



**MURCHISON**  
LAW FIRM, PLLC

## **IMA National Energy Specialty**

The Midstream Sector  
What It Is, What It Does

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**May 25, 2022**

# The Pipeline & Energy Authority



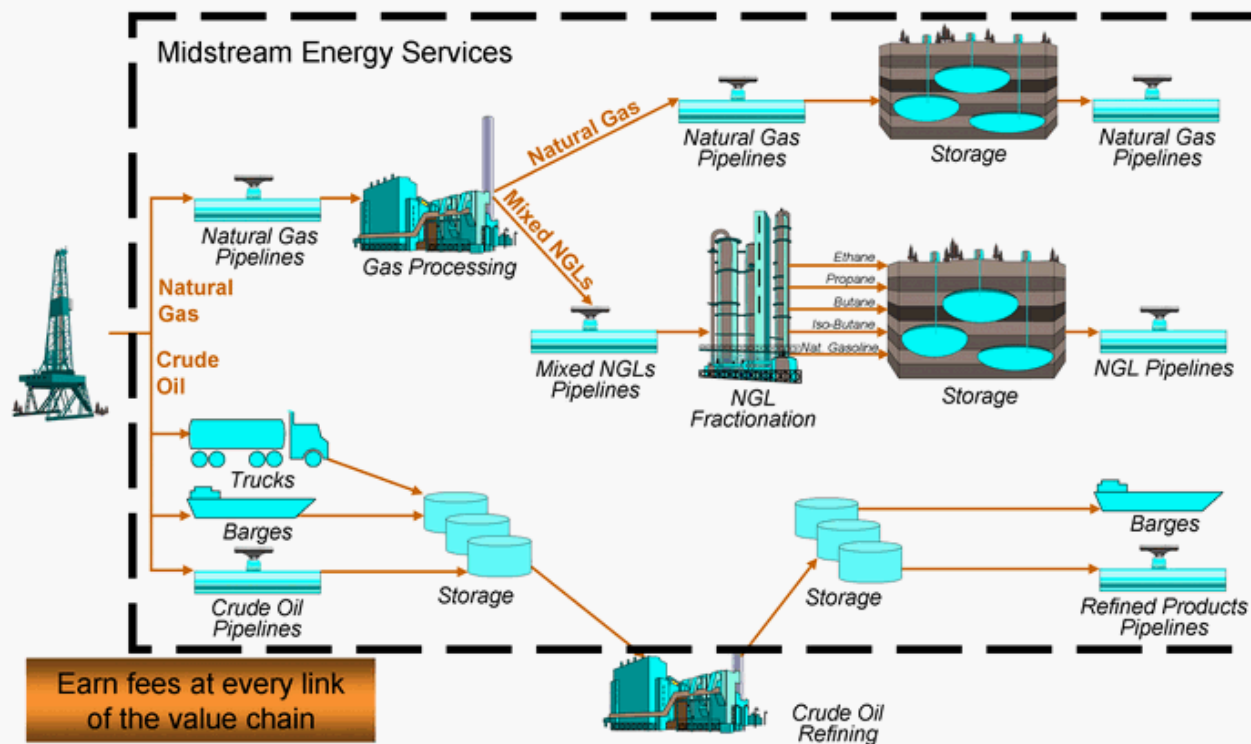
# INTRODUCTION



- What is this, this “Midstream”?
- Big Picture: Moving energy from the producing well to the end user
- But Midstream means many different things to many different people
  - Gas guys – Wellhead to end user (but not always Natural Gas Liquids aka NGLs)
  - Oil guys – midstream vs. downstream
  - NGLs?
  - LNG?



# Leading Business Positions Across Midstream Energy Value Chain





- What we will talk about today:
  - Talk through the basic “segments” of the industry:
    - Crude Oil
    - Natural Gas
    - Natural Gas Liquids
- Then about how those segments work – the processes for each “product”
- Then about the end results
- Then about the Mid 2010s “Energy Renaissance”
- Then Midstream’s recent past and prospects for the future

The background of the slide features a photograph of several large, cylindrical industrial storage tanks, likely for crude oil. Each tank is equipped with an external spiral staircase and a walkway with safety railings at the top. The tanks are arranged in a row, receding into the distance. The sky is a clear, pale blue. The overall image has a slightly faded or semi-transparent appearance, allowing the text to be clearly visible.

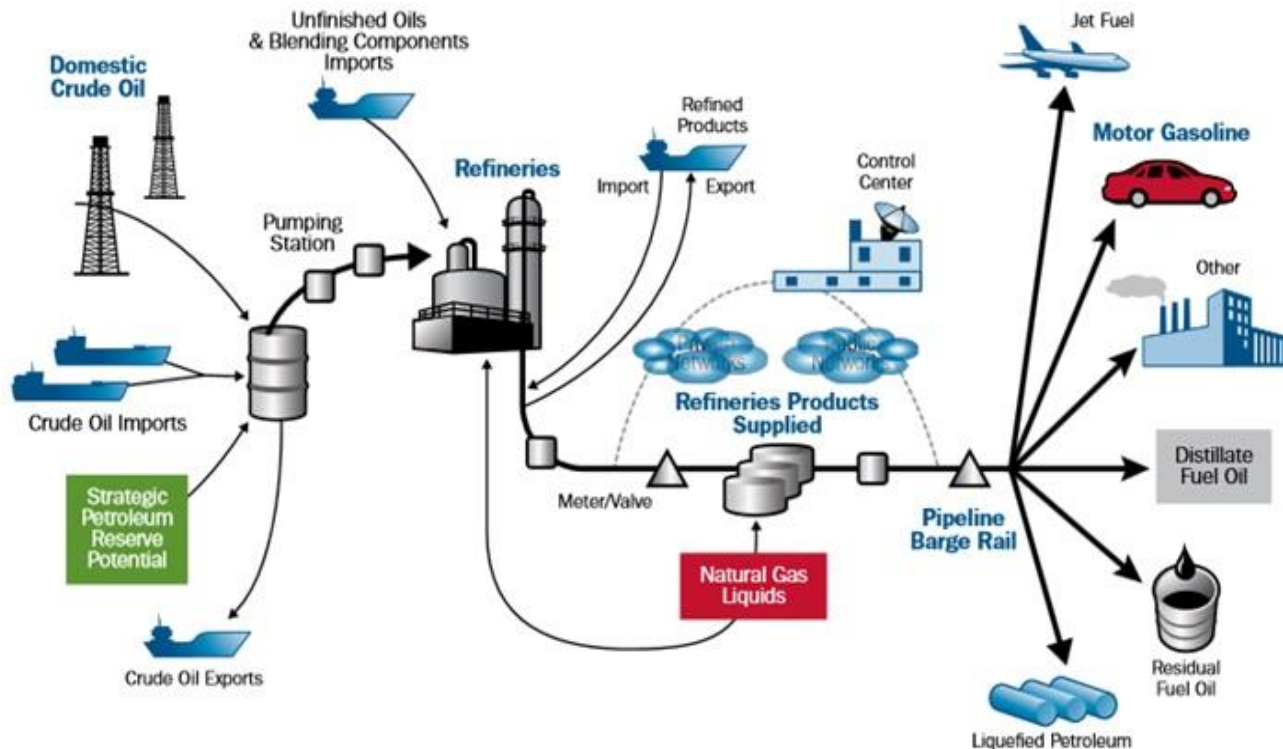
## **Crude Oil – Upstream / Midstream / Downstream**





## The Crude Oil Value Chain:

- Produce –
- Separate/Treat –
- Move –
- Refine –
- Move –
- Store –
- Distribute – Wholesale, Retail, Export





## Wellhead Production

- Mix of crude oil, dissolved gas, water (brine), sediment
- Flow lines into lease tanks
- Off the gas > Capture or flare
- Separate the water – disposal by injection (skim oil)
- Gather for bulk movement







## Two big steps:

- To the refinery
- To the end user



## Lease tanks to the refinery – field maturity factors into transportation options

- Trucks – almost always in the early years – sometimes always
  - Productivity
  - Cost / Economics
  - Practicality
- Rail
  - Loading facilities
  - Unloading facilities
  - Speed and capital costs
  - Flexibility

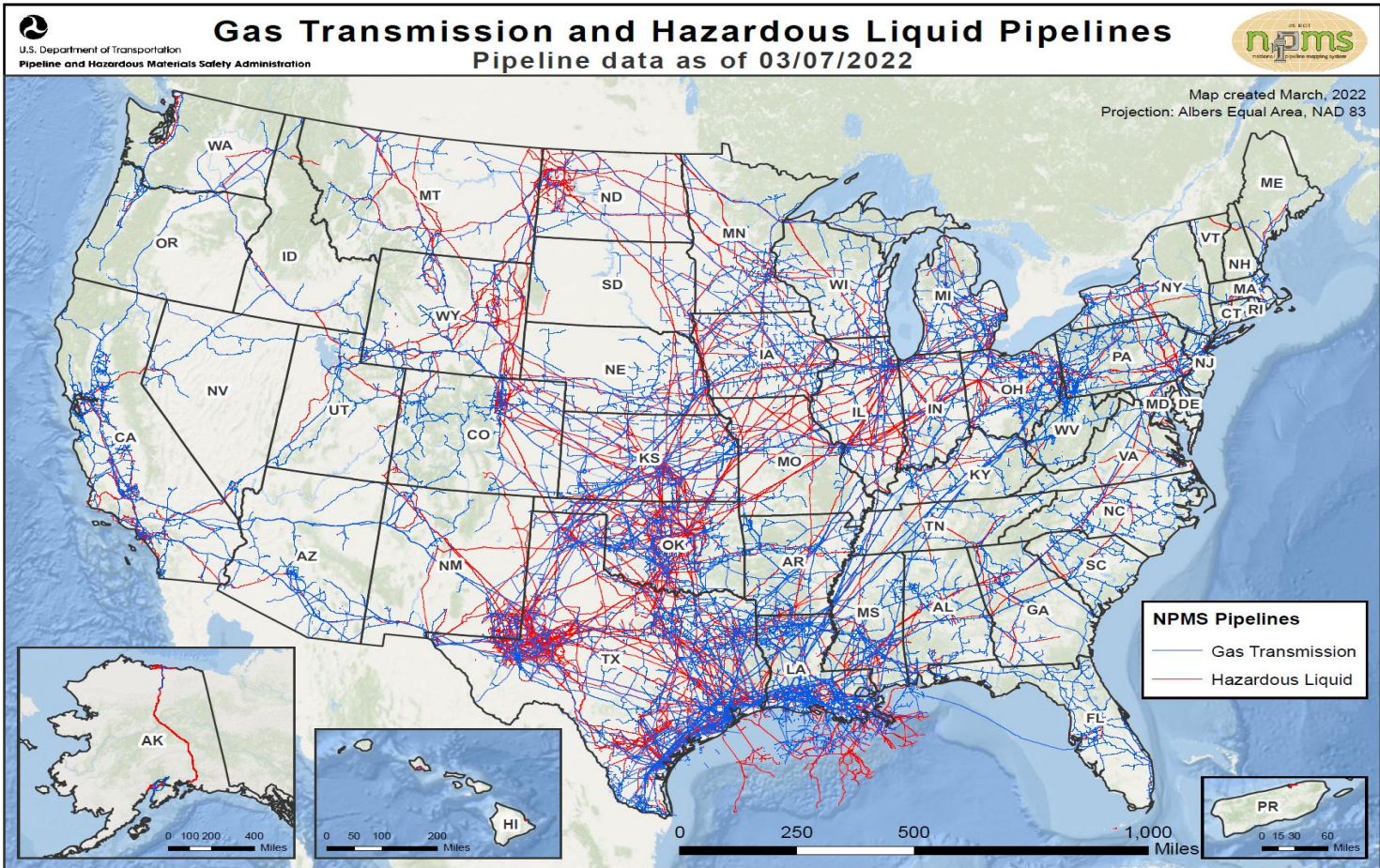




## ➤ Pipeline

- Gathering lines
  - [Differences in nomenclature - practical vs. regulatory]
    - Central processing facility
    - Central “gathering” point – commingling
- Trunk line transmission – speed and capital costs
- Trunk line transmission -
  - Larger diameter, 6/8/10/12/16/18/24/30/34/36 inches – up to 48 inches
  - Distances and destinations
    - 10, 20, 50 miles – to regional storage/consolidation – then refinery
    - Several hundred miles to market hubs – Cushing, OK; St. James, LA; Patoka, IL; Houston Ship Channel; Corpus Christi, TX
    - Export



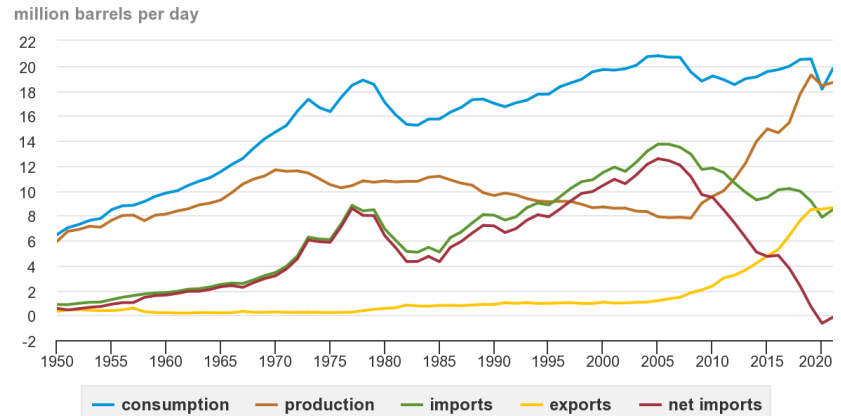




- Barge and Jones Act tankers
- Imports
  - Historical Movements
  - Recent Times – they are a' changin'



**U.S. petroleum consumption, production, imports, exports, and net imports, 1950-2021**



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 3.1, March 2022, preliminary data for 2021



## At the Refinery

- Into tanks
- Crude oil composition
- The refining process
  - Basic function is distillation – vaporizing liquids within temperature ranges (boiling points)
  - Then condensing and capturing – thereby separating the various compounds from the mixture





## Tesoro Anacortes Refinery, Washington

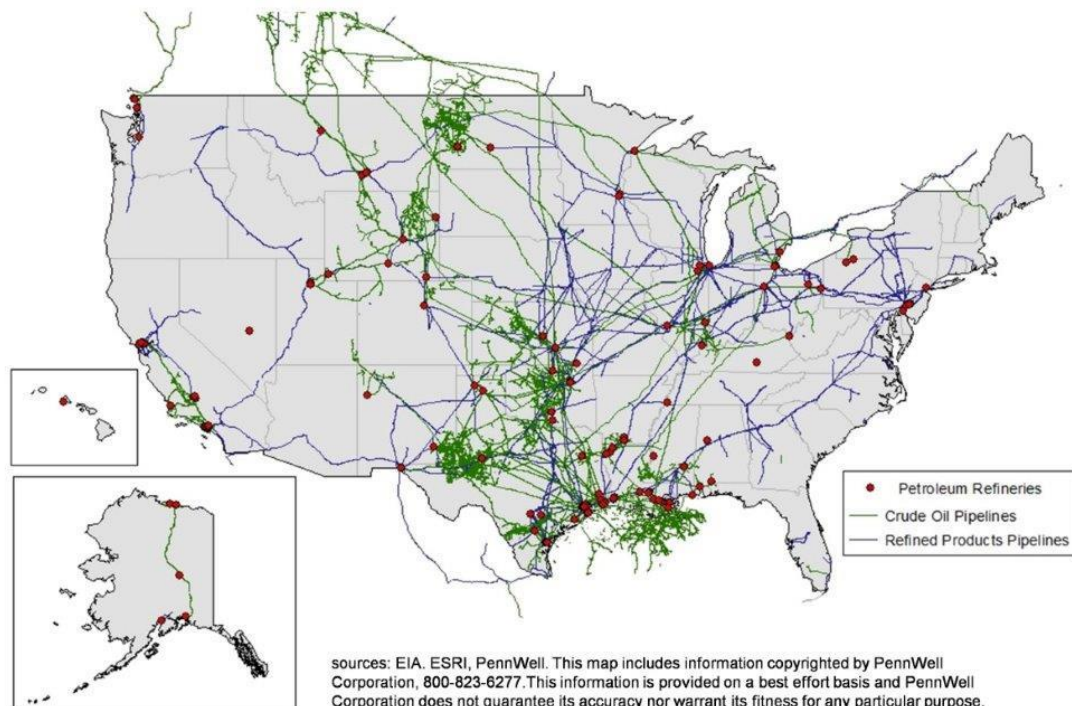




## U.S. Refining Centers



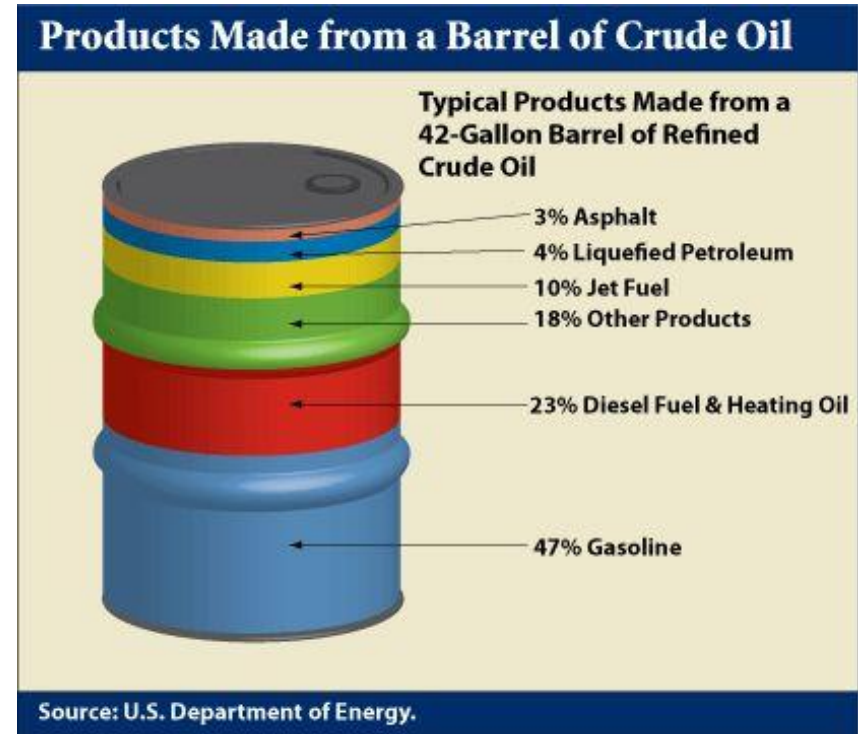
U.S. refineries and crude & refined product pipelines



sources: EIA, ESRI, PennWell. This map includes information copyrighted by PennWell Corporation, 800-823-6277. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.



- Primary products – market driven (which drives feedstocks and technology and feedstocks...)
  - Gasolines (more later)
  - Diesel fuel
  - Jet fuel
  - Heating oil
  - Bunker fuel
  - Miscellaneous products:
    - Kerosene, naphtha
  - And – Natural gas liquids







## Beyond Distillation

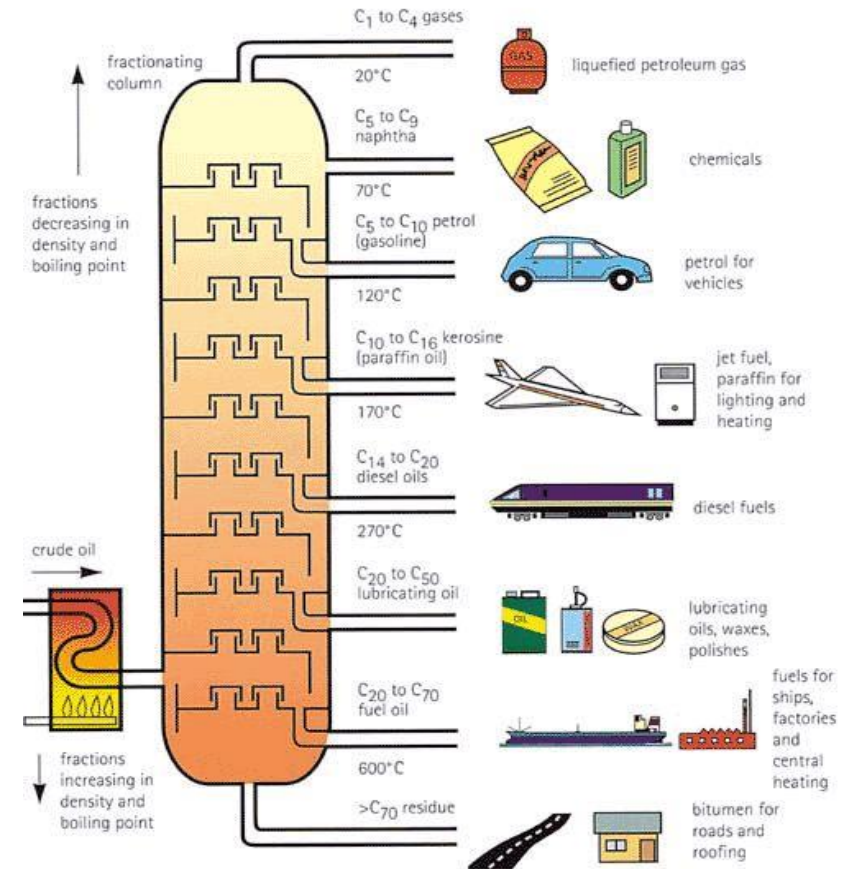
- “Synthetic” fuels and lubricants
- Hydrocracking / reformulation

## Gasolines:

- Regular
- Premium
- Blendstocks – RBOB
- Then there’s California . . . CARBOB

## Diesel fuels:

- LSD – low sulphur diesel (so has been...)
- ULSD – ultra low sulphur diesel





## Lubricants:

- Specialty products
- “Synthetic motor oil”





## Downstream – Refined Products into refinery tanks – then

- Offload to trucks (local markets – minor volumes)
- Offload to rail
- Offload to vessel (barge; tanker – exports)
- Off to Pipeline – more often than not
  - Refined product systems
    - Simple systems – Point A to Point B
    - Complex systems – Points A, B, C ... to Points X, Y, Z ...
    - Size: 4/6-inch up to 40 + inch
    - Distances – up to hundreds of miles, nearing 1,000 miles
  - Ultimate destination – distribution points
    - Terminals with tanks – lots of tanks (product segregation; EPA regulations)
      - Tank truck to retail and fleet
    - Airports – take a look around next time...
    - Railyards



The background of the slide features a photograph of several large, cylindrical industrial storage tanks, likely for natural gas. Each tank is equipped with an external spiral staircase and a walkway with safety railings at the top. The tanks are light-colored, and the scene is set against a clear, pale blue sky. The overall image has a slightly faded, semi-transparent appearance.

## Natural Gas



## The Natural Gas Value Chain:

Produce –

Treat –

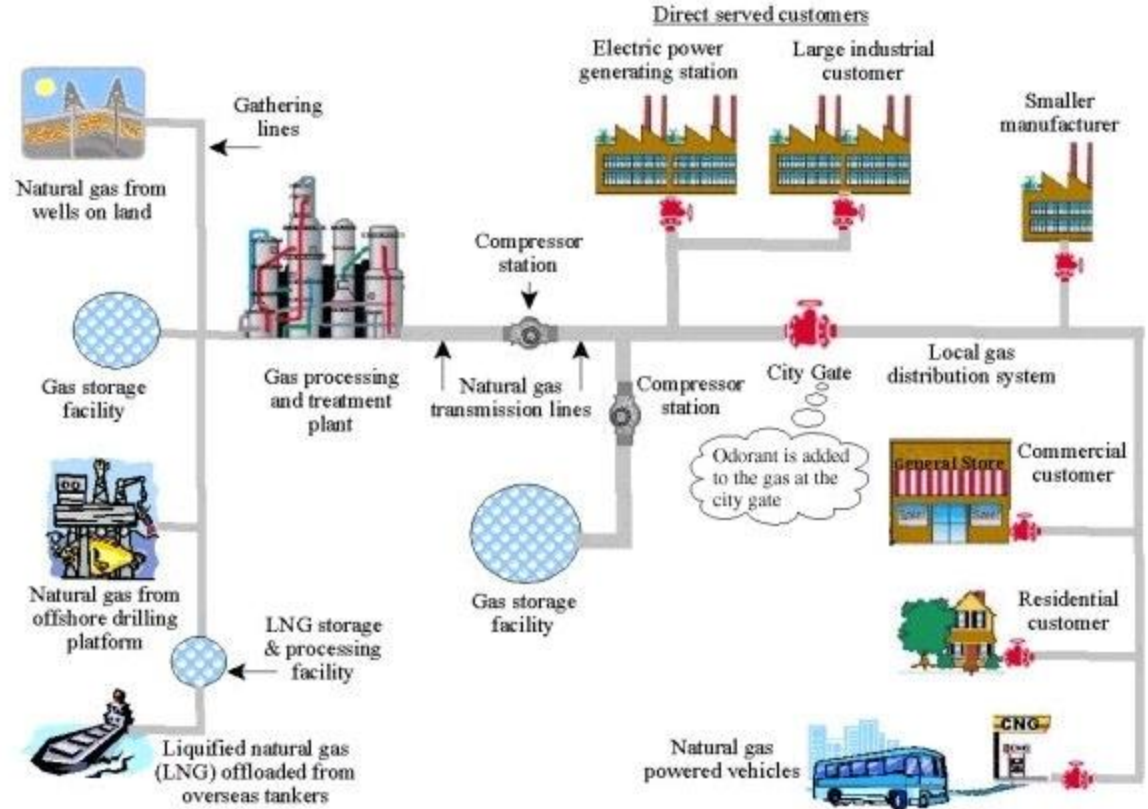
Move –

Process –

Move –

Store –

Deliver / Distribute





## Wellhead Production:

- Natural gas (methane), water; natural gas liquids, depending on field/formation
- Treatment
- Processing and treatment



## Processing and treatment:

- Remove water and contaminants – e.g., carbon dioxide, hydrogen sulfide, nitrogen, etc.
- Capturing valuable products – Condensate and NGLs
- End result: Pipeline quality gas – fungible end product – and pipeline acceptability
- Wellhead location (lease)
- Central facilities (dehy, treatment)
- Processing





## Pipeline Transportation –

- Gathering → to central facilities → to transmission
- Transmission line
- End Users
  - Local Distribution Companies to the end user, the burner tip
  - Industrial Users – Manufacturing
  - Power generation
  - LNG export
  - Compressed natural gas (CNG)
  - Hydrogen?

**Seasonal storage (Peak Shaving)** – stocks for high demand periods and events

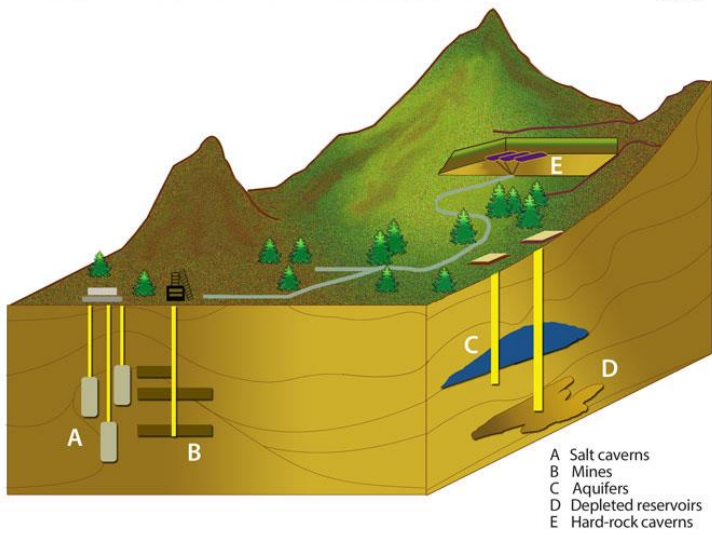
- Depleted reservoirs
- Salt caverns
- Aquifers
- LNG



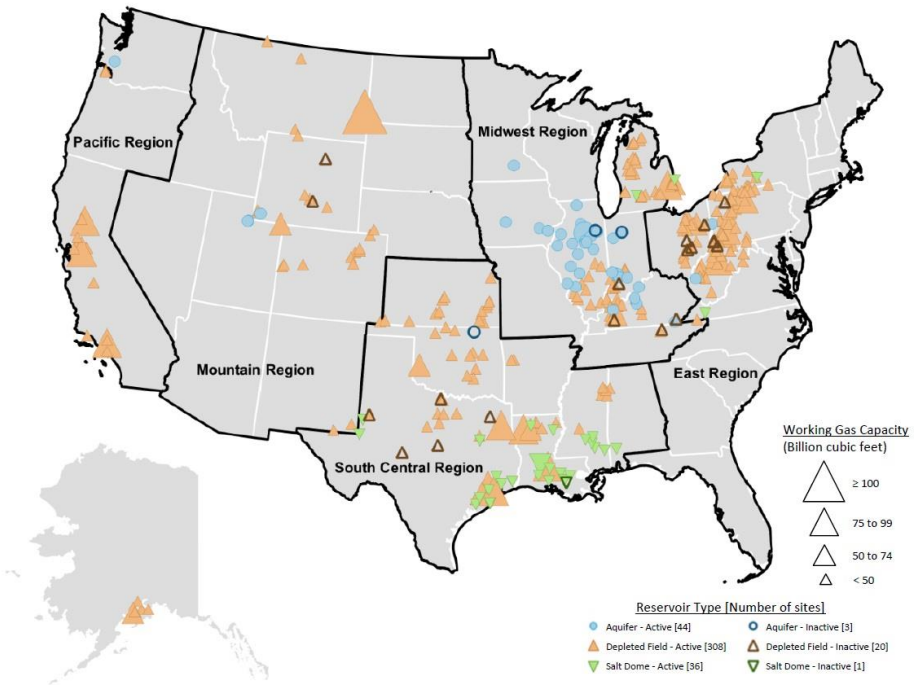


U.S. Underground Natural Gas Storage Facility, by Type (December 2019)

Figure 1. Types of underground natural gas storage facilities



Source: PB-KBB, inc., enhanced by EIA.







## Liquefied Natural Gas Facility and Tanker



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## Natural Gas Liquids (NGLs)



## The NGL Value Chain:

Produce –

Process –

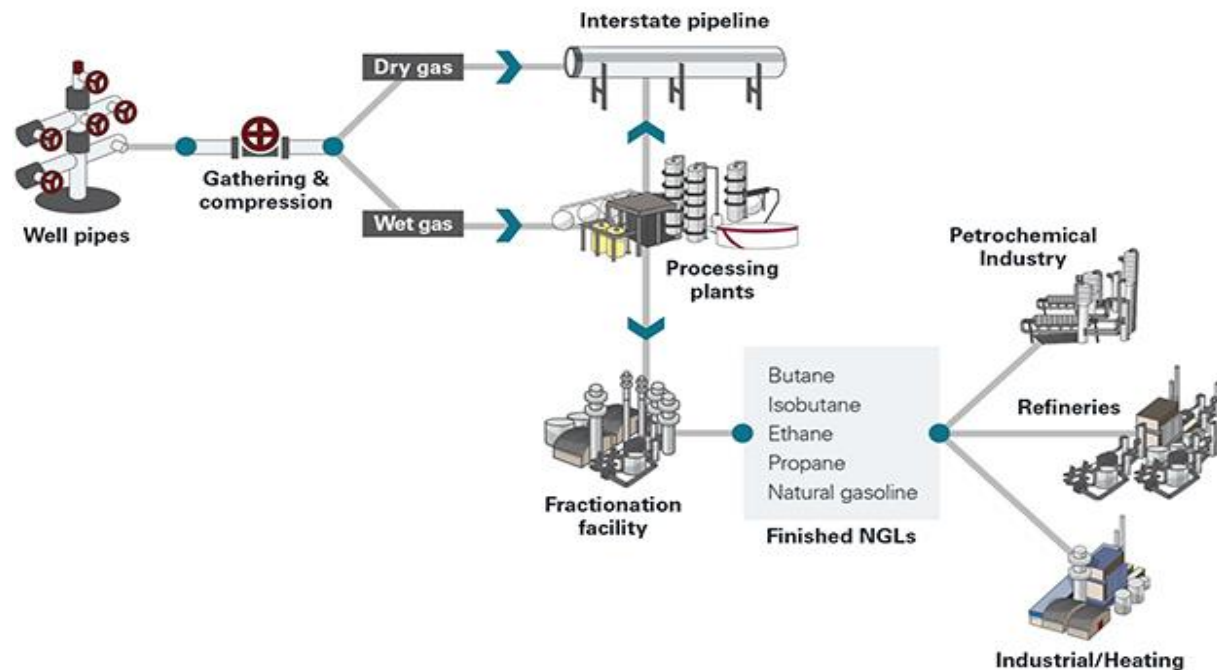
Move –

Fractionate –

Move –

Store –

Deliver/Distribute/Export





## Wellhead “Wet” Gas Production (aka “Rich” Gas)

### Processing (vs. treatment)

- Cryogenic: Condensing Liquids
- Result: “Raw Mix” NGLs
  - A mixture of ethane, propane, butane, isobutane, and natural gasoline (aka pentanes+)
- And “Residue Gas” – natural gas free of the liquid components
  - Treatment → Pipeline quality gas → Transmission Line → burner tip bound, export, etc.



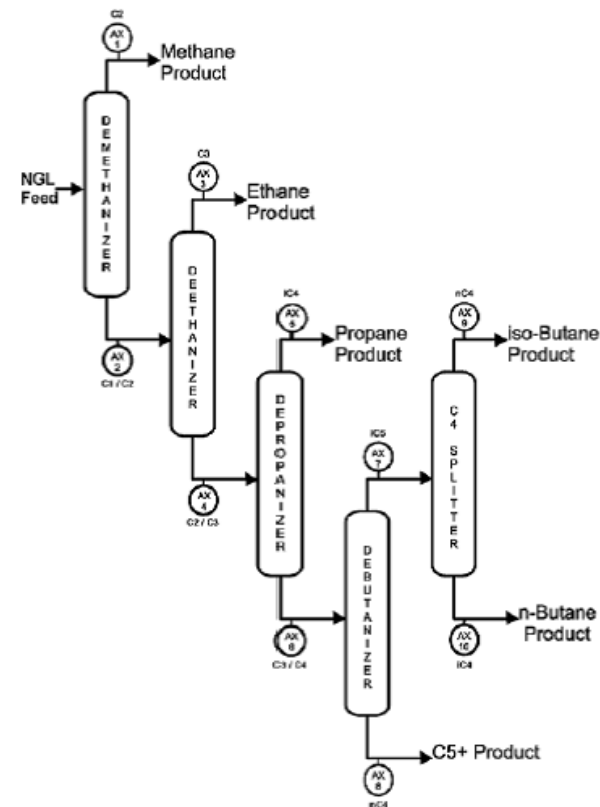


## **NGLs – Fractionation of the raw mix into marketable products**

- On-site with processing – or stand-alone central, large scale facility
- Moved-in primarily by pipeline; to a lesser extent rail, truck
- Fractionation
- On-site storage – most likely underground in salt caverns (or less so, tank/sphere)
- Actual fractionation –
  - Distillation – aka Refining – same process of distillation
  - Sequentially separate products by weight, by specific gravity



## Natural Gas Liquids Fractionation







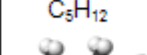




## ➤ Results

- Ethane – value influences recovery
  - Ethane rejection
  - Ethane cracker / dehydrogenation
  - Ethylene – manufacturing plastics, etc.
- Propane – heating, agriculture, portable fueling
- Butane – same; octane blending
  - Refinery grade butane
  - Isobutane – who knows, but it's worth more . . . .
- C5 – aka natural gasoline or pentanes+
  - Motor fuel blending



NGL Attribute Summary				eia
Natural Gas Liquid	Chemical Formula	Applications	End Use Products	Primary Sectors
Ethane	$C_2H_6$ 	Ethylene for plastics production; petrochemical feedstock	Plastic bags; plastics; anti-freeze; detergent	Industrial
Propane	$C_3H_8$ 	Residential and commercial heating; cooking fuel; petrochemical feedstock	Home heating; small stoves and barbeques; LPG	Industrial, Residential, Commercial
Butane	$C_4H_{10}$ 	Petrochemical feedstock; blending with propane or gasoline	Synthetic rubber for tires; LPG; lighter fuel	Industrial, Transportation
Isobutane	$C_4H_{10}$ 	Refinery feedstock; petrochemical feedstock	Alkylate for gasoline; aerosols; refrigerant	Industrial
Pentane	$C_5H_{12}$ 	Natural gasoline; blowing agent for polystyrene foam	Gasoline; polystyrene; solvent	Transportation
Pentanes Plus*	Mix of $C_5H_{12}$ and heavier	Blending with vehicle fuel; exported for bitumen production in oil sands	Gasoline; ethanol blends; oil sands production	Transportation

C indicates carbon, H indicates hydrogen; Ethane contains two carbon atoms and six hydrogen atoms

\*Pentanes plus is also known as "natural gasoline." Contains pentane and heavier hydrocarbons.

The background of the slide features a photograph of several large, cylindrical industrial storage tanks. Each tank is equipped with an external metal staircase that spirals around its side, leading to a platform at the top. The tanks are light-colored, and the sky in the background is a pale, clear blue. The overall image has a slightly faded or semi-transparent appearance, allowing the text to be clearly visible.

# Re-Plumbing the United States



## **Really Coarse and Recent History of Oil and Gas Production**

1970s – 1990s: Declining domestic production – increasing imports

Peak Oil?

1980s – 1990s: Mitchell Petroleum – Fort Worth Basin – The Decoder Ring

2000s – Devon Energy Acquires Mitchell

Yet again, technology yields previously unrecoverable reserves





## Shale Formations and Hydraulic Fracturing

2008 – Gas prices crash – so do crude oil prices, but not nearly as much

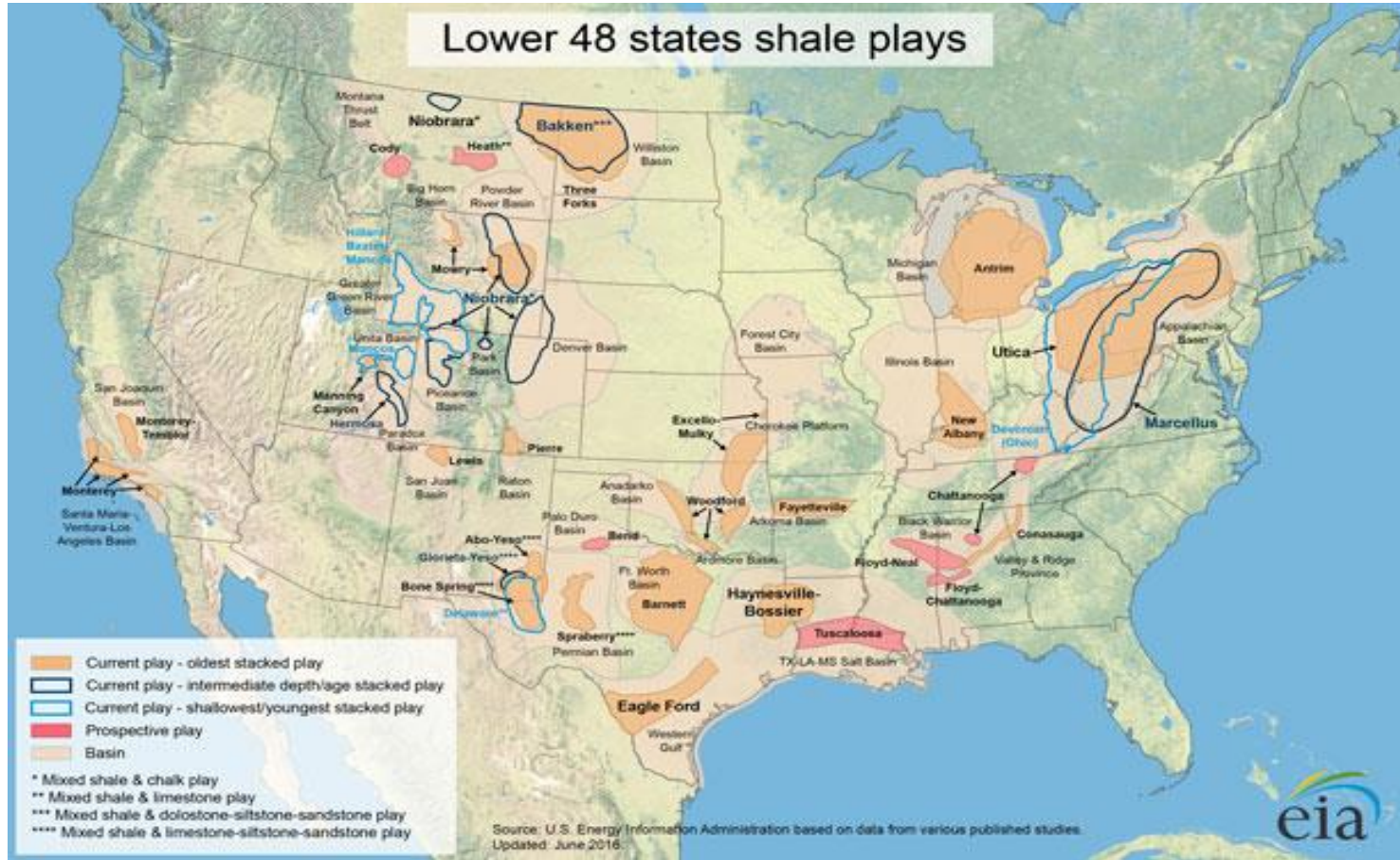
The shale boom – another energy renaissance (we'll talk logistics....)

- Energy infrastructure: Historical movement of imports inland
- Production at the terminus – needs to be the origin – pipeline is pointed the wrong way!
- Eagle Ford: At best, nominal infrastructure in place



## The Shale Basins and Oil Sands

- Bakken: Not much takeaway
- Eagle Ford: Not much of anything
- Denver-Julesburg Basin: About the same
- Permian: Abandoned or re-purposed (Longhorn) and New lines
- Alberta Oil Sands: Searching for a way out
  - Keystone XL?





## Major Oil Pipeline Projects –

- Keystone WHO? (Enter: Enbridge Lakehead System)
- Keystone XL Southern Extension
- Enbridge Lakehead System
- Permian Basin: Longhorn Pipeline, Wink to Webster, Sand Hills, Grand Prix
- Seaway and Seaway Twin
- Eagle Ford Systems: Kinder Morgan and Enterprise and EPIC and Numerous Others
- Williston Basin: Dakota Access + ETCP + Enbridge + OPPL + Elk Creek
- Storage, storage, more storage, and then how about some more storage....



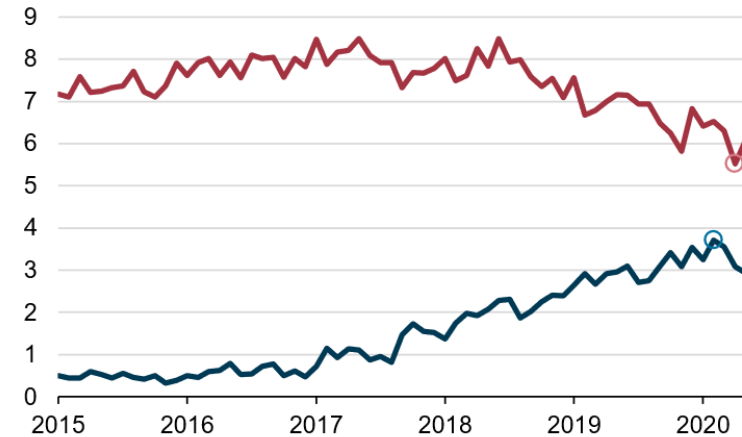


## Exports – More to Come?

- Crude Oil
  - LOOP
  - Capline Reversal
  - Corpus Christi/Ingleside
- LPG (same as NGL)
- LNG

U.S. monthly crude oil imports and exports (Jan 2015–Jun 2020)

million barrels per day



**U.S. crude oil imports** in April 2020 were the lowest since the early 1990s but have since increased

**U.S. crude oil exports** reached a record high in February 2020 but have since fallen



Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*



**Thank you for the opportunity – and for your time and attention**

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