***
- ***Middle distillates (speciation)***
 - ***Naphtha cracker***
 - ***Gasoline blender & petrochemicals are examples***
- ***High boilers (fingerprinting)***
 - ***Refinery material simulated distillation***
 - ***Oligomeric or low molecular weight polymers***

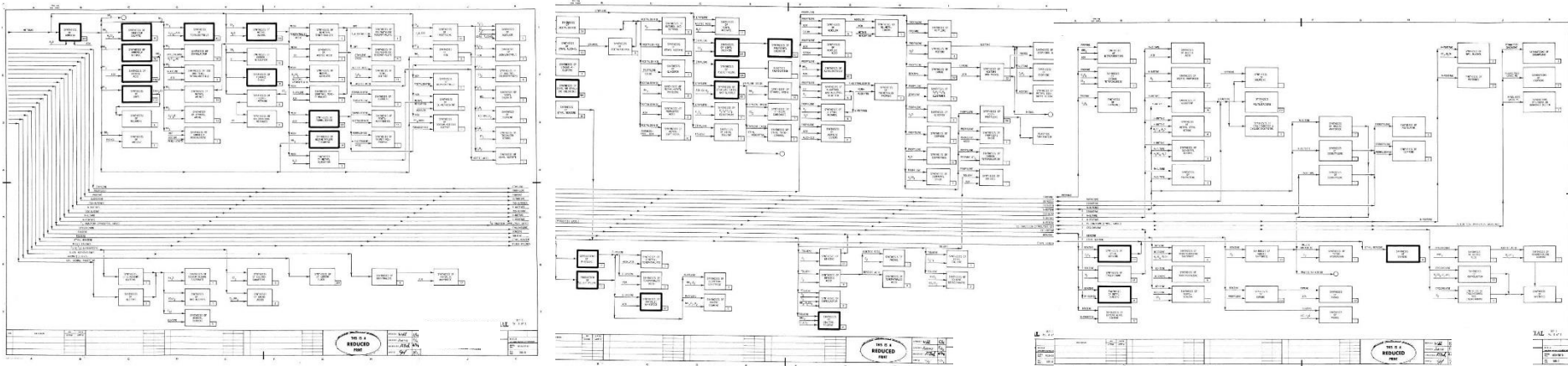
Crude Oil & Gas, the most important natural resource next to the human resource.



Leads to... Refining, Gas Processing & Petrochemicals



Leads to... Chemicals, Specialty Chemicals, Plastics & Resins



- **You get the idea...**
 - **Efficient production of the materials we use every day mandates that gas & liquid chromatography live on!**

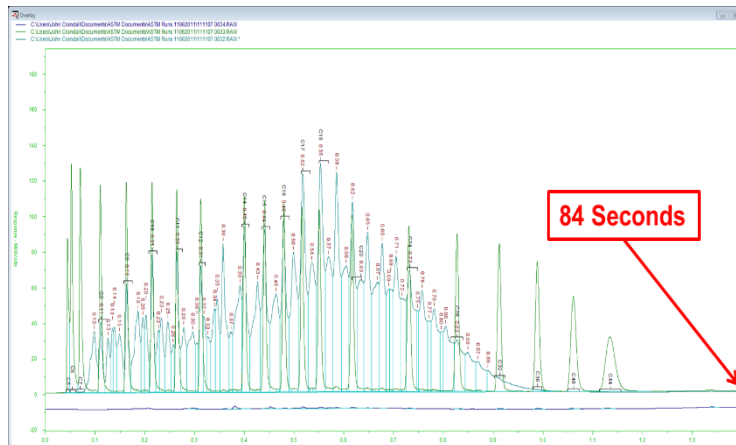
Falcon Analytical
makers of the . . .

CALIDUS
micro GAS CHROMATOGRAPH

in the lab...

in the process...

in the field.



The short answer...

YES!

**There will be gas chromatography
in 2020.**

Chromatography? Not dead yet!

Questions?

