TRENDS IN ENERGY & BASIC MATERIALS

The Path to Decarbonization: Implications for Rail

Railroad Financial CORPORATION

PREPARED FOR:

Rail Equipment Finance Conference

Graham Brisben – Chief Executive Officer
PLG Consulting

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March 6, 2023 **La Quinta, CA**

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Today's Themes

1. **Energy production and consumption**
2. **Decarbonization underway**
3. **Green energy supply chains**
4. **Implications for rail**

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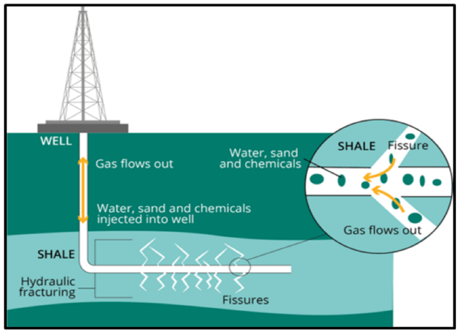
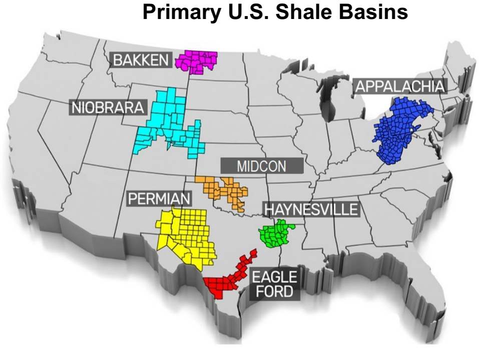
The Story Begins With Unconventional Extraction

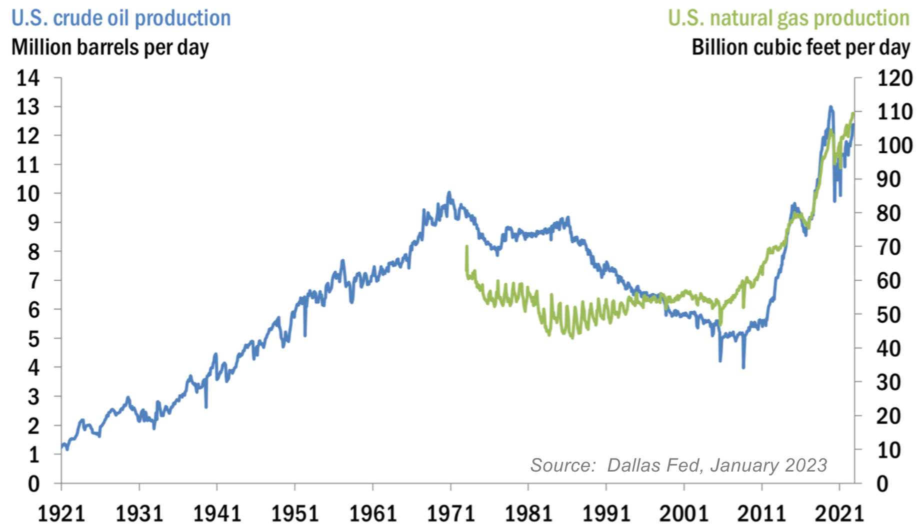
- THE energy story of the 2010s
- Includes both US shale development (fracking) and Canadian oilsands
- No longer "unconventional" or a "revolution" - now the primary means of hydrocarbon extraction in North America
- Mature market
- Has created North American energy independence
- Has provided the baseload and transition fuels for the path to decarbonization



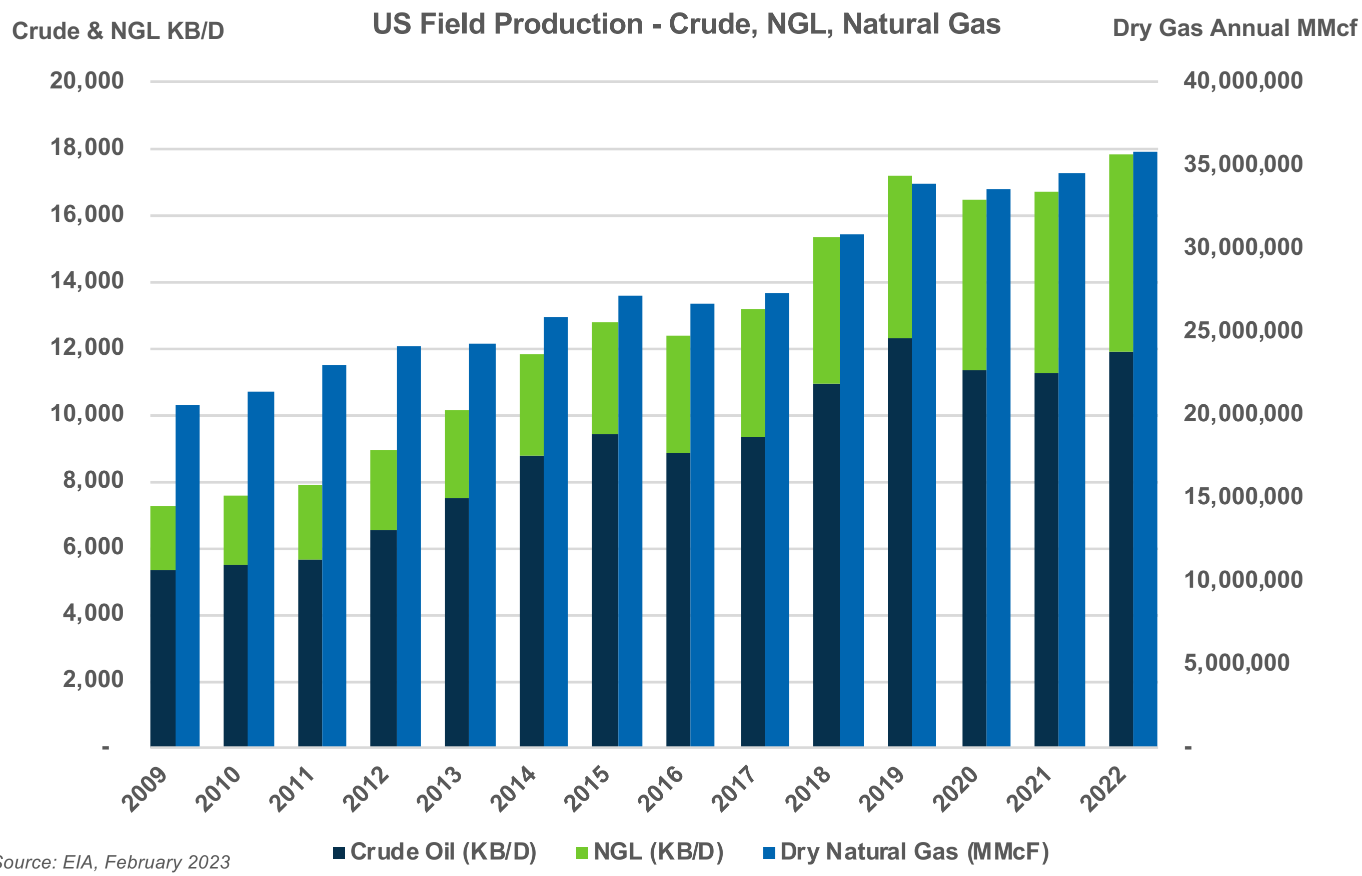
Source: European Environment Agency



U.S. Oil & Gas Production



Hydrocarbon Outputs and Primary End Uses



Source: EIA, February 2023

Crude

Transportation fuels

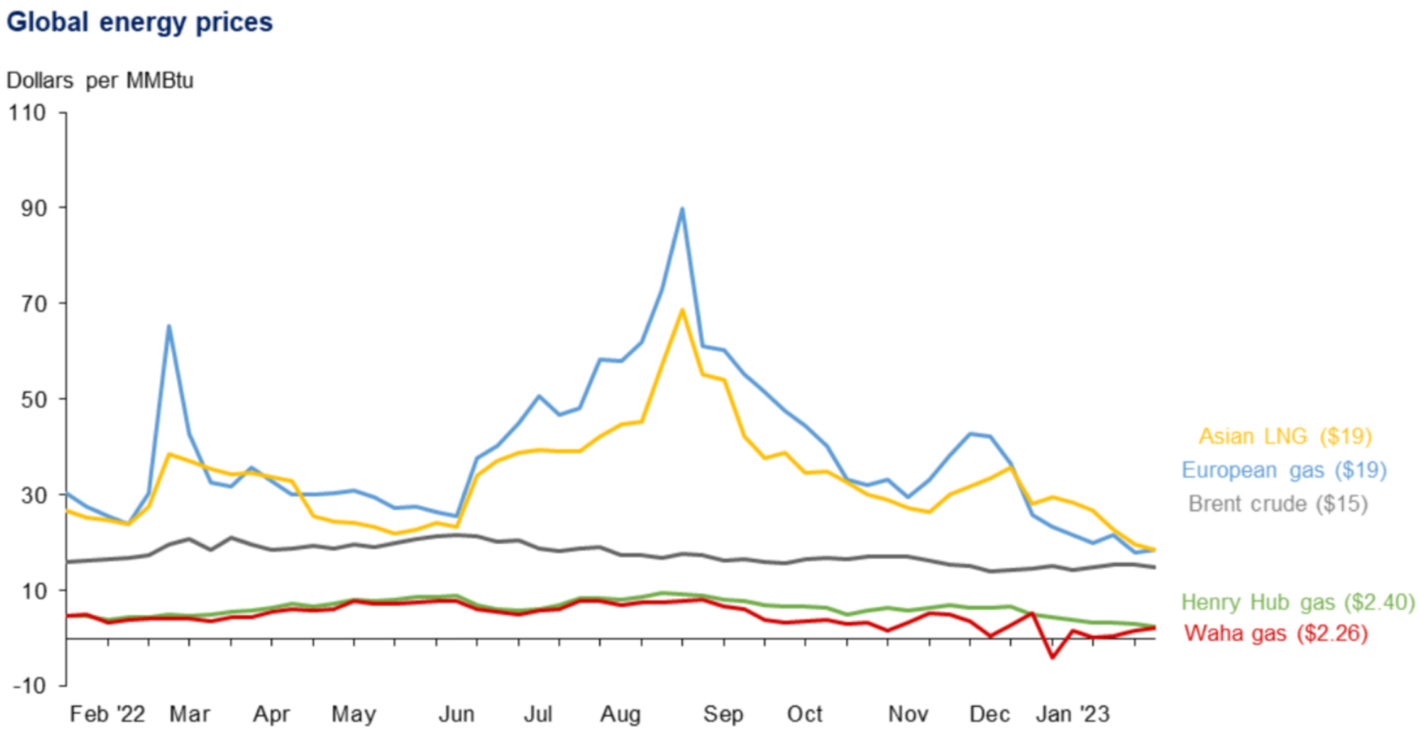
NGLs

Power, heating, chemical feedstocks

Gas

Electricity generation, process feedstocks

Heading Into 2023, Energy Markets Have Stabilized



NOTE: European gas is the Netherlands TTF price, Asian LNG is the Japan–Korea marker. Prices in parentheses are for Feb. 3, 2023. Currencies are converted using exchange rates.
SOURCE: Bloomberg; S&P Platts; author's calculations.

Source: Dallas Fed, February 2023

- Normalization of crude, dry gas, and NGL prices since last summer
  - Reduction in demand
  - SPR releases
  - Continuing supply growth
- Winter energy crisis in Europe avoided, largely due to:
  - LNG deliveries from US and elsewhere
  - Replenishment of storage
  - Mild winter

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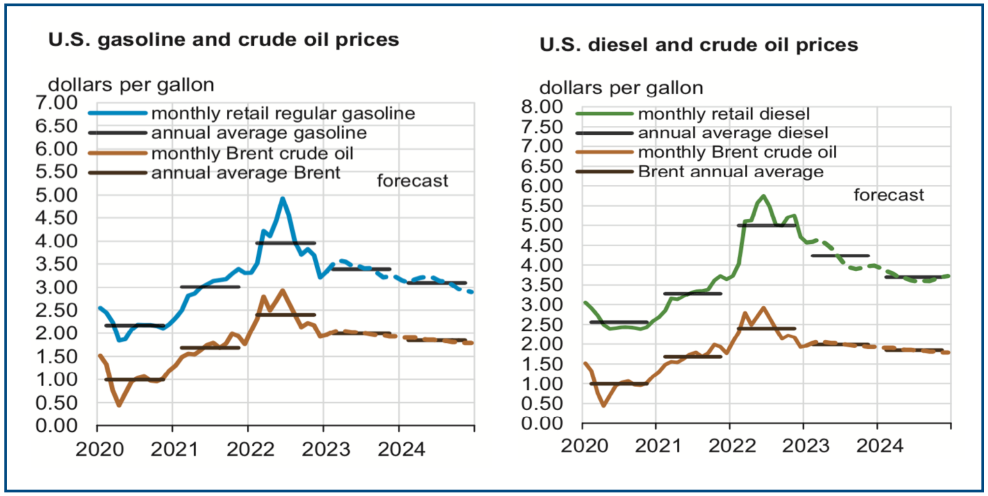
Gasoline Prices Have Eased Since Summer 2022



Source: EIA, February 2023

- Lower crude prices
- Reduced demand
- Replenished inventories

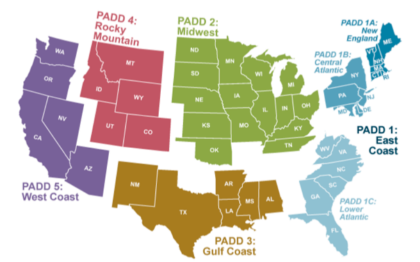
National average gasoline and diesel prices down 33% and 20%, respectively

Regular Gasoline & Highway Diesel

July 2022

PADD	Gasoline	Diesel
1	$4.69	$5.85
1A	$4.89	$6.12
1B	$4.87	$6.01
1C	$4.52	$5.74
2	$4.82	$5.63
3	$4.50	$5.37
4	$4.98	$5.69
5	$5.79	$6.42
U.S.	$4.87	$5.72

Retail price per gallon



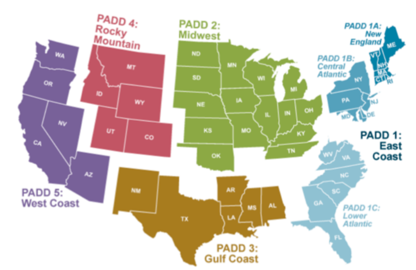
Source: Dallas Fed, July 2022

Regular Gasoline & Highway Diesel

January 2023

PADD	Gasoline	Diesel
1	$3.22	$4.81
1A	$3.27	$5.09
1B	$3.42	$5.20
1C	$3.08	$4.64
2	$3.15	$4.39
3	$2.89	$4.22
4	$3.12	$4.70
5	$3.96	$5.08
U.S.	$3.26	$4.55

Retail price per gallon



Source: Dallas Fed, January 2023

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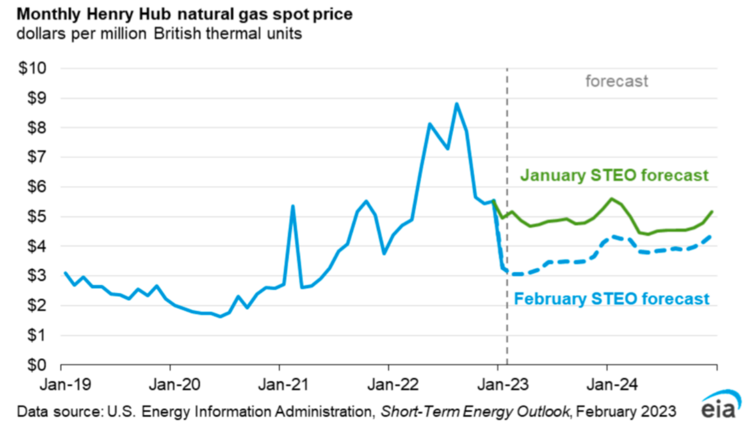
Near Term Forecast Remains Stable

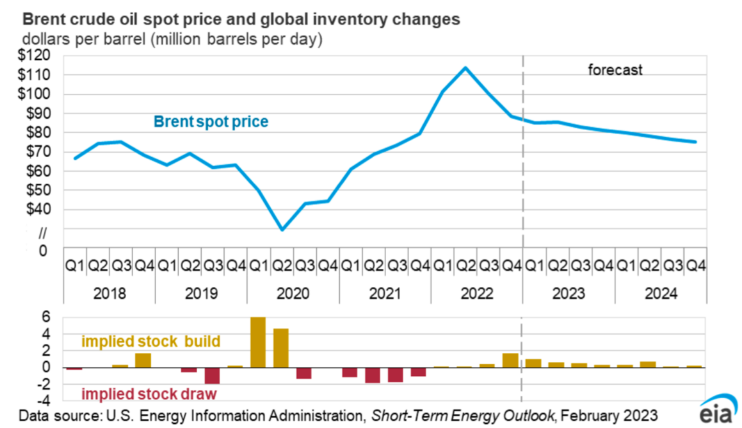
U.S. energy market indicators	2022	2023	2024
Brent crude oil spot price (dollars per barrel)	**$101**	**$84**	**$78**
Retail gasoline price (dollars per gallon)	**$3.97**	**$3.39**	**$3.10**
U.S. crude oil production (million barrels per day)	**11.90**	**12.49**	**12.65**
Natural gas price at Henry Hub (dollars per million British thermal units)	**$6.42**	**$3.40**	**$4.04**
U.S. liquefied natural gas gross exports (billion cubic feet per day)	**10.6**	**11.8**	**12.6**
Shares of U.S. electricity generation			
Natural gas	39%	39%	37%
Coal	20%	17%	17%
Renewables	22%	24%	26%
Nuclear	19%	20%	19%
U.S. GDP (percentage change)	**2.0%**	**0.8%**	**2.1%**
U.S. CO_2 emissions (billion metric tons)	**4.97**	**4.78**	**4.79**

Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook,* February 2023

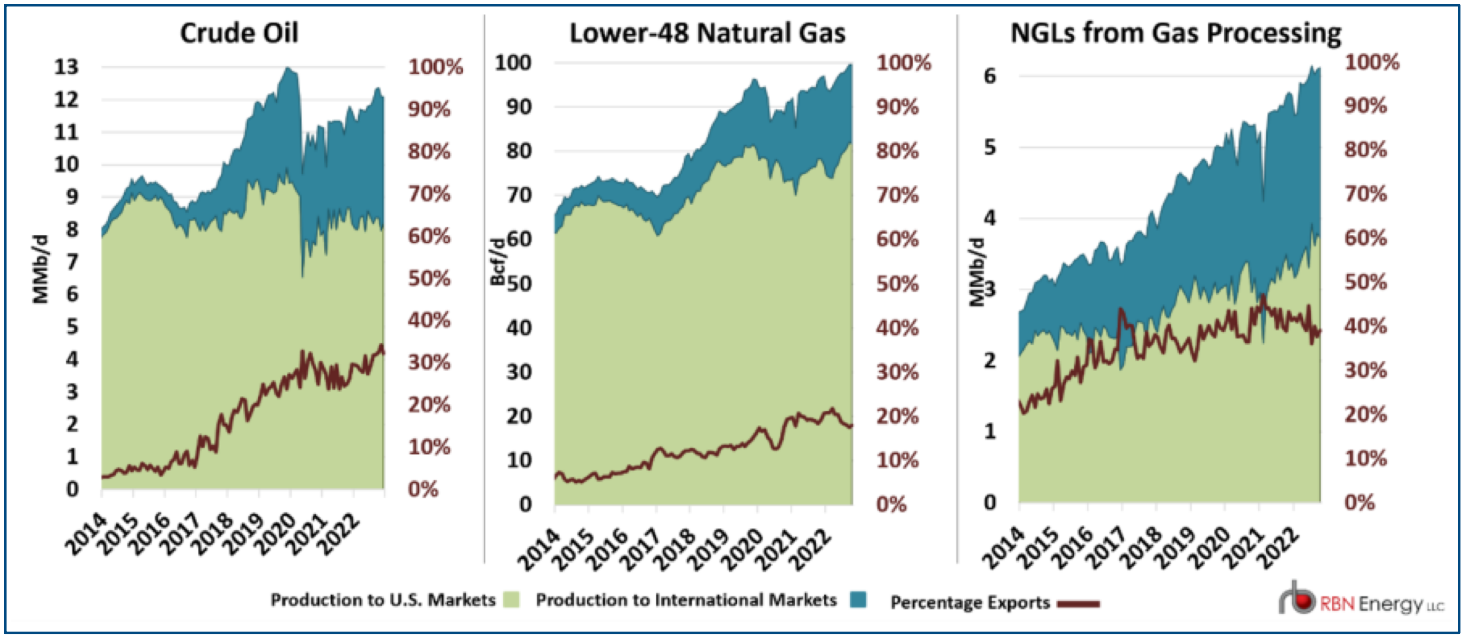
- Expect continued easing of crude, gasoline, and jet fuel prices into 2024
- Moderate increase in natural gas prices
- LNG exports continue to grow



Global oil markets



The US Has Become the Most Influential Player in Global Hydrocarbons Supply



Source: RBN, January 2023

- Surging production and large scale refining capacity
- ~30% of crude, ~20% of gas, and ~40% of NGL production are exported

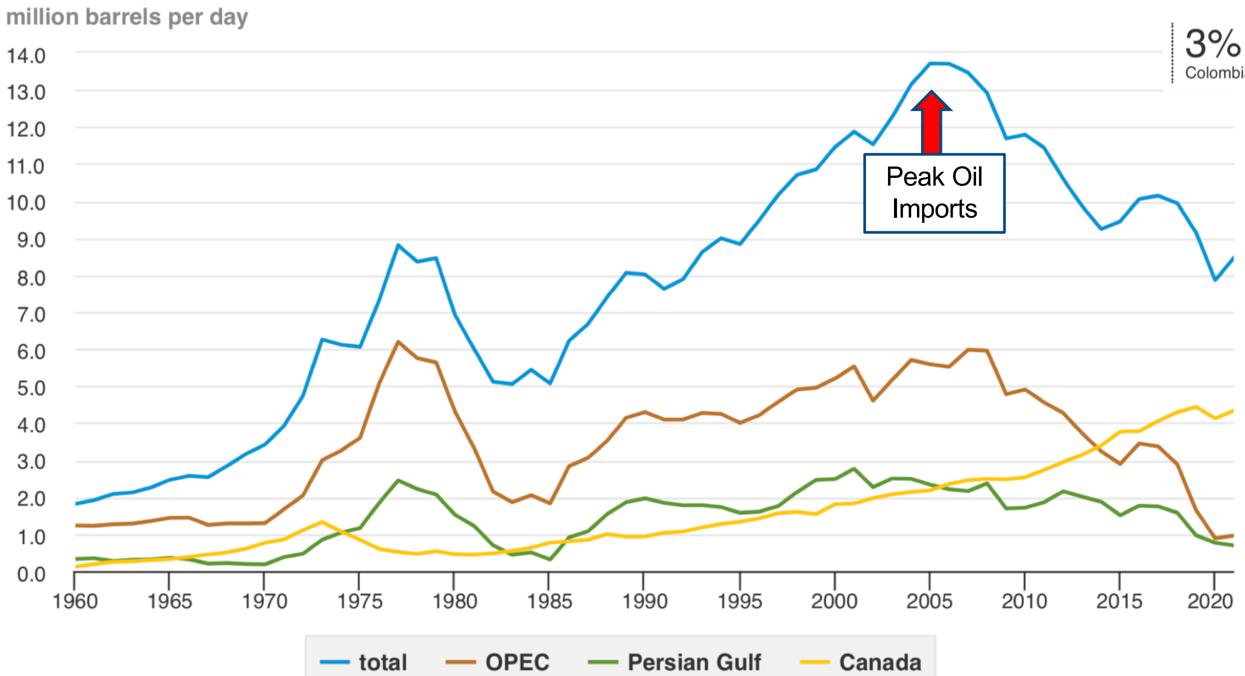
The top five destinations of U.S. crude oil exports by percentage share of U.S. total crude oil exports in 2021 were:

14%	12%	10%	10%	9%
India	South Korea	Canada	Netherlands	China

Source: EIA, October 2022

US Shale + Canadian Oil Sands Has Created *North American* Oil Independence

U.S. petroleum imports: total, and from OPEC, Persian Gulf, and Canada, 1960-2021



eia Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Tables 3.3a, 3.c, and 3.3d, October 2022

The top five sources of U.S. crude oil imports by percentage share of U.S. total crude oil imports in 2021 were:

61% Canada	10% Mexico	6% Saudi Arabia	3% Russia	3% Colombia

- 71% of US oil imports supplied by Canada and Mexico in 2021
- Historical dependency on OPEC, Persian Gulf sources has been eliminated (in 1977, 85% of US oil imports were provided by OPEC)

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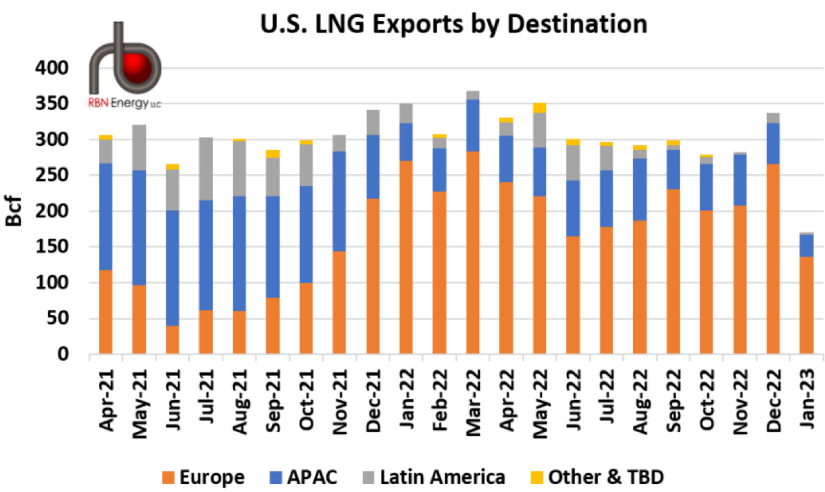
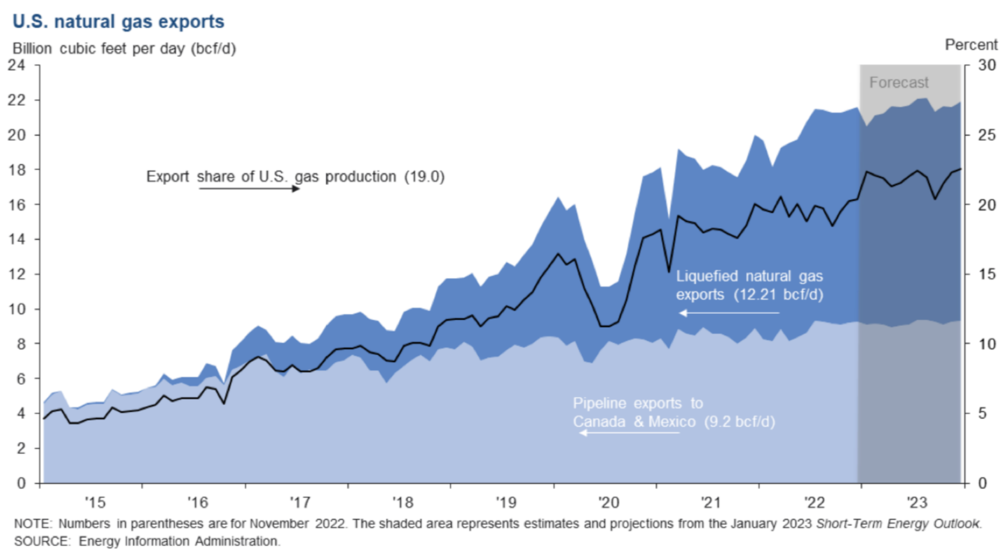
Shale Development: Increasing Domestic Production, Achieving Energy Independence, and Creating an Export Powerhouse in Gas

- Gas production now exceeds 100 Bcf/d
- Significant build-out of LNG export capacity since 2016; Europe has become the top destination
- Current exports roughly split between waterborne LNG and pipeline exports to Mexico and Canada
- Total exports forecasted to be 30% of production by end of 2023
- Primary driver in shift away from coal for electricity generation due to lower cost per kw/h

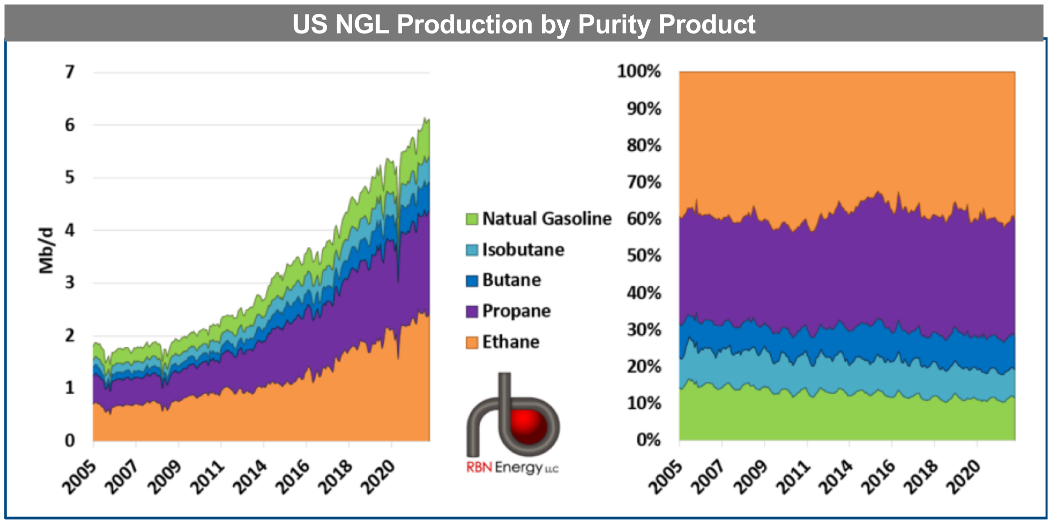


Source: RBN, January 2023

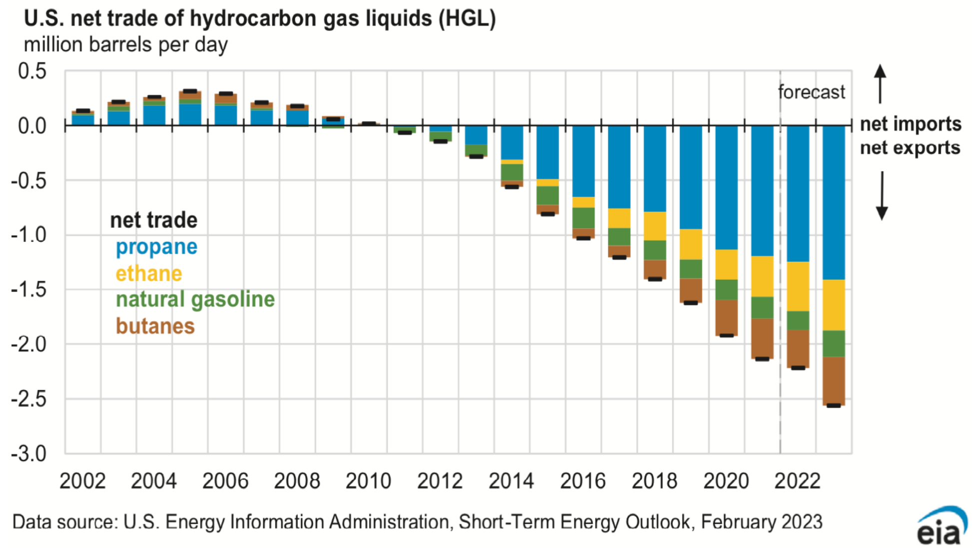


Source: Dallas Fed using EIA data, February 2023

NGLs Continue to Fuel Energy Exports and Domestic Chemical Build-Out

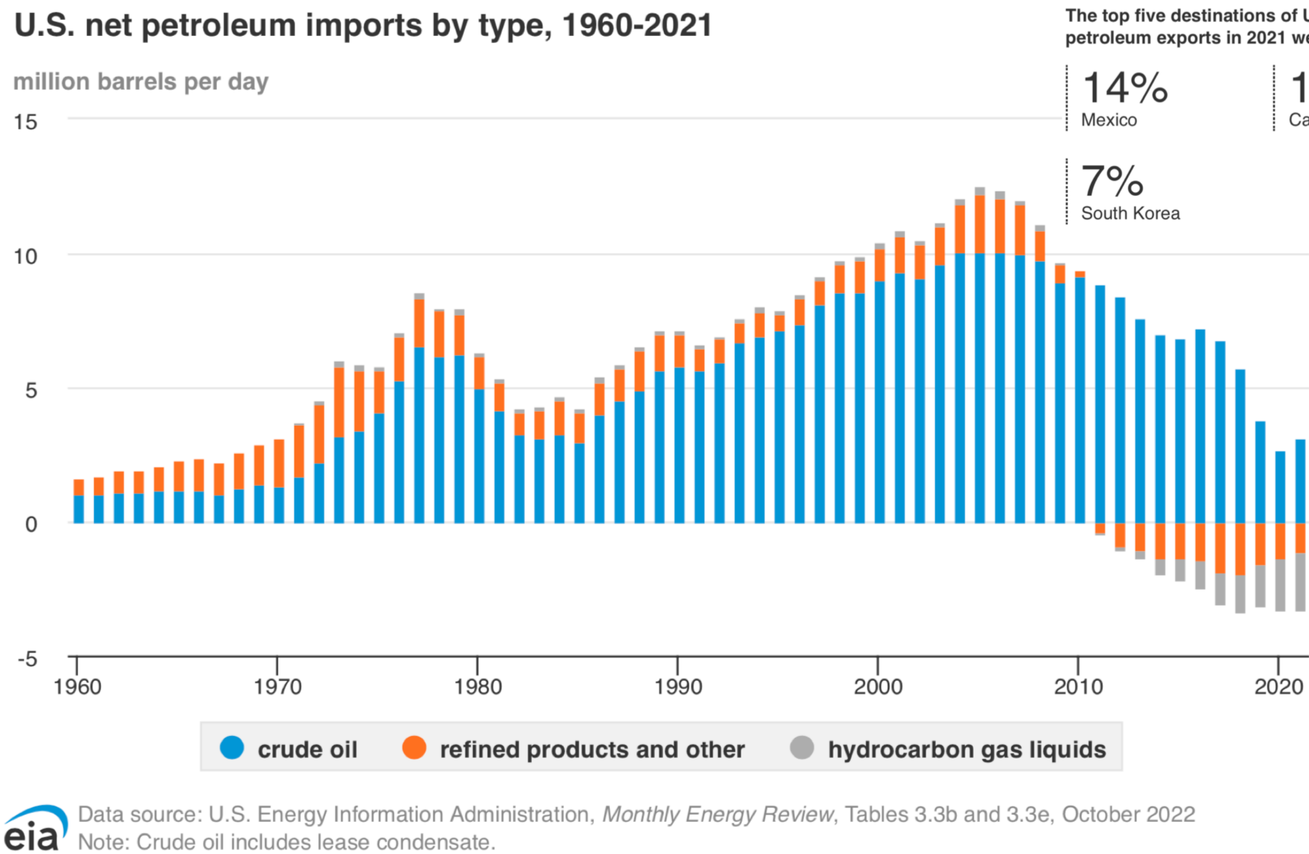


Source: RBN Energy, January 2023



- Final 1-2 projects from second wave of ethane-based US chemical investment may occur by 2026
- More US propane now exported to Asia than consumed domestically

The US is a Critical Supplier of Refined Products

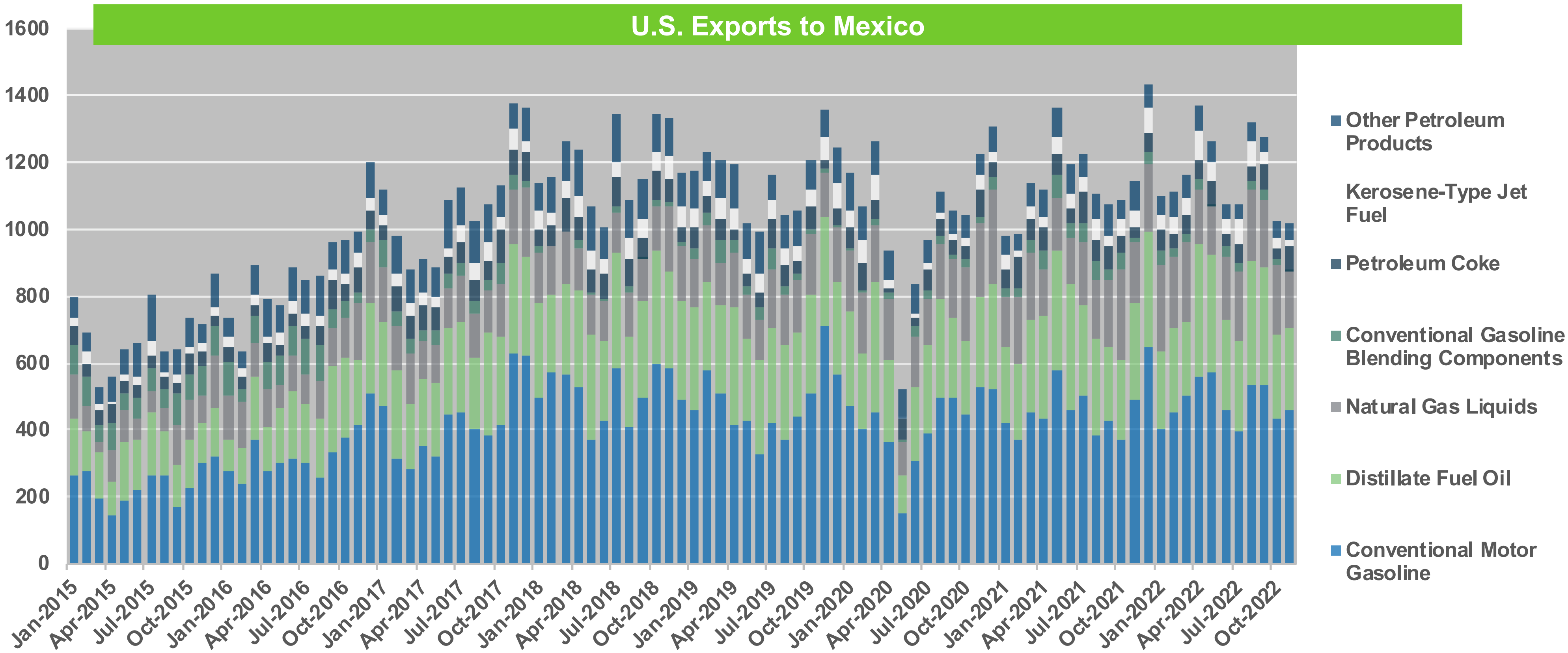


The top five destinations of U.S. total petroleum exports (including crude oil) by percentage share of U.S. total petroleum exports in 2021 were:

14% Mexico	10% Canada	7% China	7% India
7% South Korea			

- Taken together, both crude exports and refined products produced from US and Canadian crudes have made the US a net exporter of petroleum products

US Refined Products Exports Have Been Meeting the Growing Demand for Energy in Mexico



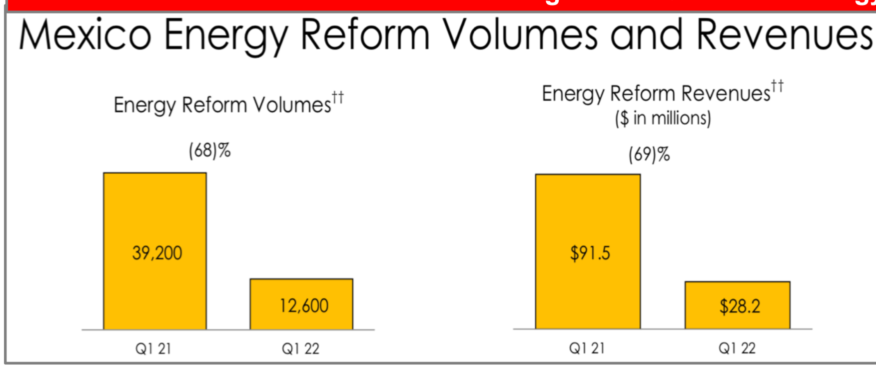
Source: EIA, January 2023

Mexican Energy Reform in Reverse

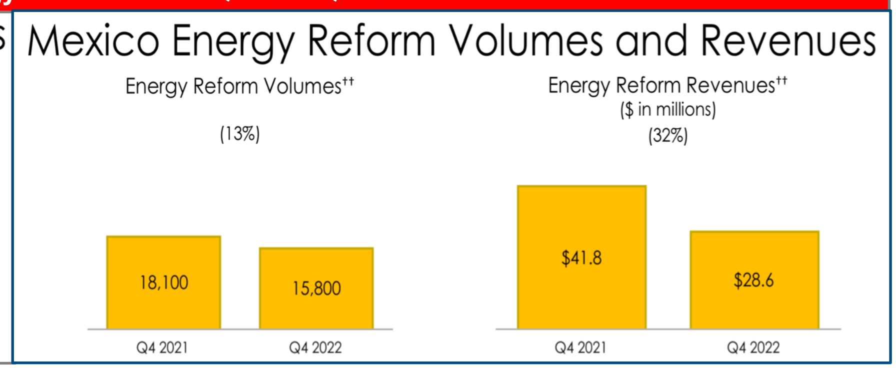
- Goal is to restore monopoly of Pemex and reversal of Mexican energy reforms of 2013-2014, but doubtful that Pemex can meet Mexico's needs
  - Pemex oil production down 75% from 2004 peak
  - Over $100B of debt
  - Refinery operating rates below 50% since 2016

- KCS volumes as proxy for slowdown in US energy by rail volumes to Mexico: Units and revenue down 60% and 69%, respectively, since Q1 2021
  - Government reversal of Energy Reform
  - Increased waterborne market share

Changes in KCS Mexican Energy-Related Traffic Q1 2021-Q4 2022

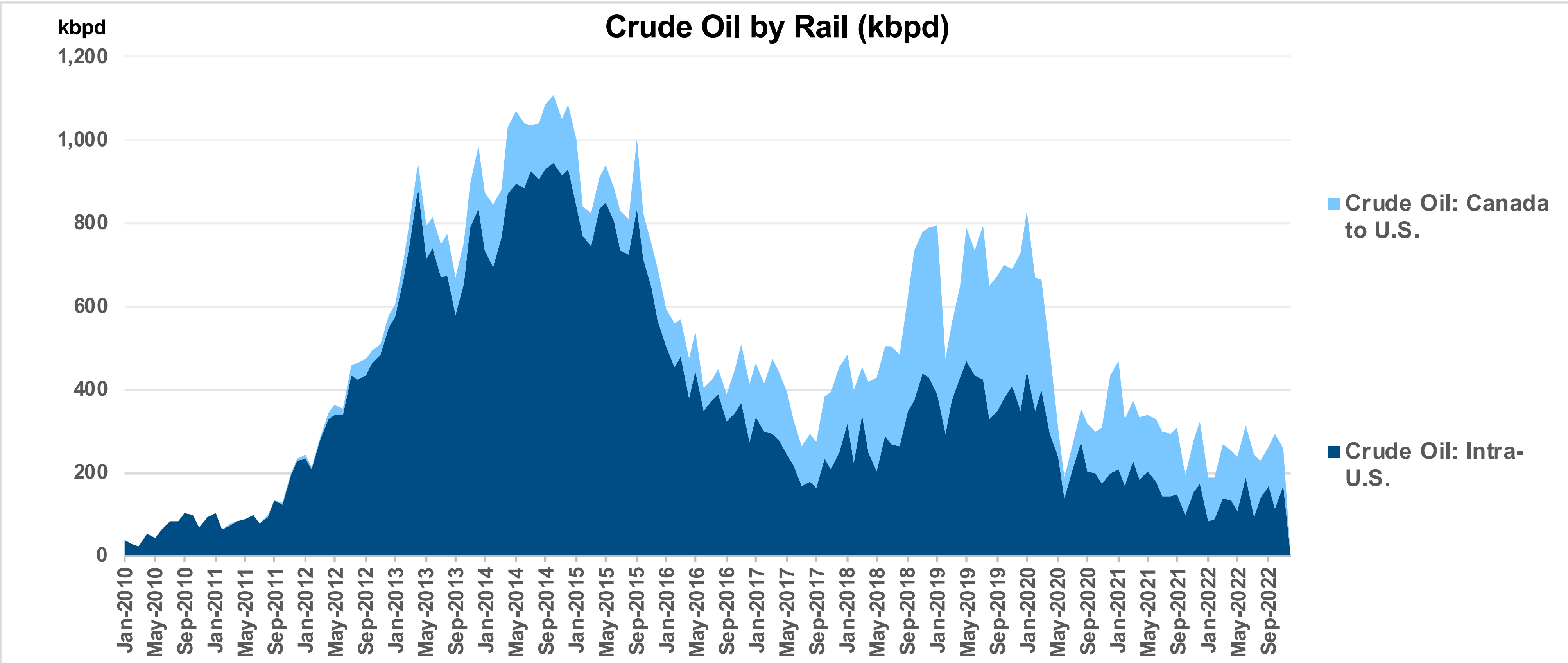


Source: Kansas City Southern Q1 2022 investor presentation



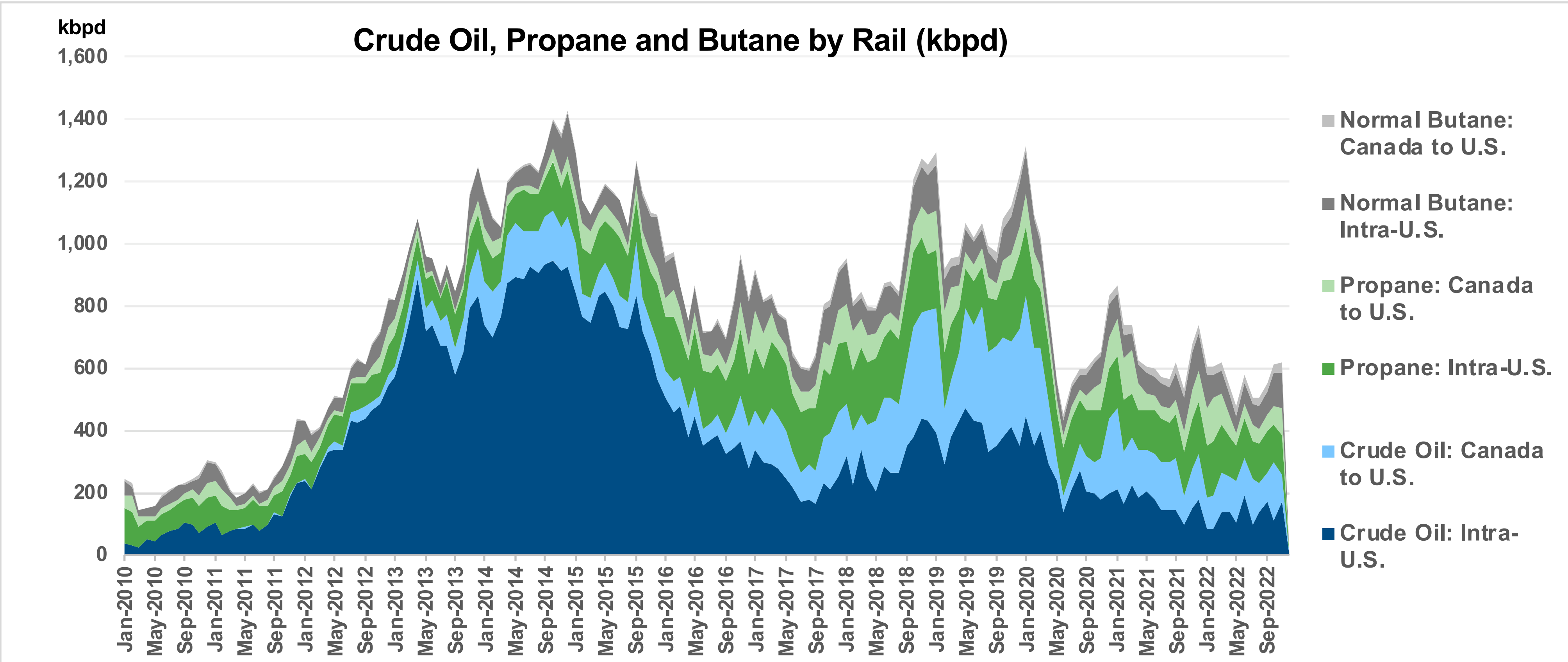
Source: Kansas City Southern Q4 2022 investor presentation

US & Canadian Crude By Rail Volumes



Source: EIA, January 2023; does not include intra-Canada movements

US & Canadian Crude and LPG By Rail Volumes



Source: EIA, January 2023; does not include intra-Canada movements

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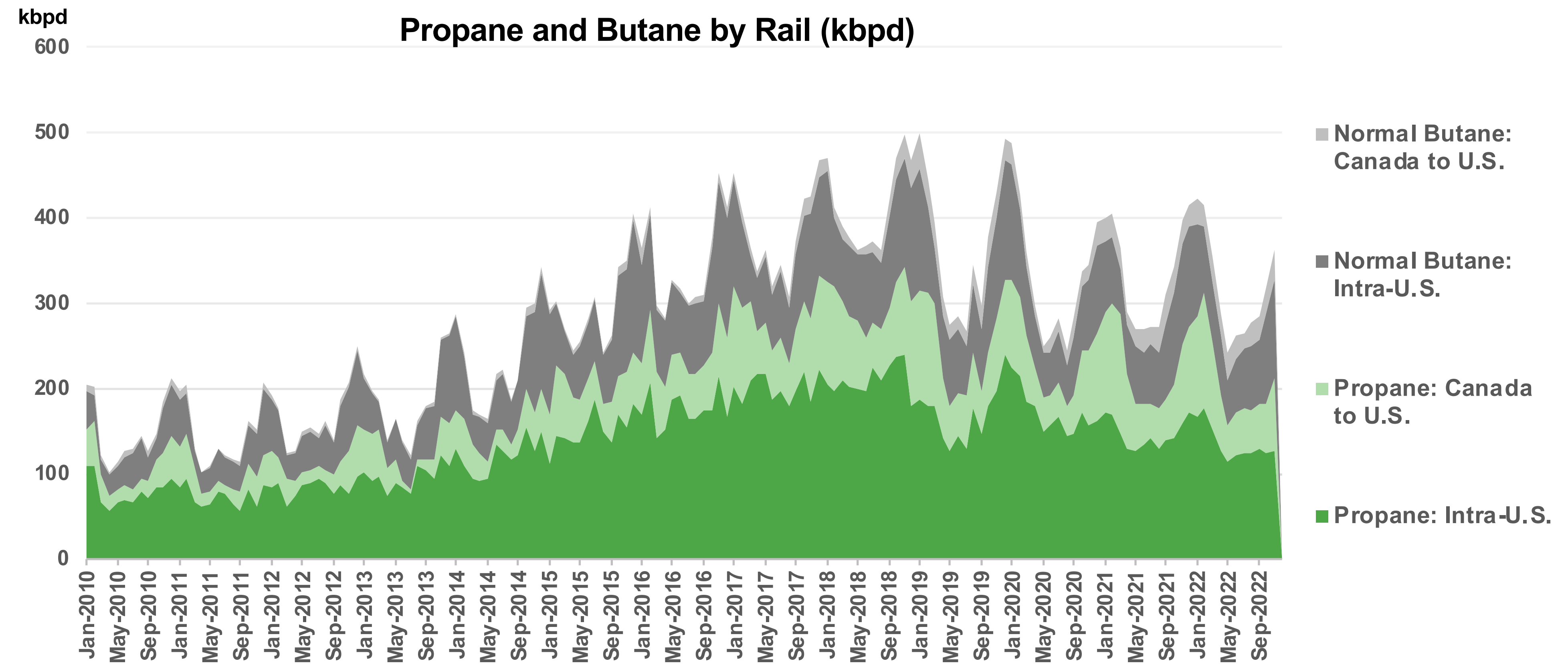
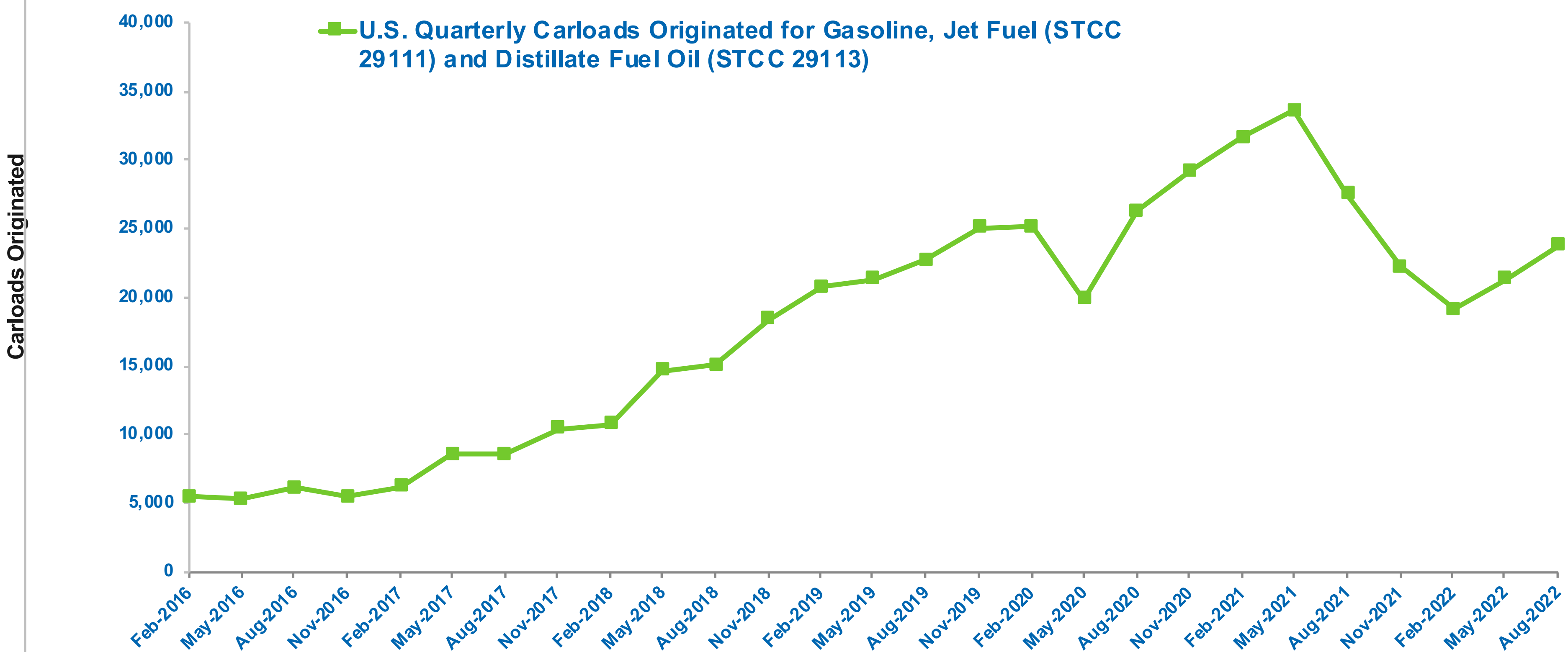
US & Canadian LPG By Rail Volumes



Source: EIA, January 2023; does not include intra-Canada movements

Gasoline, Jet, and Diesel Rail Shipments

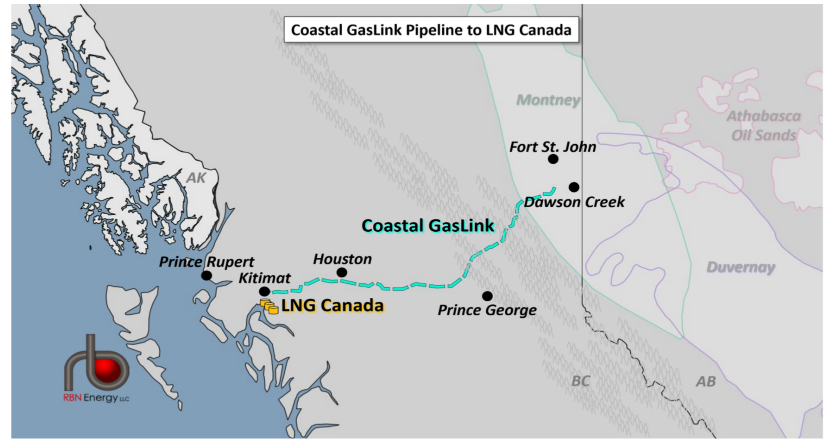
U.S. Class I Carloads Originated for Crude and Selected Petroleum Products



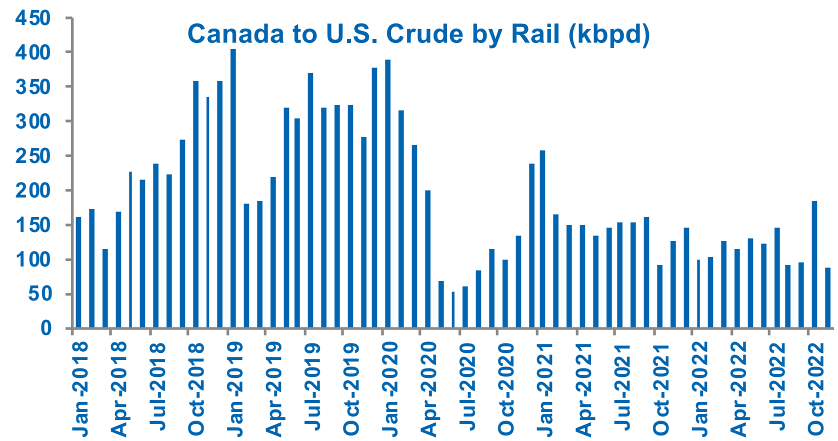
Source: Surface Transportation Board, December 2022

Western Canada Energy Outlook

- TransMountain Pipeline expansion operational late 2023 with net increase of 590 Kbpd targeted for export to US West Coast and Asia (China) – expect WCS and WTI spread to narrow
- Expect very modest increase in production in 2023 from many smaller projects – aggressive greenhouse gas emission reduction targets (including prospect of legislated cap) & carbon pricing has put Canadian producers at competitive disadvantage to US counterparts
- Enbridge Line 3 additional capacity and SPR releases continued to dampen US Gulf Coast demand/price for WCS in 2022, and, by extension, crude by rail
- TC Energy's Coastal Gaslink Pipeline terminating in Kitimat on track for completion later in 2023 -- LNG Canada export facility is targeting 2025 startup



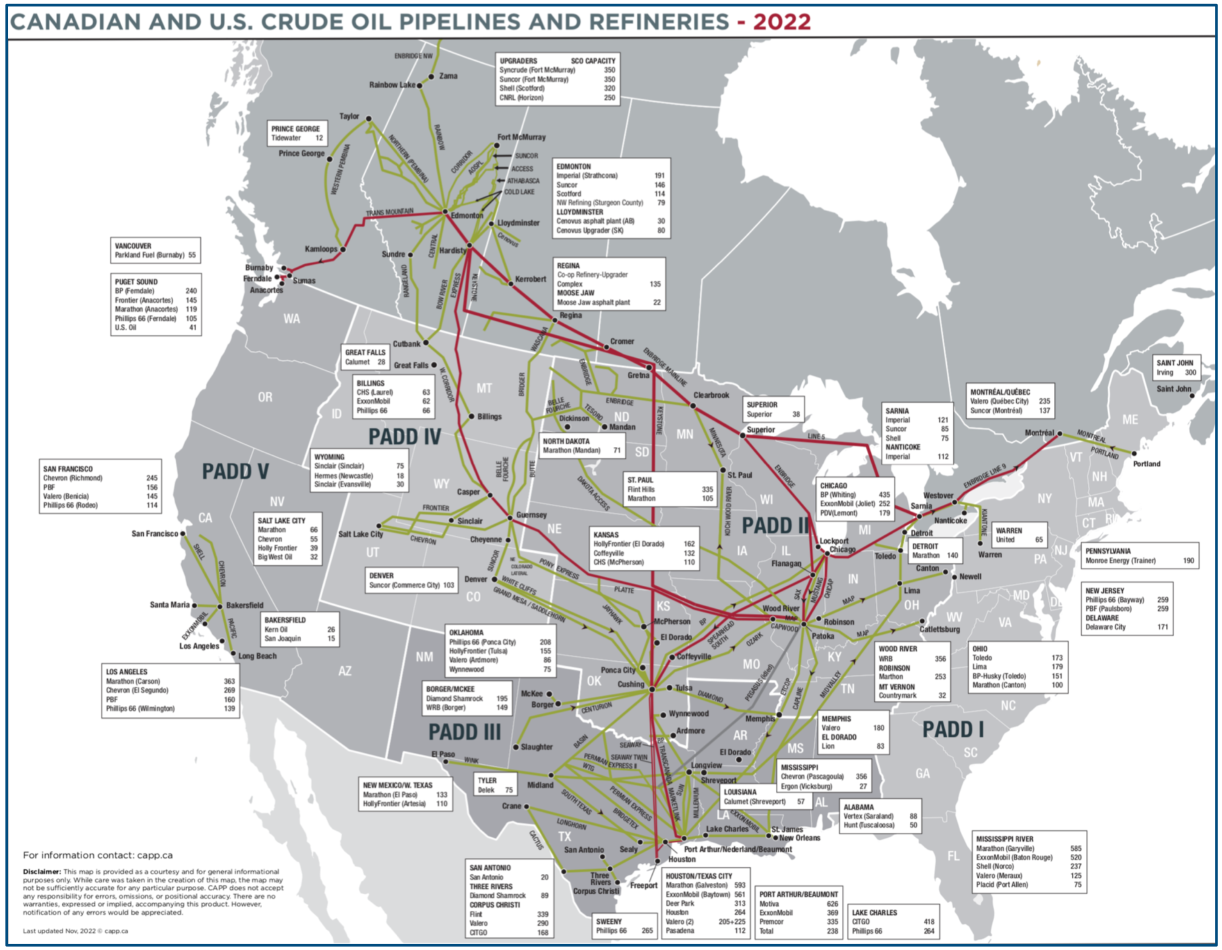
Source: RBN Energy



Source: EIA and PLG Analysis, February 2023

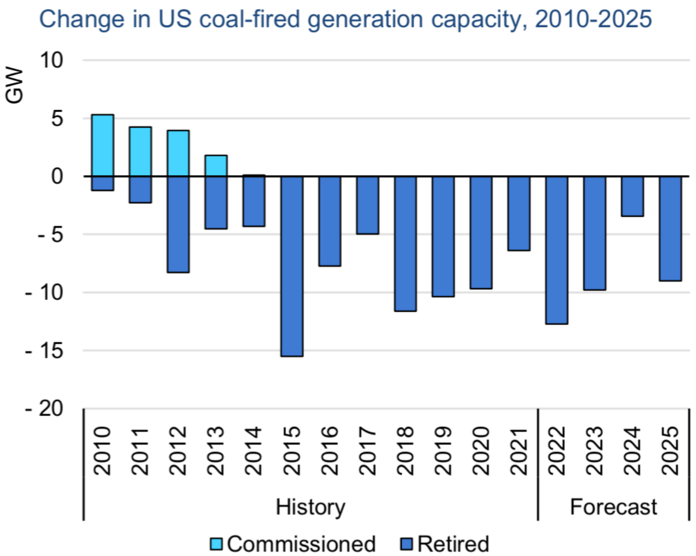
Pipeline Developments

- Crude oil pipelines from Permian Basin to Corpus Christi expected to reach capacity in 2023, increasing exports via Houston
- State of Michigan efforts to shut down Line 5 (crude and NGLs) under Straits of Mackinac will create incremental rail volumes if successful

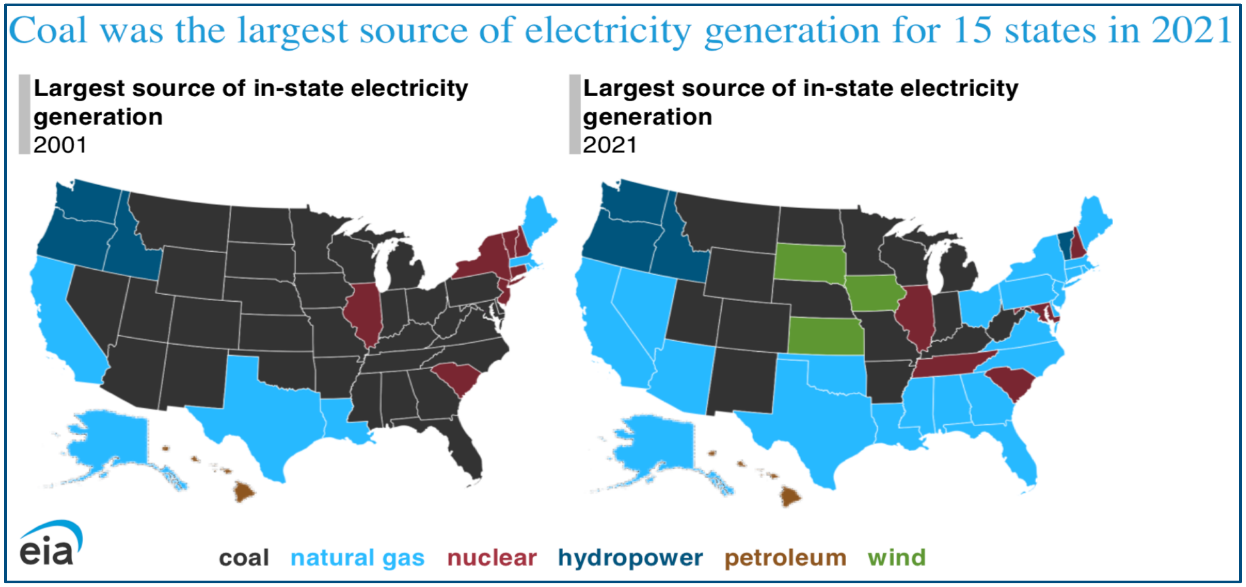


Source: CAPP, November 2022

Despite Temporary Reprieve in 2022, Thermal Coal Use Continues to Decline



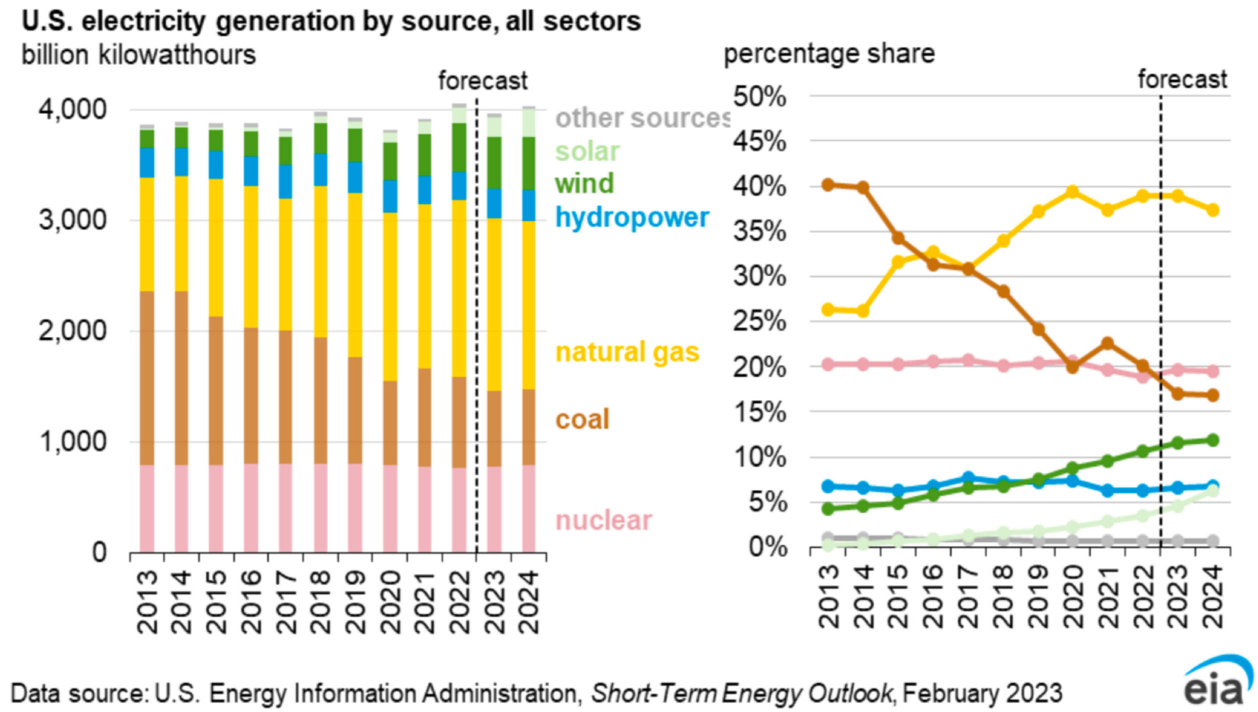
Source: IEA, December 2022



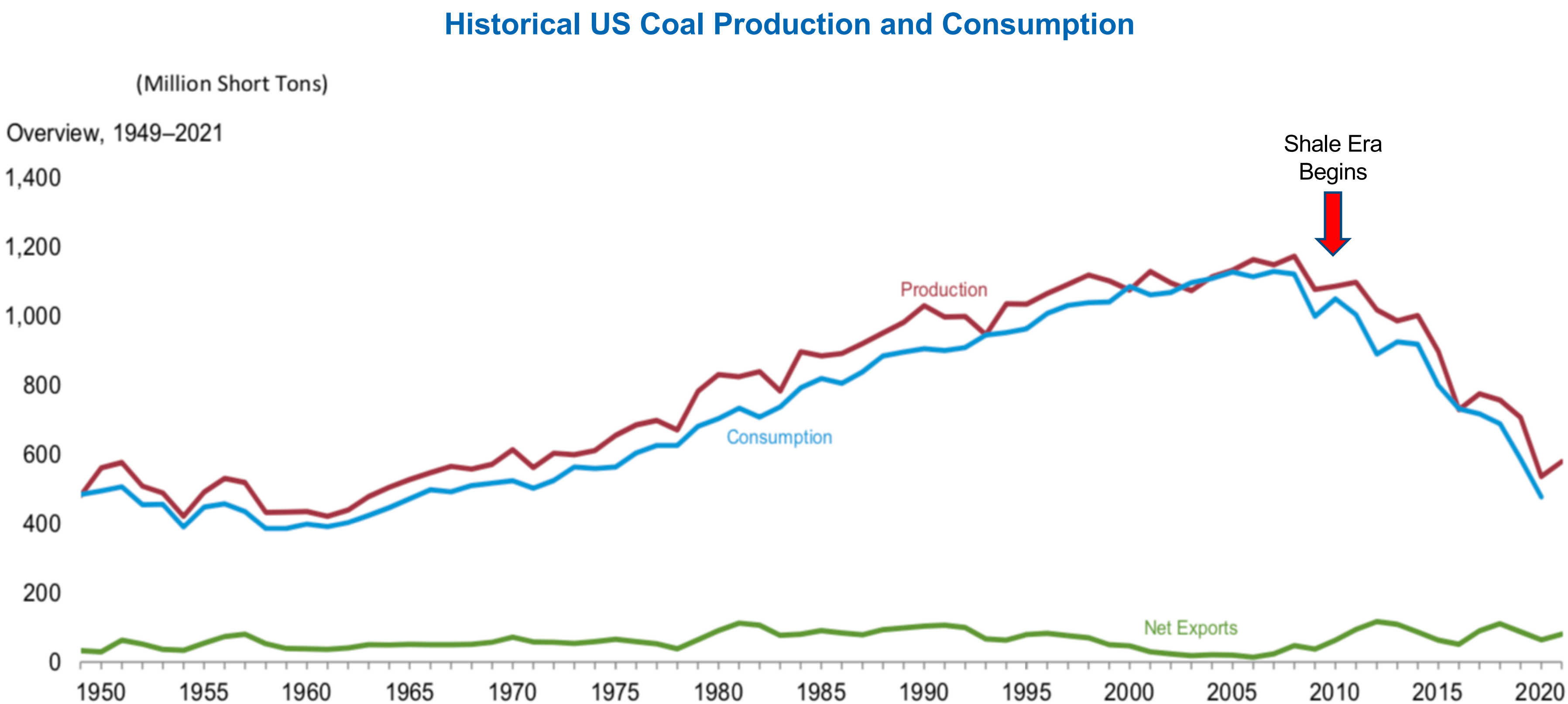
Source: EIA, December 2022

Surging Natural Gas Production and Growth of Renewables for Electricity Generation

- Natural gas production is expected to surpass 100 Bcf/d in 2023
- Primary driver in shift away from coal for electricity generation due to lower cost per kw/h
- Natural gas a bridge fuel to lower carbon fuels, but may have longer runway now due to new carbon capture and sequestration (CCS) incentives

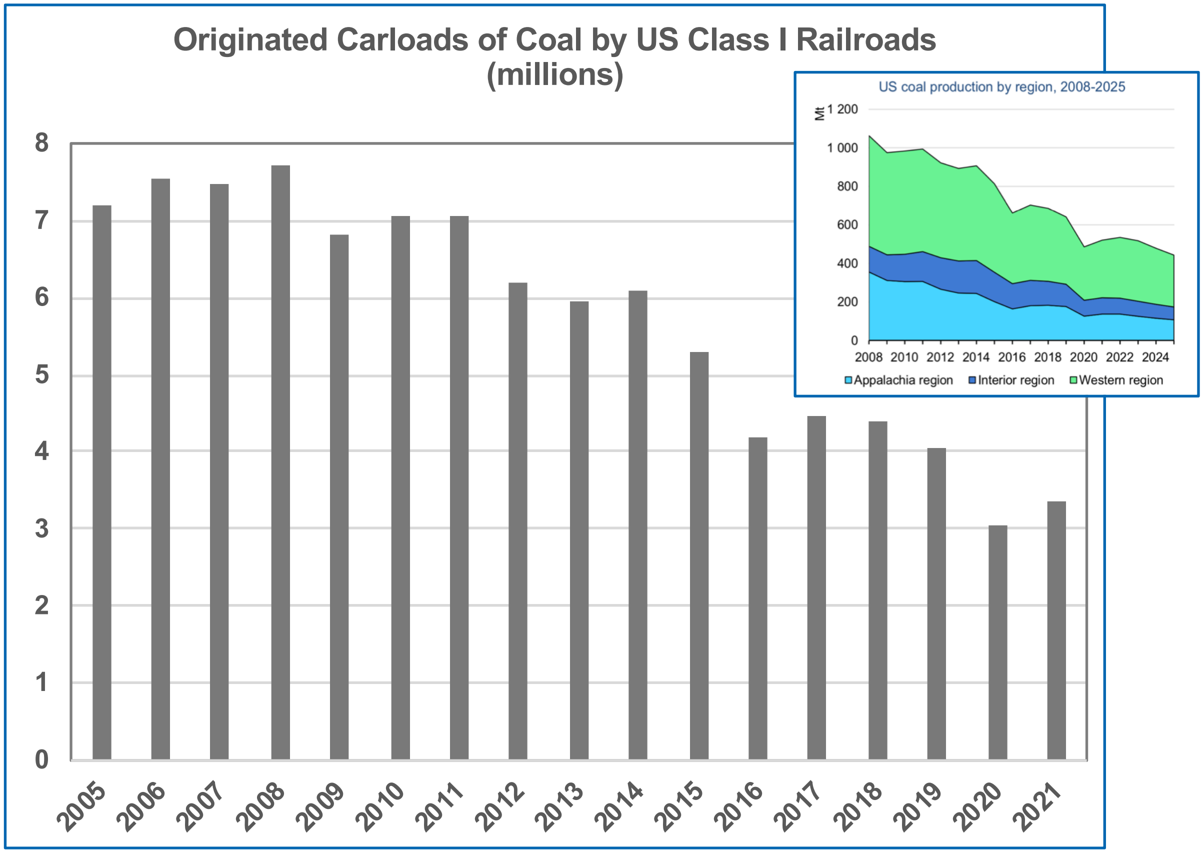


Arguably the "Starting Point" of Decarbonization



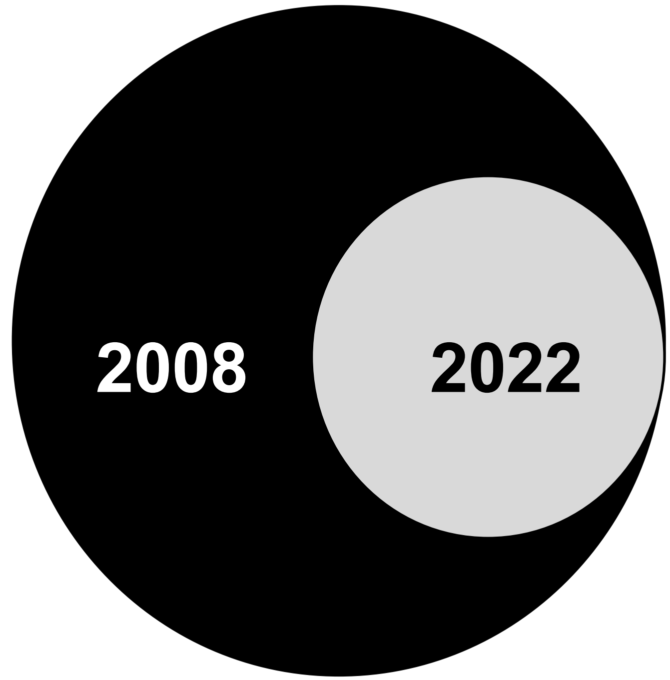
Source: EIA, February 2022

Coal Carloads Down Significantly From 2008 Peak



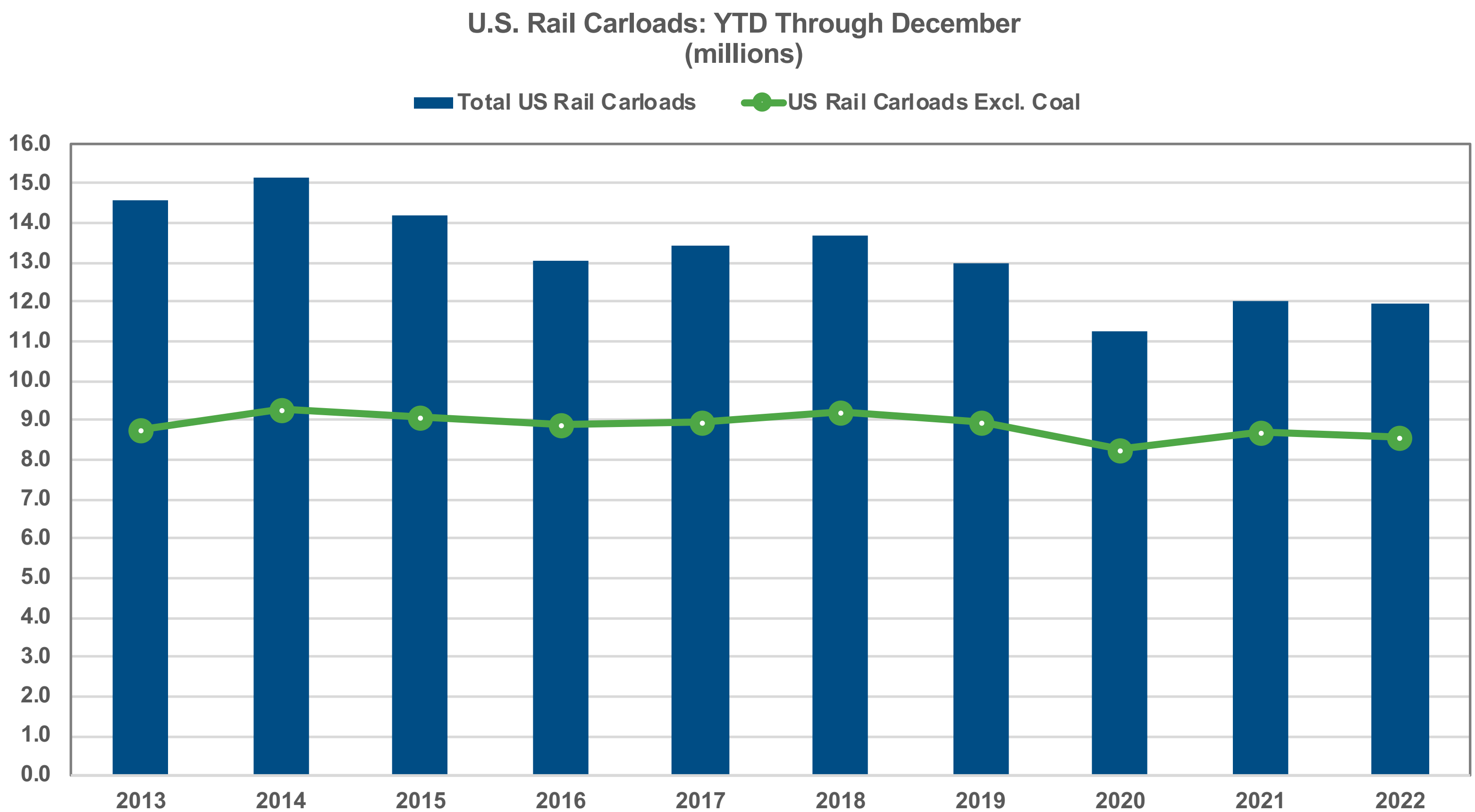
Source: PLG analysis using AAR data; inset chart: IEA, December 2022

Proportionality of 2008 vs. 2022 US Rail Carloads of Coal



Source: AAR, STB, PLG analysis

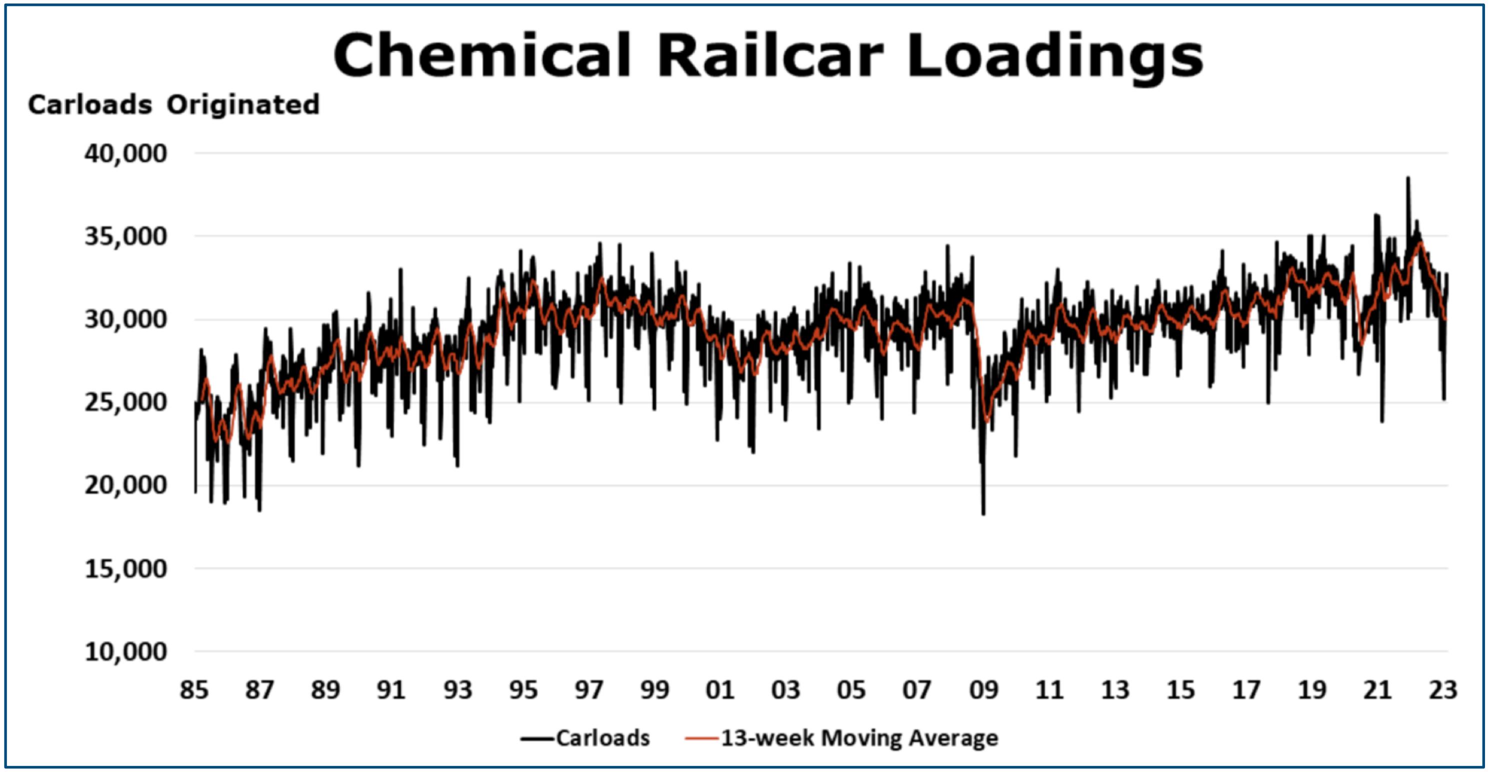
Coal Carloads Still a Critical Source of Rail Traffic



Source: PLG analysis using AAR data, March 2023

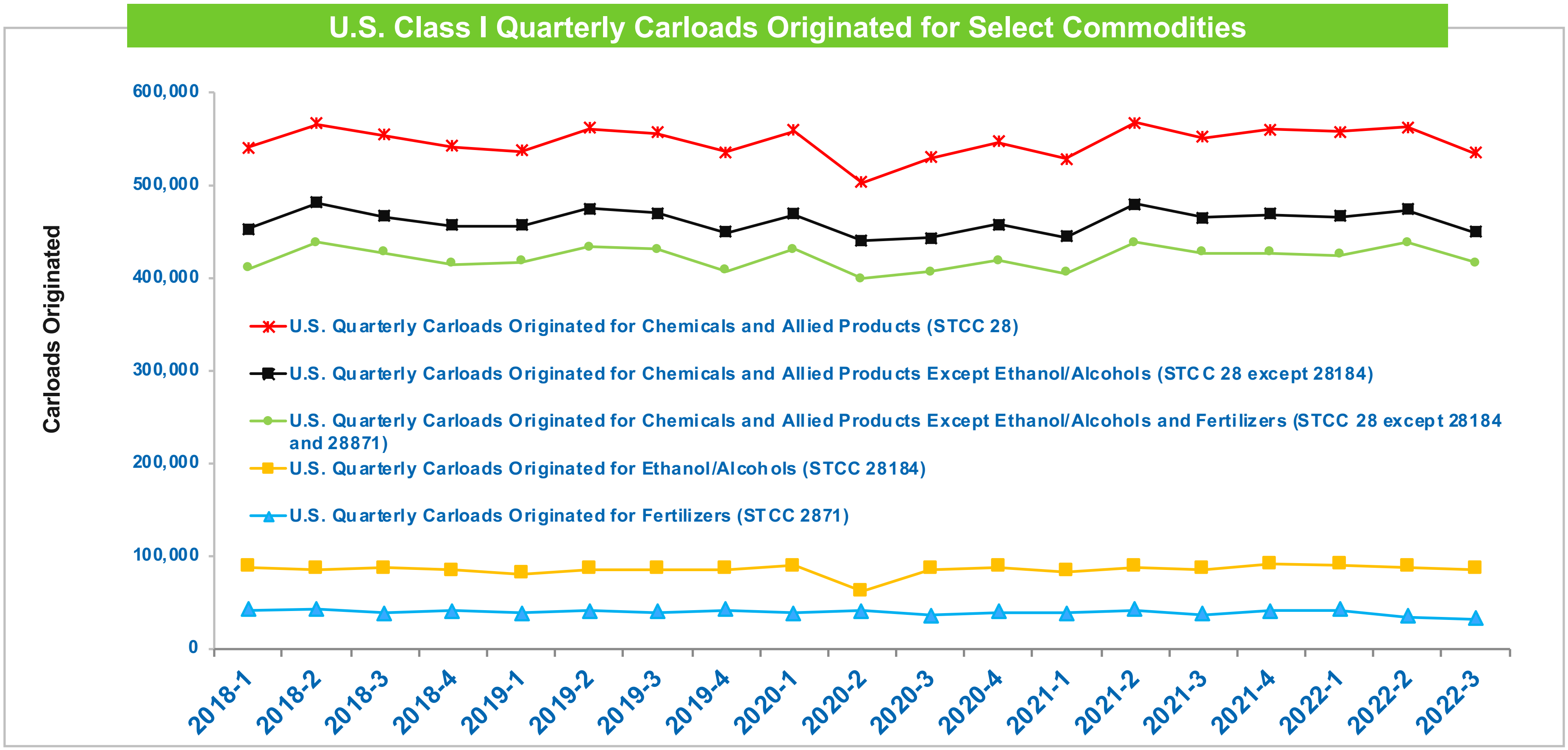
Chemicals Continue to Represent Attractive, Steady Growth Volume for Railroads

- "Chemicals" standard transportation commodity code (STCC) 28 actually comprises a broad range of products, including ethanol, fertilizer, and resins



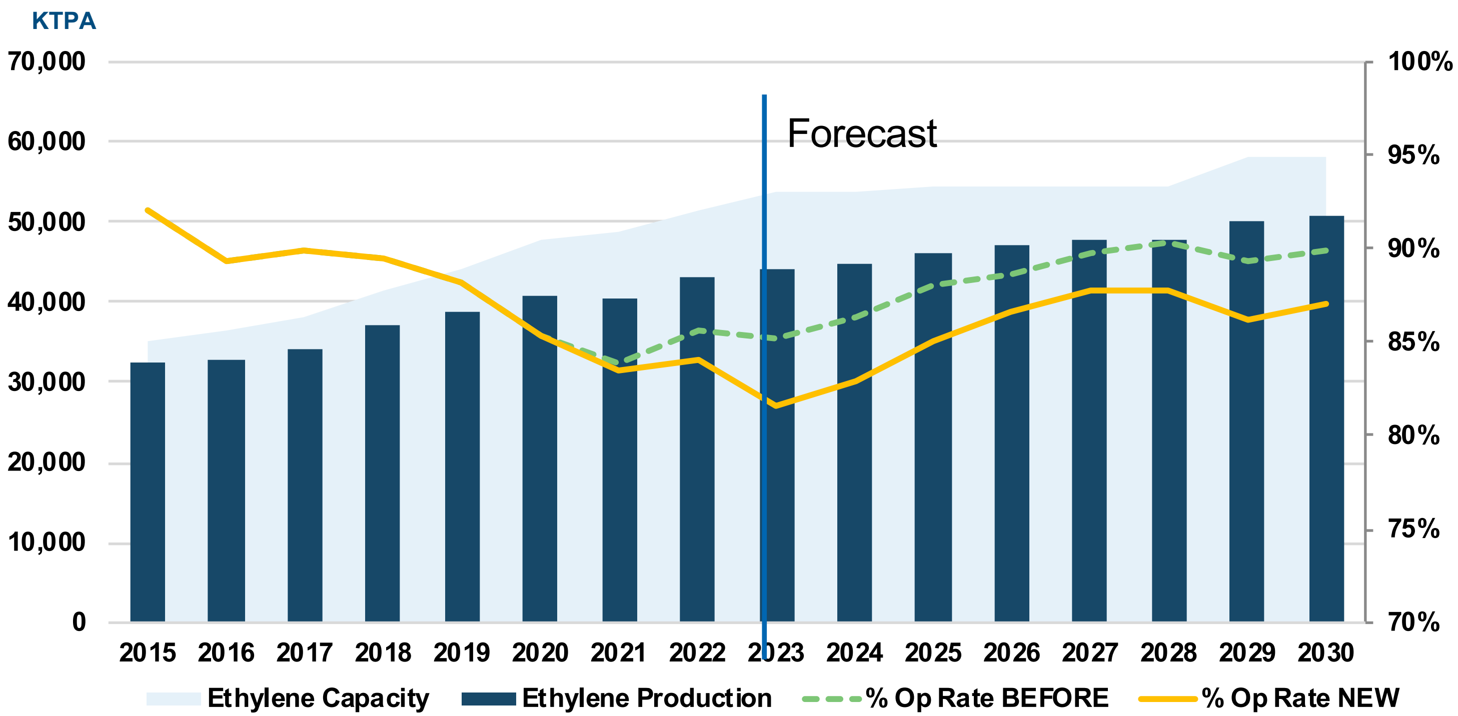
Source: American Chemistry Council using AAR data, February 2023

Primary Components of “Chemicals” STCC 28



Source: Surface Transportation Board, February 2023

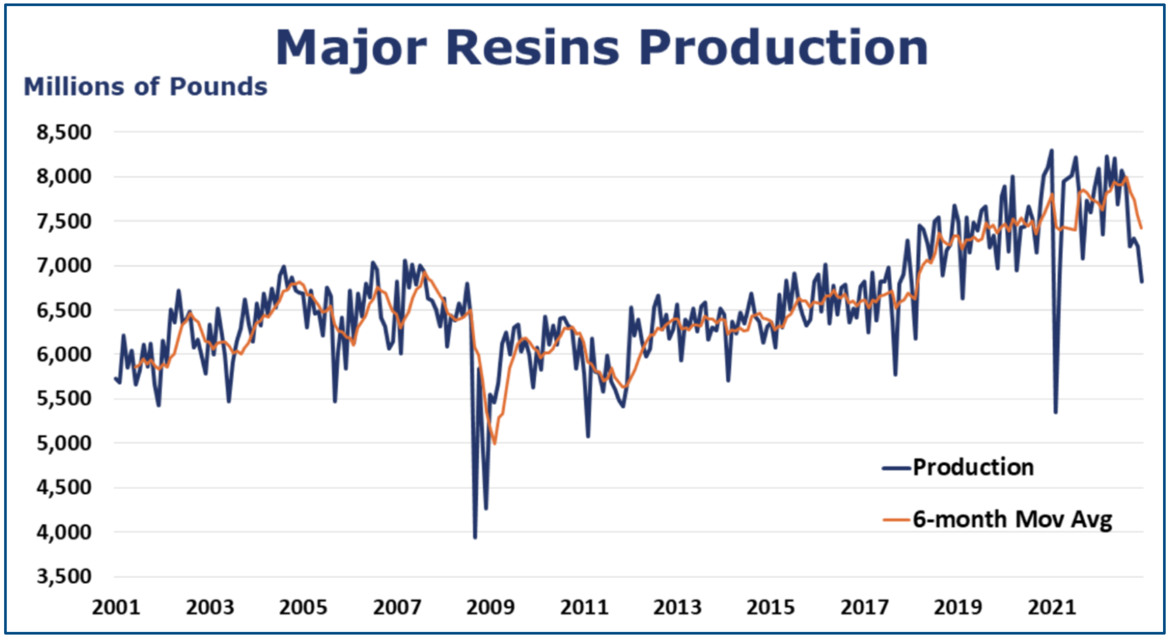
North American Ethylene Capacity & Production



Source: PLG, February 2023

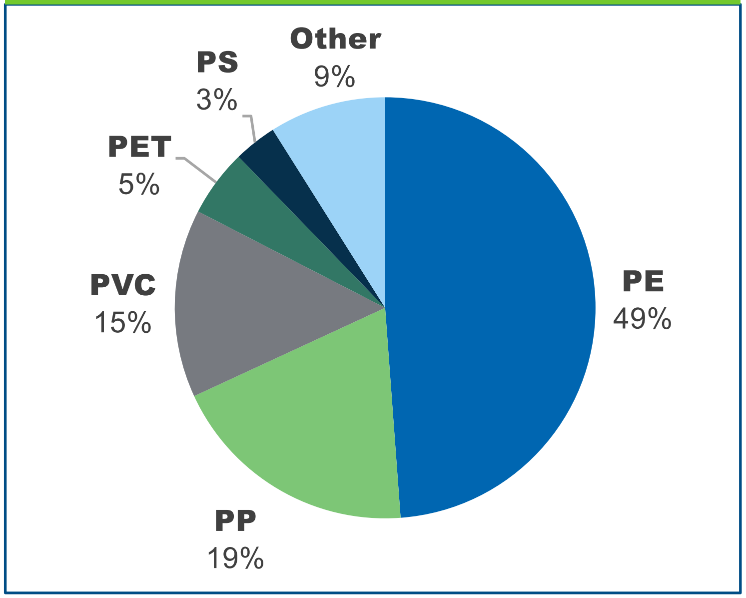
- "Third wave" might come by the end of this decade, including new potential projects from Enterprise (ethane-ethylene) and LyondellBasell (polyethylene)
- For now, deferral of Third Wave is keeping operating rates at reasonable levels
- Actual operating rates affected by supply chain constraints and lower demand
- However, fundamentals of US low cost ethane will persist and potentially spur new investment

Plastics Continue to Provide Steady Growth as a Rail Commodity



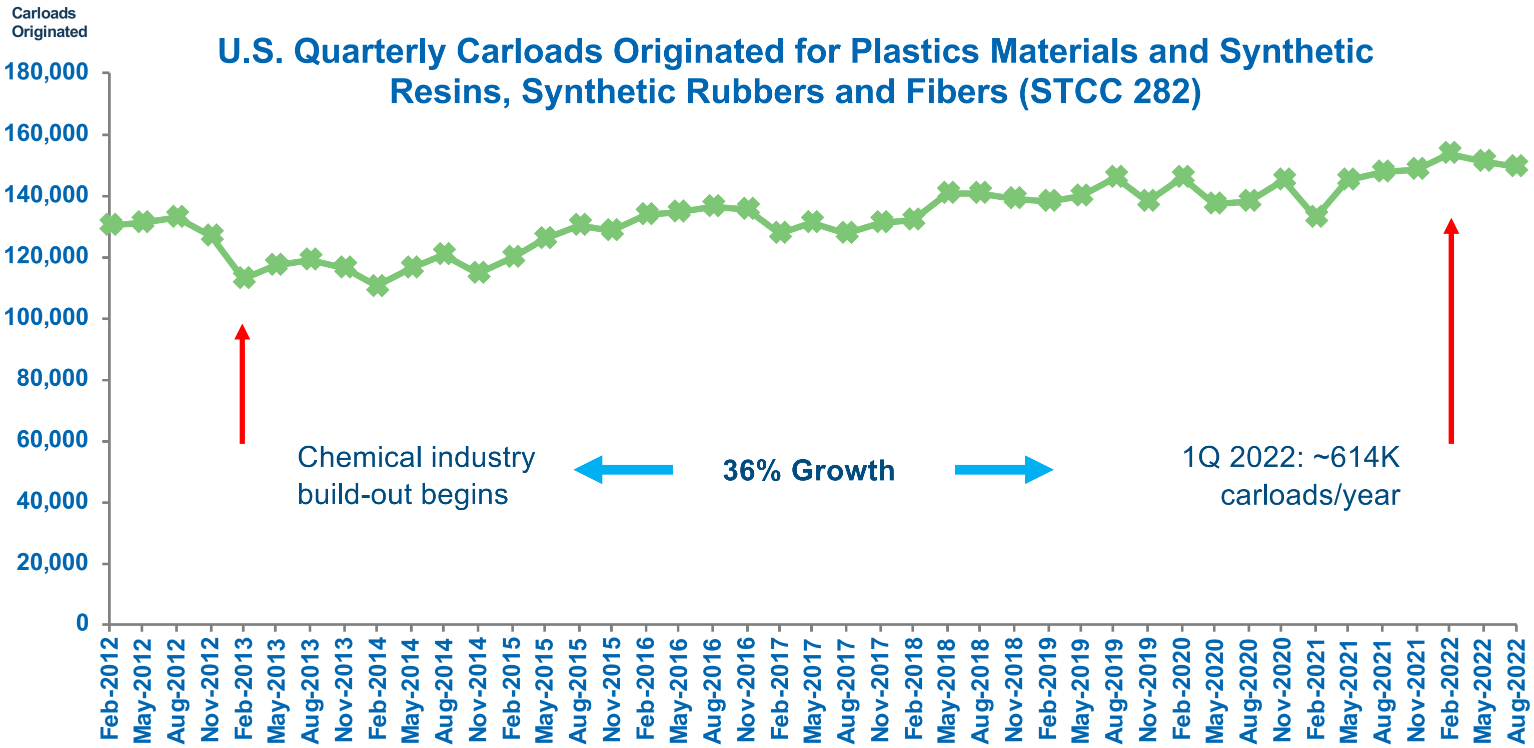
Source: ACC, February 2023

2021 Plastic Resin Carloads by Resin Type (STCC 282)



Source: PLG analysis using STB data, February 2023

Plastic Resin Related Railcar Originations



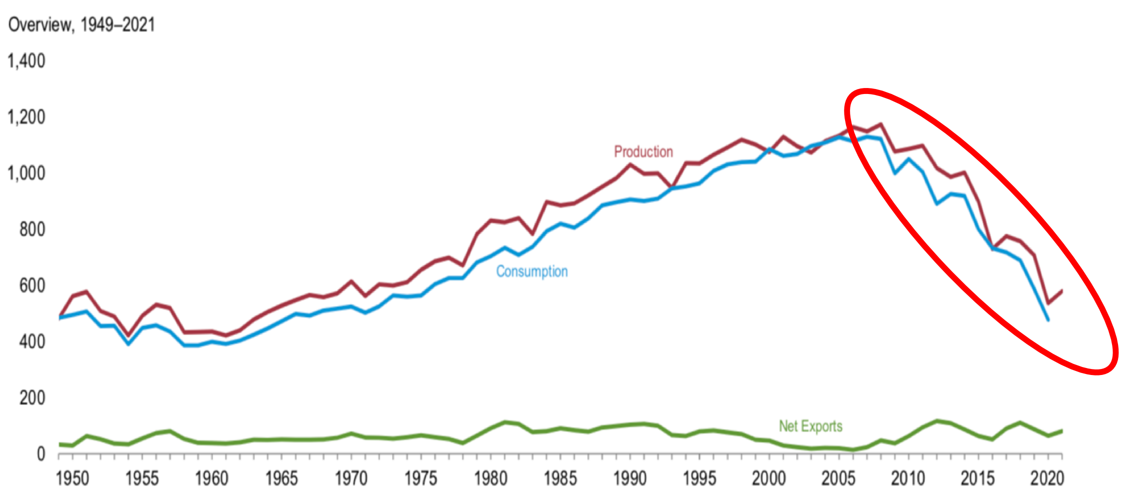
- Expansion of US plastics production continues to be export-oriented
- Except for certain plants, most new volume moving via rail to packagers, ports

Source: Surface Transportation Board, February 2023

Selected Impacts of the "Decade of Shale"

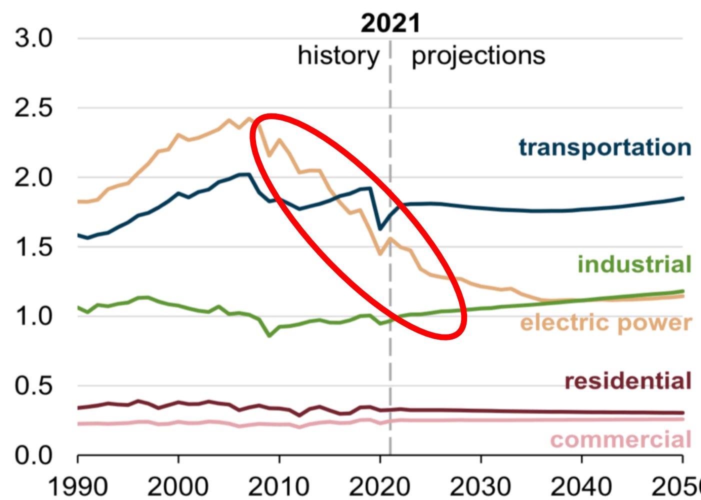
Historical US Coal Production and Consumption

(Million Short Tons)



Source: EIA, February 2022

Energy-related CO_2 emissions by sector
AEO2022 Reference case
billion metric tons



Source: EIA, April 2022

Decarbonization Requires Multiple Transitional and Future Fuels, Along with CCS

2010s (The Shale Era)		2020s	2030s & Beyond
Crude – Transportation fuels	Gasoline (Light Duty Vehicles)	Gasoline	Gasoline/Electric
	Diesel (Trucks)	Renewable Diesel	Hydrogen/Electric
	Bunker Fuel (Ships)	IMO 2020 LSMFO	Ammonia/Methanol
	Jet-A (Airplanes)	Jet-A/R-Jet	SAF

Gas – Electricity generation
- Gas + Renewables
- Renewables + Gas + GH2 + Green Ammonia + E-Methanol

NGLs – Power, heating, chemical feedstocks
- NGLs + GH2 + Green Ammonia + E-Methanol

All Refining & Process Industries: Carbon Capture & Sequestration

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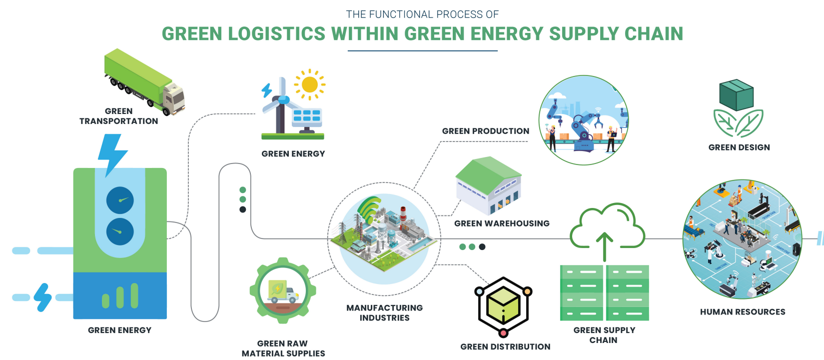
Green Energy Supply Chains (GESC)

GREEN ENERGY INDUSTRIES & THEIR SUPPLY CHAIN DEVELOPMENT STAGES

FORMING	SCALING	MATURING/MATURE
Offshore Wind Green Hydrogen Fuel Cell Vehicles (Class 6 & 8 Trucks) ★ Energy Storage (New Technology Batteries) ★	Electric Vehicles (Light Duty) ★ EV Batteries (Lithium Ion) ★ Renewable Diesel ★ Renewable Natural Gas (RNG)	Commercial Solar Onshore Wind ★ Ethanol (Mature) ★ Hydropower (Mature)
These categories are in the earlier stages of development potentially with proof of concept still being carried out, low-volume pilots, and high-volume infrastructure being planned or built in future years.	These industries have proven technologies and production /assembly processes with infrastructure build-out in process.	These industries have mature designs that have been produced in high-volume and have significant infrastructure in place.

- Paths to market for each are varied in time and cost
- Significant challenges exist to achieving pledged or net-zero emissions goals

★ Multiple opportunities exist for rail to participate in these supply chains



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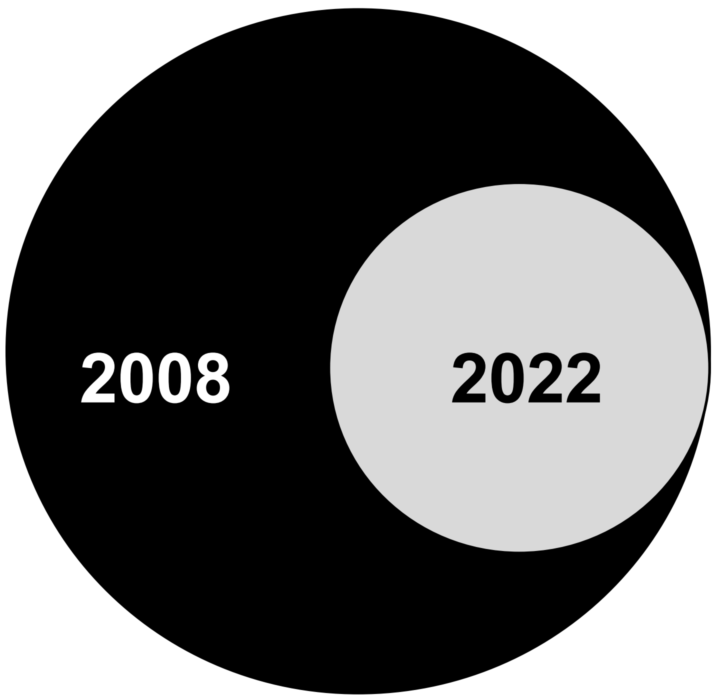
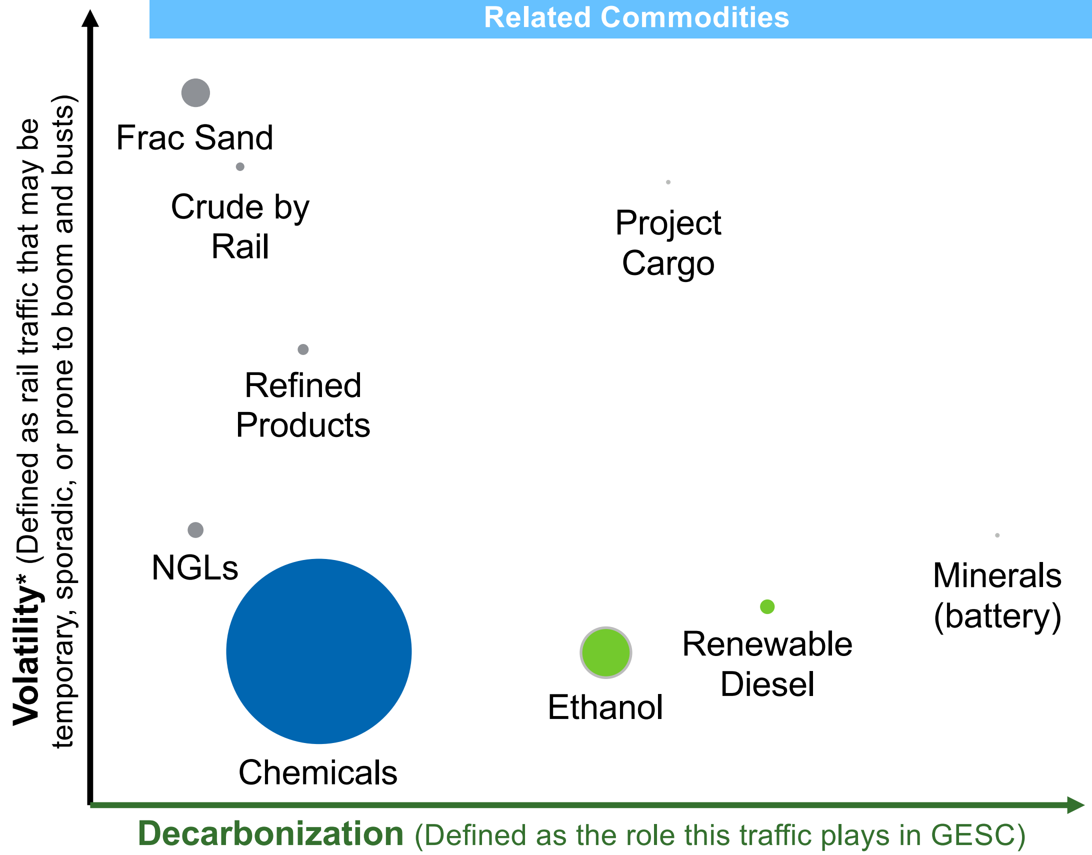
Perspective: Comparing Downstream and GESC Rail Volumes Relative to Coal

Proportionality of 2008 vs. 2022 US Rail Carloads of Coal

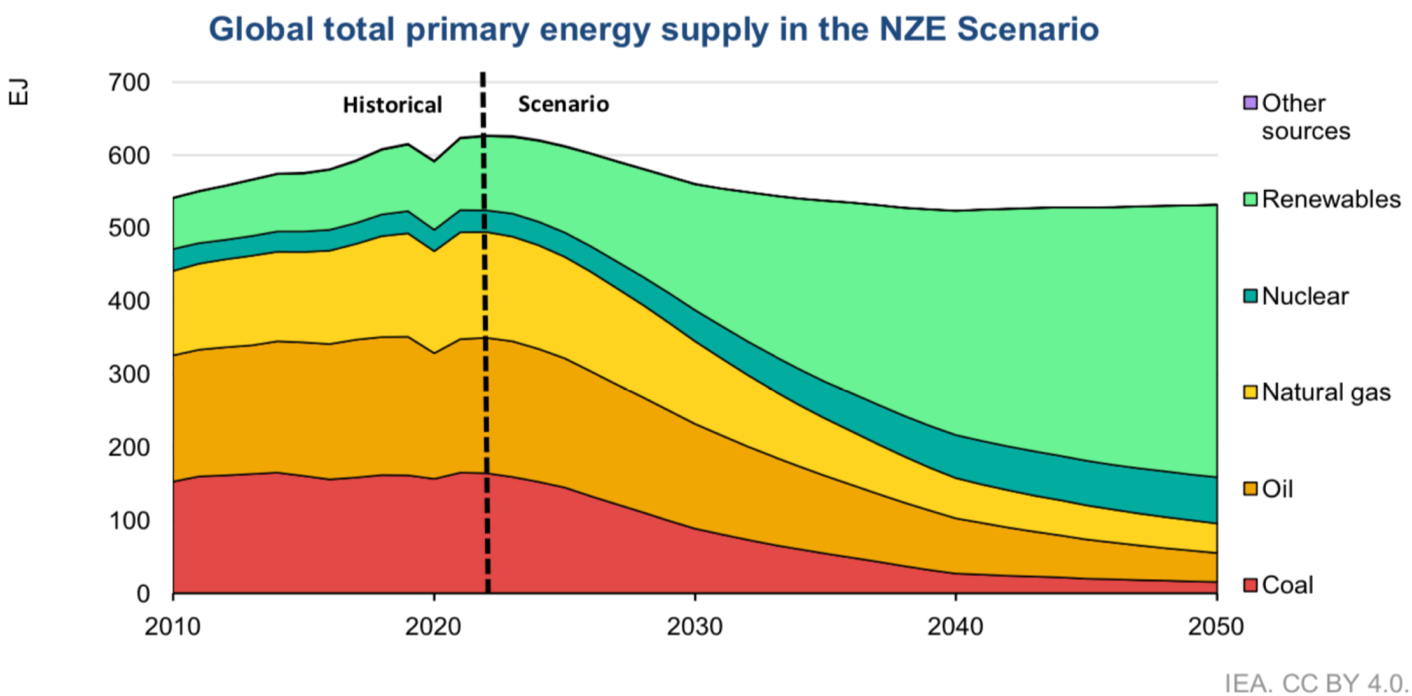


Proportionality of Approximate 2022 Carloads of Other Energy-Related Commodities



Source: AAR, STB, PLG analysis

Goal of Net Zero Emissions (NZE) Will Require Massive Transition and Investments



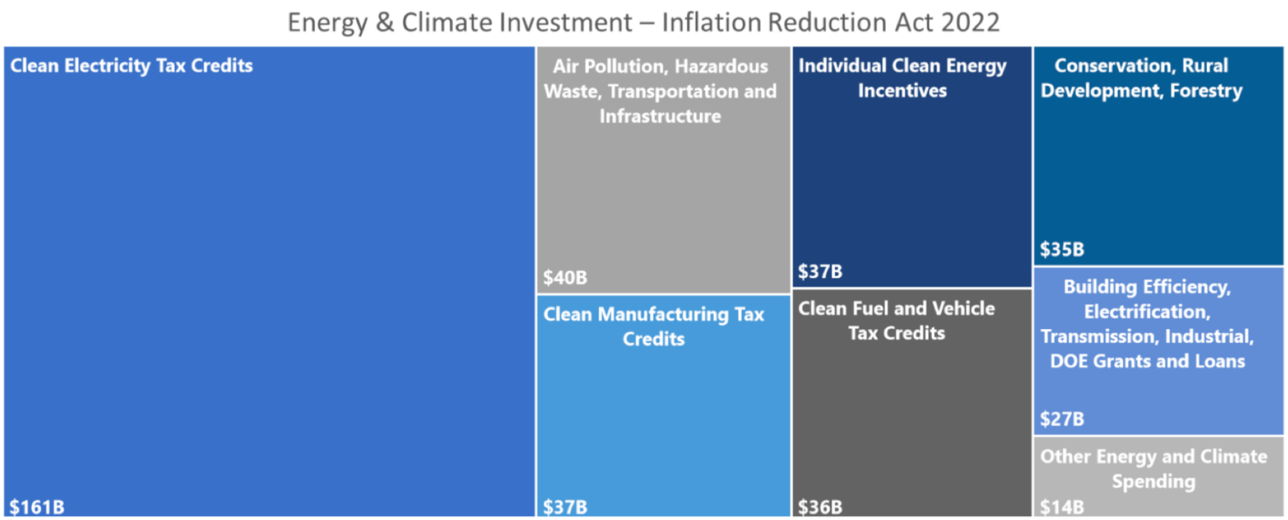
- Transition will require about $650B in investments annually by 2030
- IEA: Most developed economies are acting to combine climate, energy security, and industrial policies

Renewables and nuclear displace most fossil fuel use in the NZE Scenario, with the share of fossil fuels plunging from almost 80% in 2021 to less than 20% in 2050.

Source: IEA, January 2023

The Game Changer: Inflation Reduction Act of 2022

HOW IS THE INFLATION REDUCTION ACT DIVIDING THE INVESTMENT?



-40%

THROUGH DIRECT INVESTMENT, TAX INCENTIVES, AND LOAN PROGRAMS, THE INFLATION REDUCTION ACT AIMS TO REDUCE U.S. GREENHOUSE GAS EMISSIONS BY 40% BY 2030, 2/3 OF THE WAY TO THE U.S. COMMITMENT TO THE PARIS CLIMATE AGREEMENT.

CLIENT UPDATE

INFLATION REDUCTION ACT:
A GAME CHANGER FOR ENERGY

On August 16, 2022, President Biden signed the **Inflation Reduction Act of 2022**, a $386 billion bipartisan bill for energy and climate investment and the U.S.' largest decarbonization funding yet.

The Inflation Reduction Act includes $386 billion in energy and climate investment and tax breaks aimed at reducing energy costs and carbon-based emissions, increasing energy security, and environmental conservation/development. Specifically, main sector investments include new or expanded tax credits to promote the increased production of clean fuels, clean energy generation, wider adoption of electric vehicles, electrification, green technology retrofits for homes and buildings, environmental conservation, and other energy and climate spending.

HOW IS THE INFLATION REDUCTION ACT DIVIDING THE INVESTMENT?

Energy & Climate Investment – Inflation Reduction Act 2022

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PLG Consulting has been helping green energy companies design, build and refine their logistics and supply chains for over twenty years. Our domain expertise includes renewable diesel, hydrogen, RNG, electric vehicles, wind, solar, and energy storage along with the transportation modes that service these industries. PLG is monitoring the implementation of the Inflation Reduction Act to better understand key nuances of the tax incentive structures and how to maximize the available economic incentives for our clients.

SOURCES: The Atlantic; Committee for a Responsible Federal Budget; PLG Consulting Analysis, August 2022

AUGUST 2022 - PAGE 1

Whitepaper available now at https://plgconsulting.com/resources/presentations-and-white-papers/

IRA Will Accelerate Adoption of Key Clean Energy Technologies

KEY IMPLICATIONS OF THE INFLATION REDUCTION ACT

ACCELERATION OF U.S. PERMITTING

The lagging development of ETM mining and processing poses the greatest risk to the achievement of emissions goals. Permitting/start-up for new processing facilities averages 10+ years in most regions. In the early 70s the U.S. dominated the global supply of lithium, but today China refines 60% of the world's lithium.

CLEAN ENERGY PRODUCTION CREDITS

The clean energy tax credits offer the choice to developers and investors to take the credits on the initial project investment (ITC) or receive them over time via production (PTC). This will affect all primary forms of clean energy including wind, solar, biofuels, and grid storage.

BOOST TO GREEN HYDROGEN

Hydrogen producers are eligible for production tax credits of up to $3/kilogram based on their emissions footprint. Green hydrogen will now become more cost-competitive with natural gas hydrogen which is more carbon-intensive. RNG can also be used in the production of green H2.

SPUR ELECTRIC VEHICLE DEMAND

Additional EV tax incentives will spur demand for electric vehicles (consumer & commercial). The combination of easier permitting for ETM mining/processing and domestically sourced/processed mineral requirements means tax credits are more easily met.

- Key question: Which technologies will present the best new growth opportunities for rail?
- Carriers and suppliers are engaged

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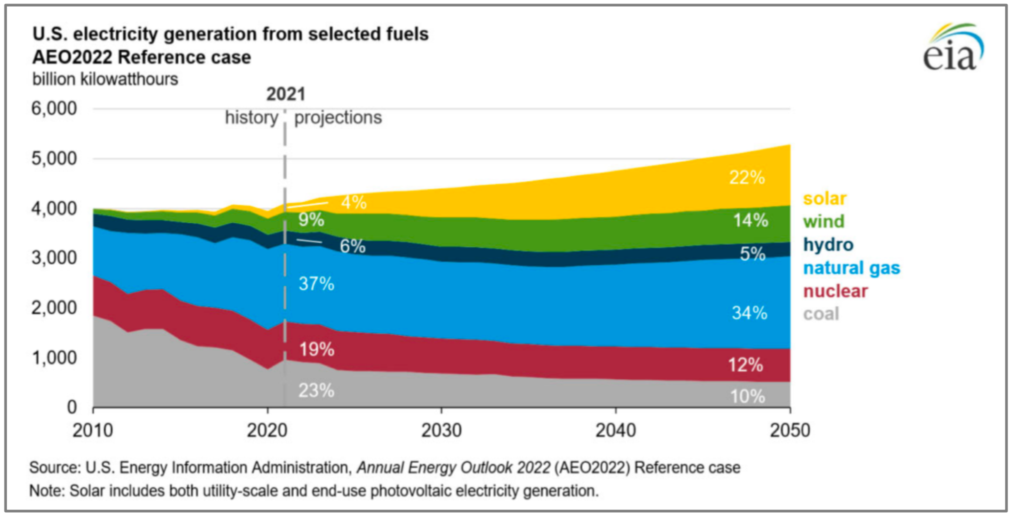
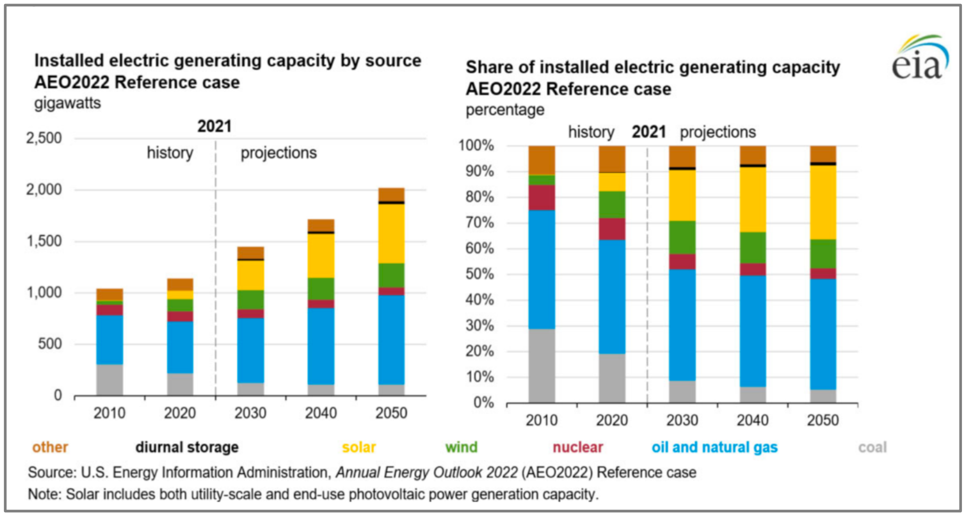
For Electricity Generation Renewables Grow Fastest While Gas is the Foundation





- Tax credits for wind phase out in 2024
- Solar tax credits scale down in 2026 but do not expire
- By 2030 most coal plant retirements are complete; coal then retains about 10% of fuel market share
- Forecast may further favor renewables in AEO 2023 (due March 15th) resulting from IRA

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Renewable Diesel Overview

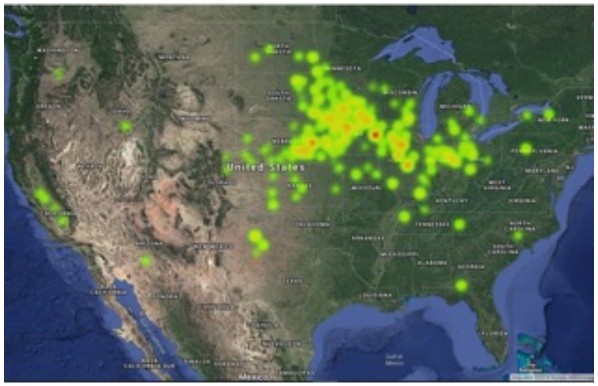
- Market initially developed by Low Carbon Fuel Standards (LCFS) in California
- Different from biodiesel, renewable diesel is a 1 for 1 drop-in replacement for conventional diesel
- Four main feedstocks, with varying carbon intensity (CI) scores:

DCO (Distillers corn oil)
- Residual byproduct of ethanol production
- Made in large quantities (based on size of the ethanol facility)
- Focus on corn growing regions (Midwest)

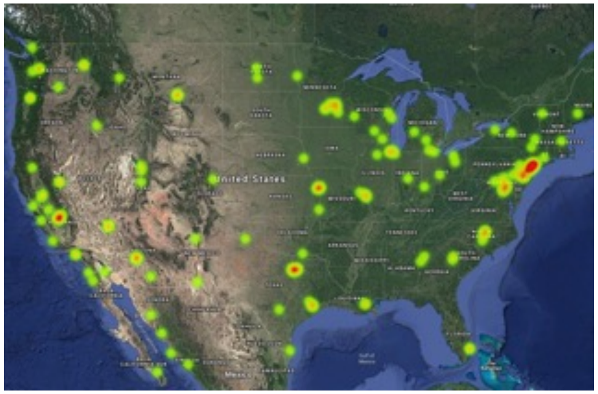
UCO (used cooking oil)
- Commercially localized gathering across the US
- Local distribution to terminals

Animal Fat (Tallow)
- Focused on Midwest US at meat rendering facilities
- Additional limited coverage across the United States

Soybean Oil
- Focused on Midwest and Southeast
- Will compete with exports and domestic consumption
- Dominated by three major corporations for processing

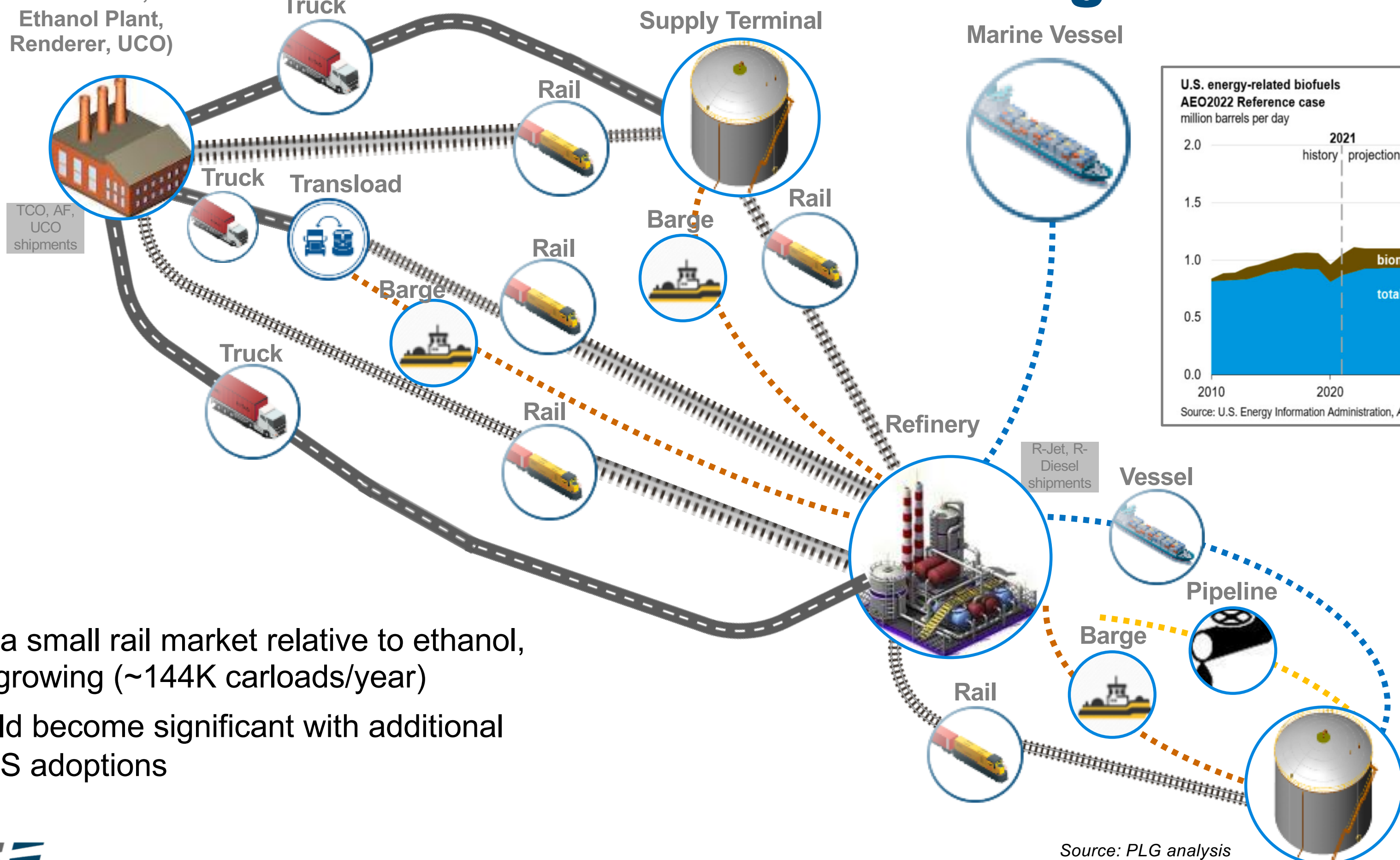


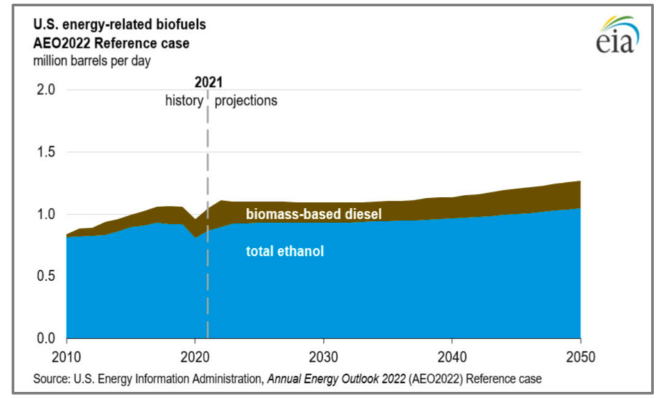
Ethanol heat map for DCO *Source: PLG Consulting*



Used cooking oil heat map *Source: PLG Consulting*

Renewable Diesel Multi-Modal Supply Chain With Significant Role for Rail





- Still a small rail market relative to ethanol, but growing (~144K carloads/year)
- Could become significant with additional LCFS adoptions

Source: PLG analysis

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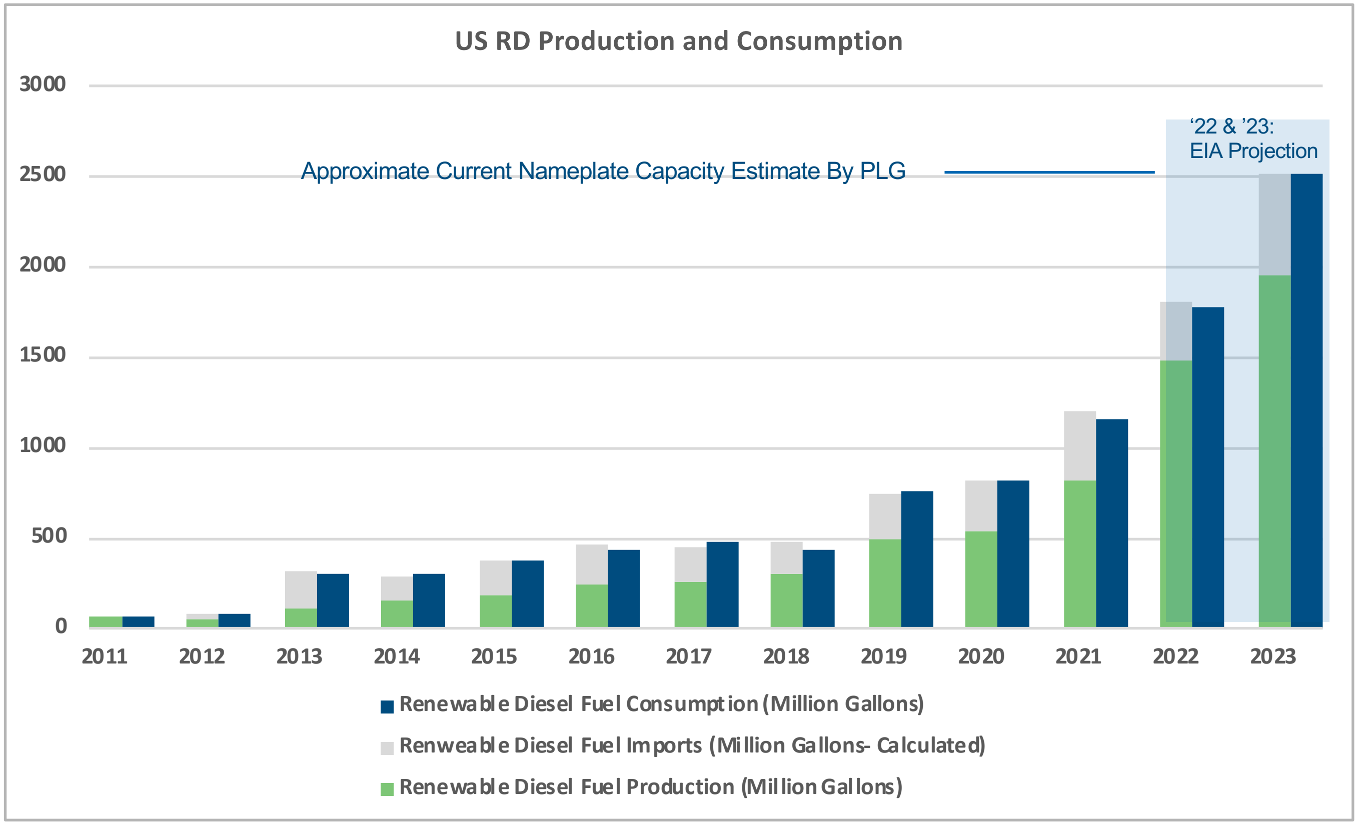
RD Production and Consumption

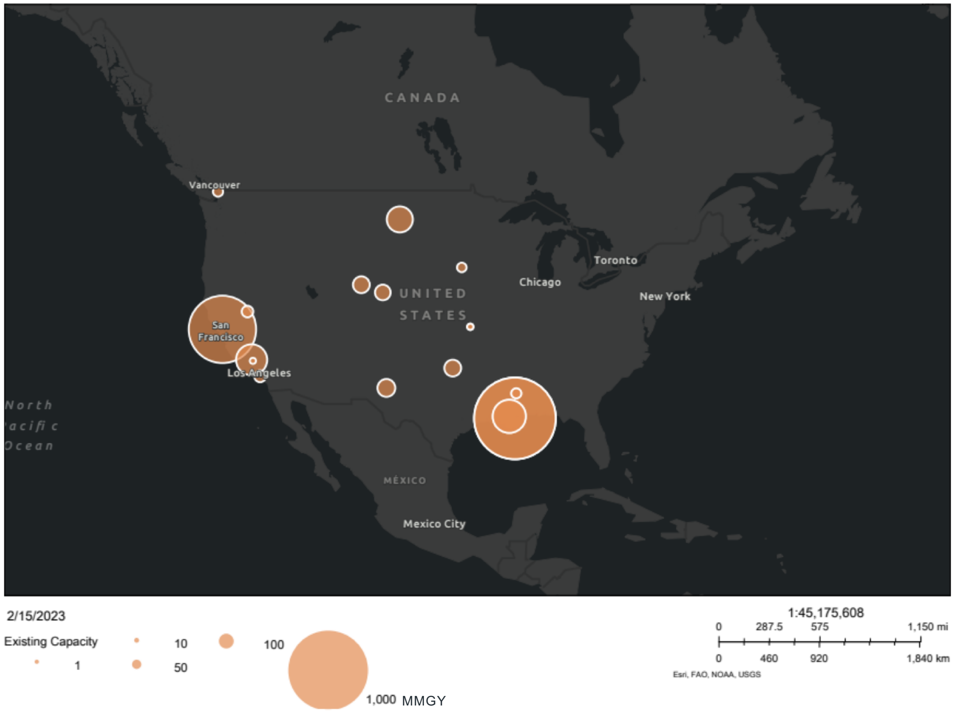


Source: PLG analysis using data from EIA, August 2022

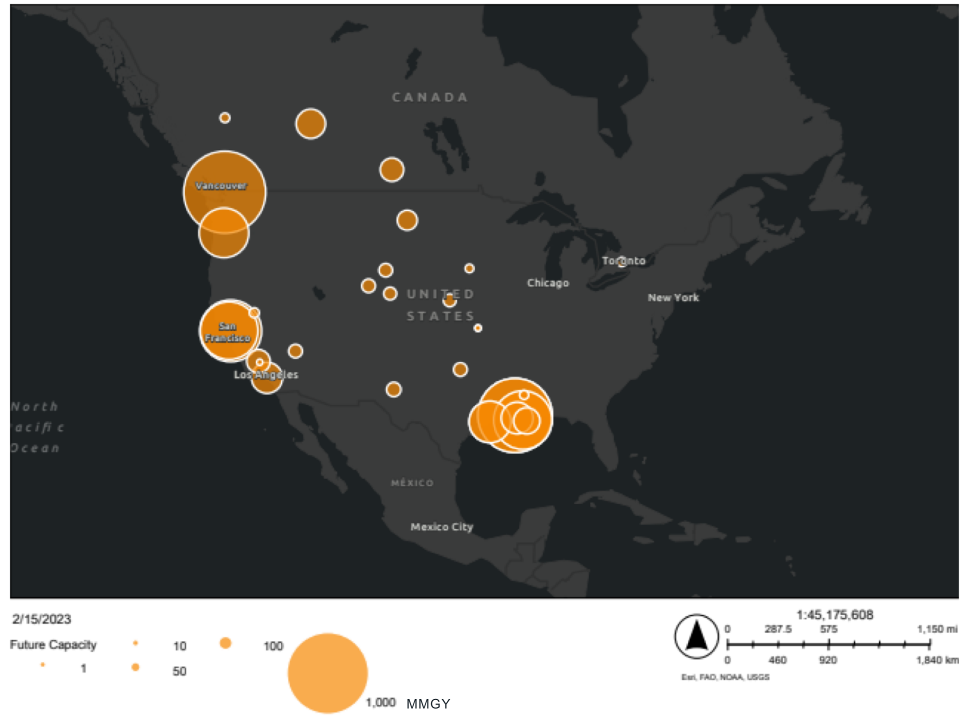
- 815 MM gal RD produced in 2021
- 60,400 MM gal distillate fuel oil produced
- ~1.3% of diesel production
- 2,500 MM gal: Total US nameplate capacity (including recent expansions)
- 7,850 MM gal: Total RD capacity if all announced projects are built (includes Canadian projects)
- ~ 3,400 MM gal: PLG estimate of RD capacity to be in place by 2025
- **RD surpassed biodiesel consumption for the first time in 2022**
- **Positive short-term growth potential; long-term potential depends on feedstock supply and expanded incentives**

Current & Planned RD/SAF Facilities

Current



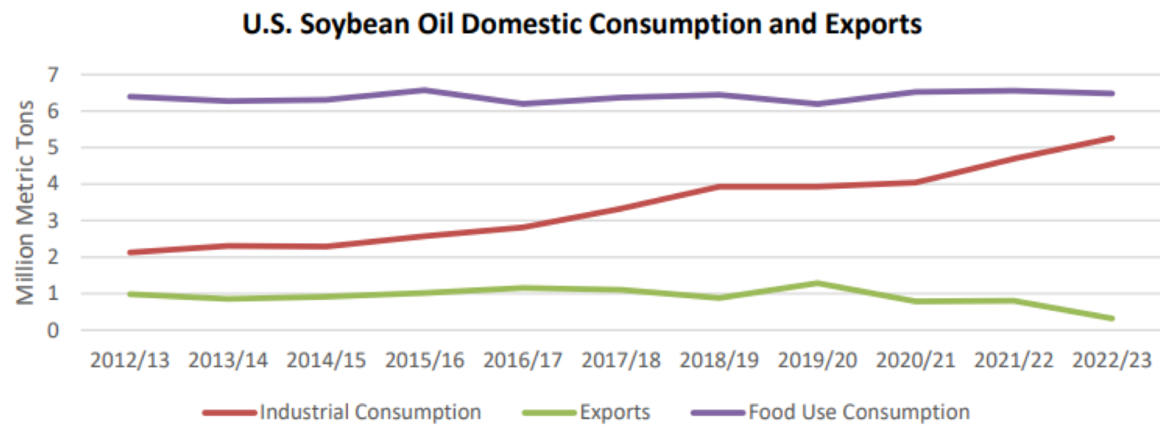
Current + Planned/Expansions



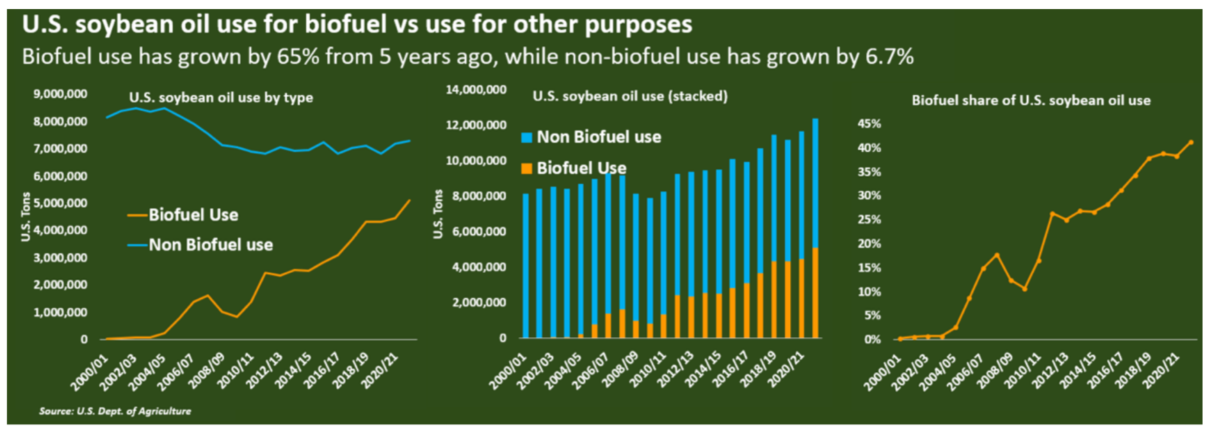
Source: PLG analysis of plant announcements, February 2023

Soybean Oil Increasingly Used for Biofuel

- U.S. soybean oil exports are continuing a multi year downward trend with a forecasted low of 318,000 tons for the 2022/23 period
- 44% of U.S. soybean oil production was used for industrial consumption in the period 2022/23 compared to 25% a decade ago



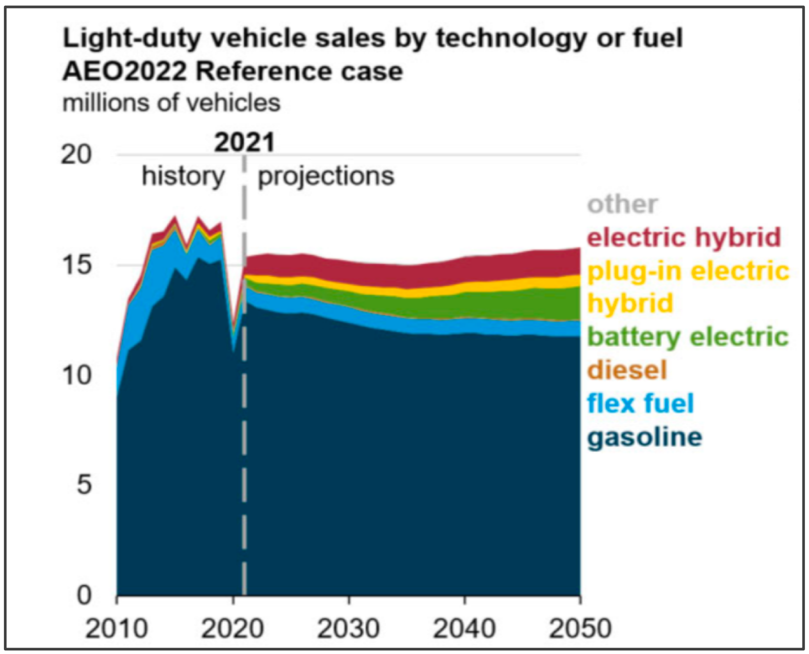
Source: USDA Production, Supply and Distribution Database, February 2023



Source: Reuters, November 2022

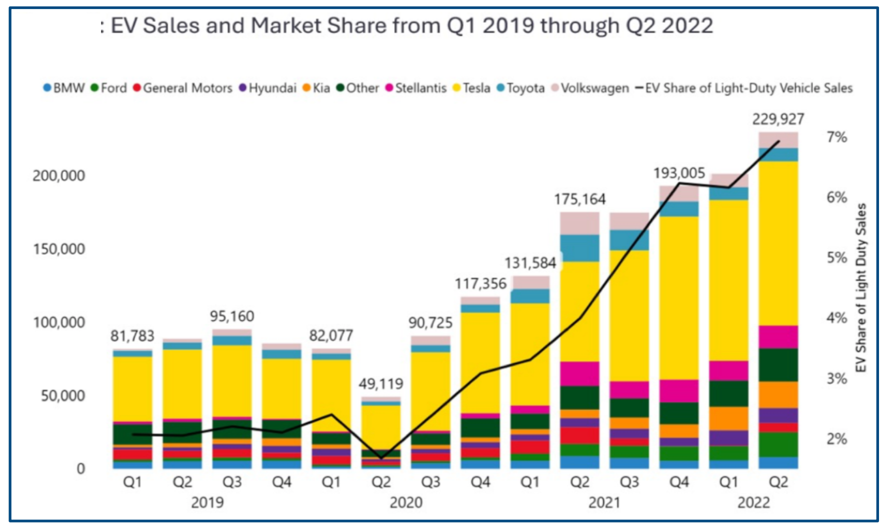
Prior to IRA, Decarbonization a Long Road for Light Duty Vehicles

- EIA AEO 2022 forecasted that, barring any dramatic changes, internal combustion engines remain 80% of LDVs through 2050



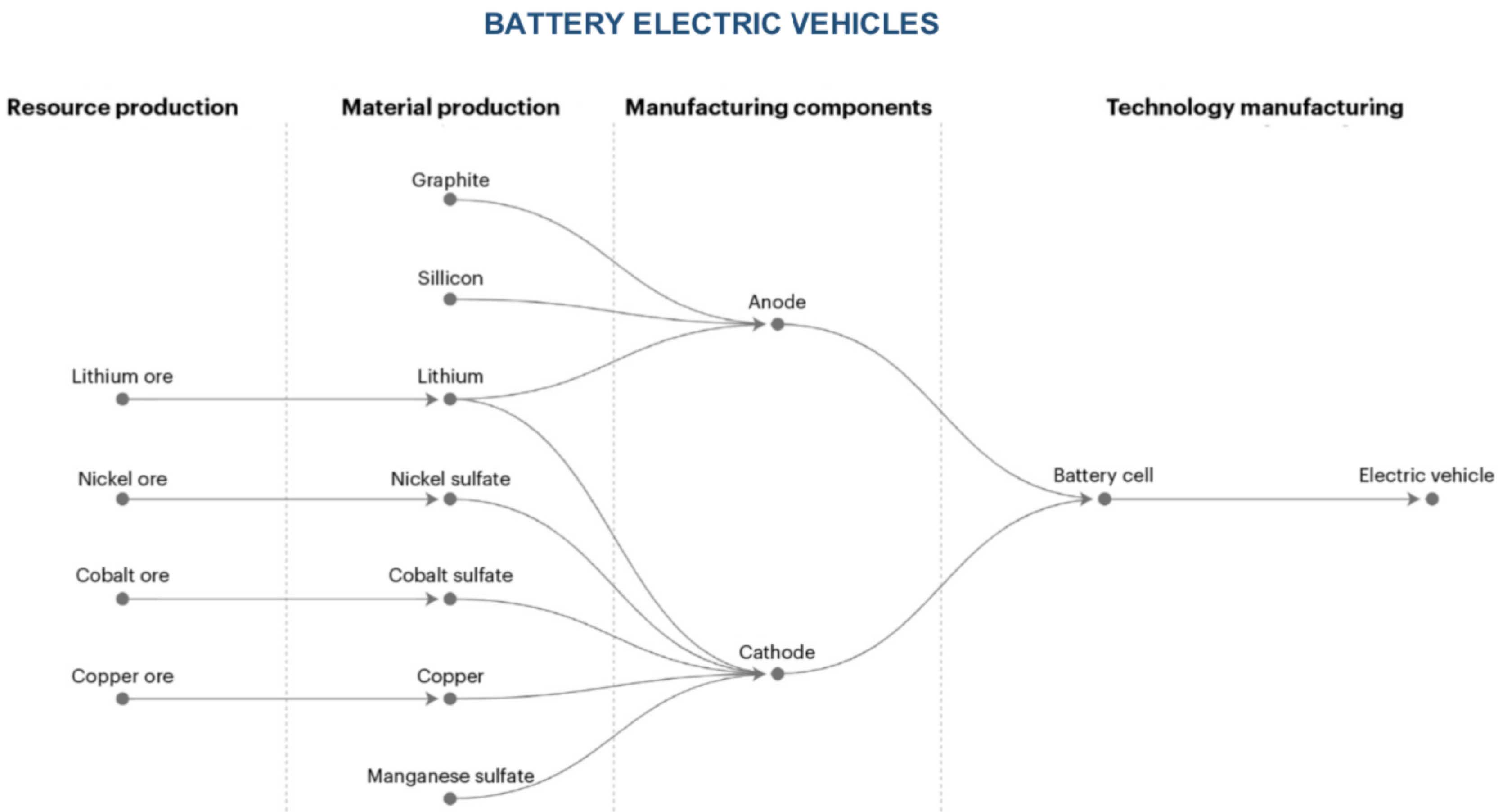
Source: EIA, March 2022

- However, IRA incentives likely to accelerate adoption of EVs in the US, provided that domestic supply and processing of critical minerals is expanded
  - New requirements for producer EV tax credits - mineral extraction/refinement in US or countries with FTAs; % of battery components manufactured in America
  - Consumer tax credits of up to $7,500 per vehicle, dependent on % of mineral and component sourcing



Source: Atlas Policy, November 2022

Schematic of Supply Chain Elements for EVs

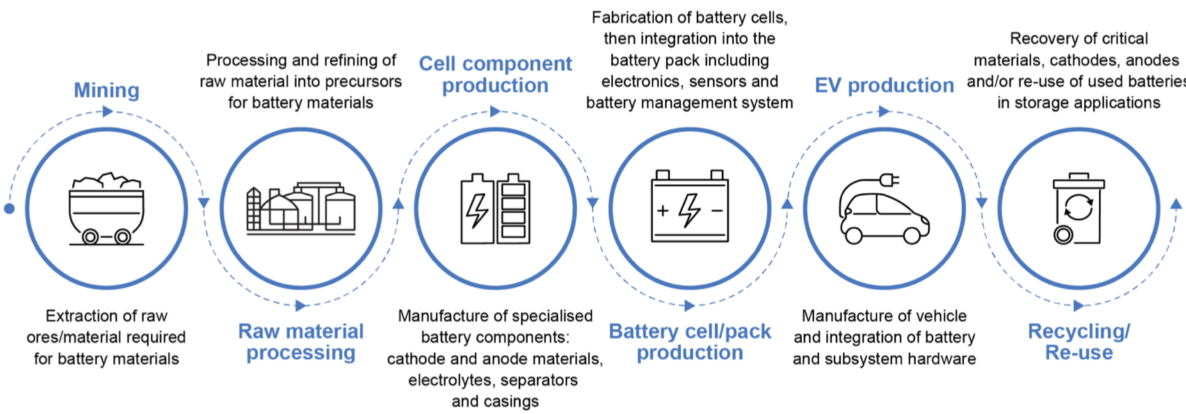


Source: IEA, January 2023

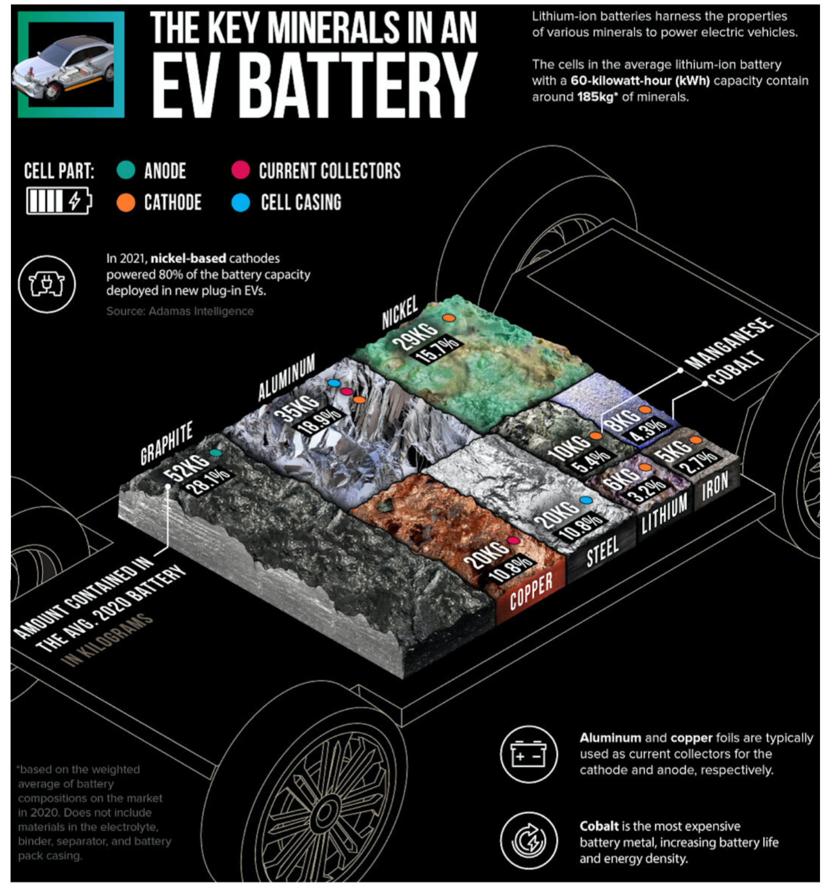
While Domestic EV Manufacturing is Well Established, the Battery Components are Lagging

Making batteries for EVs requires several stages

EV battery supply chain



Source: IEA, May 2022



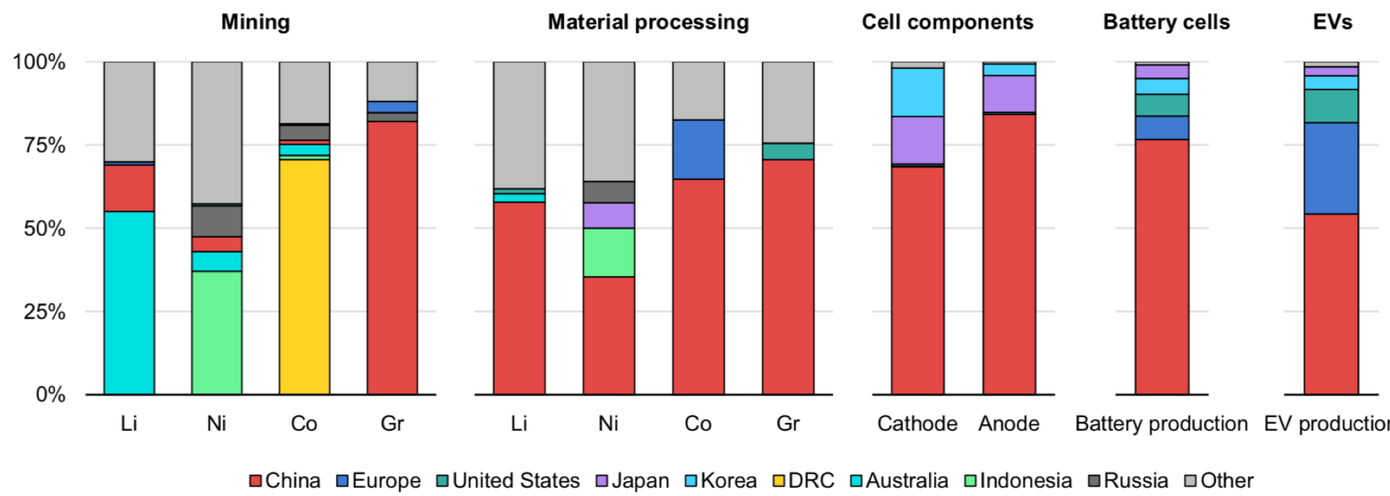
Source: Visual Capitalist, March 2022

US Lacks "Energy Independence" in EVs and Other Clean Energy Technologies

- Domestic sourcing and processing is needed for the expanding US EV and grid battery industries, as well as offshore wind and other applications using ETMs

China dominates the entire downstream EV battery supply chain

Geographical distribution of the global EV battery supply chain



Notes: Li = lithium; Ni = nickel; Co = cobalt; Gr = graphite; DRC = Democratic Republic of Congo. Geographical breakdown refers to the country where the production occurs. Mining is based on production data. Material processing is based on refining production capacity data. Cell component production is based on cathode and anode material production capacity data. Battery cell production is based on battery cell production capacity data. EV production is based on EV production data. Although Indonesia produces around 40% of total nickel, little of this is currently used in the EV battery supply chain. The largest Class 1 battery-grade nickel producers are Russia, Canada and Australia.

Sources: IEA analysis based on: EV Volumes; US Geological Survey (2022); Benchmark Mineral Intelligence; Bloomberg NEF.

Source: IEA, May 2022

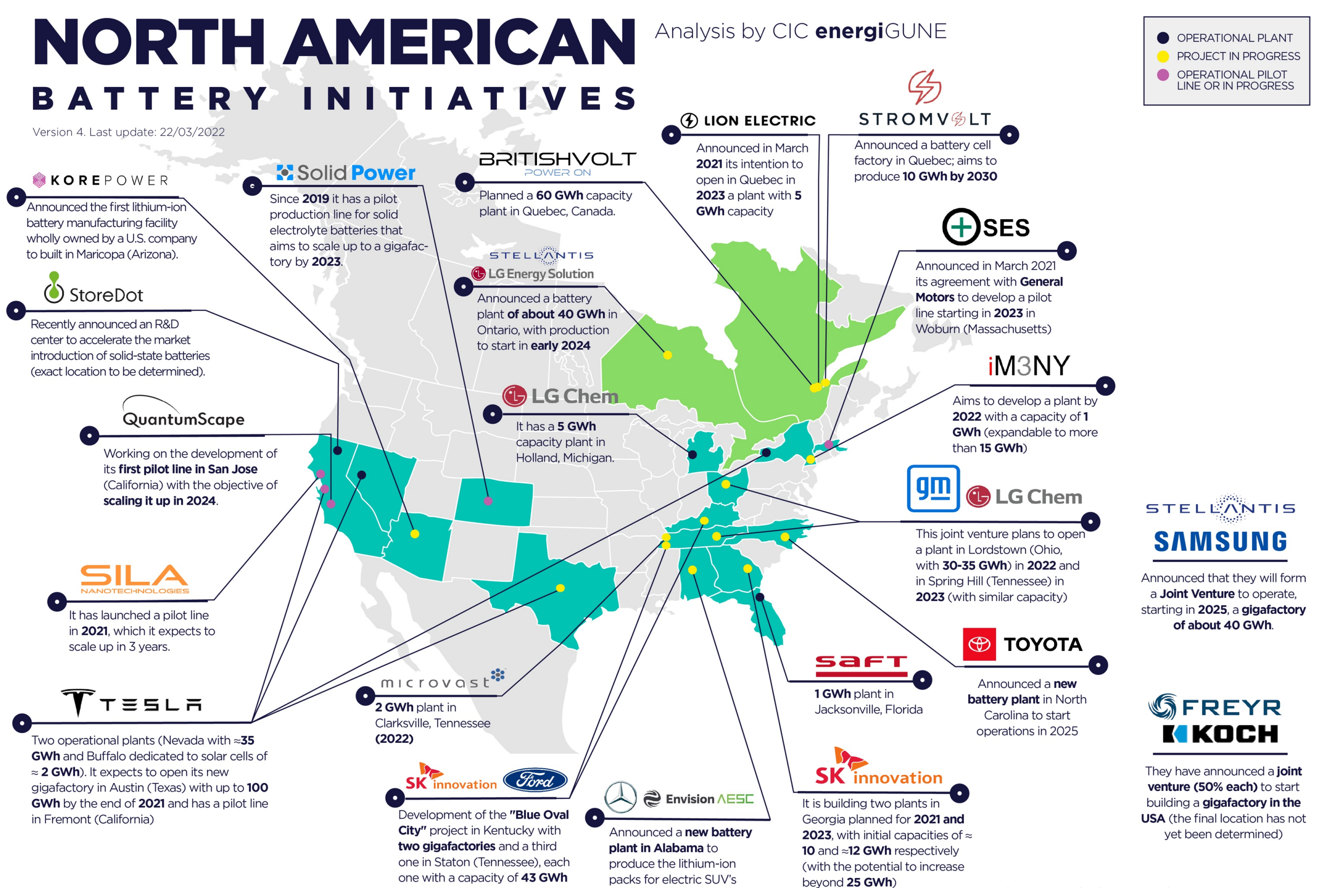
EV Supply Chain SuperFans

- Video explaining import supply chain for EV batteries, circa 2020

https://youtu.be/U6x2pD6-EiM

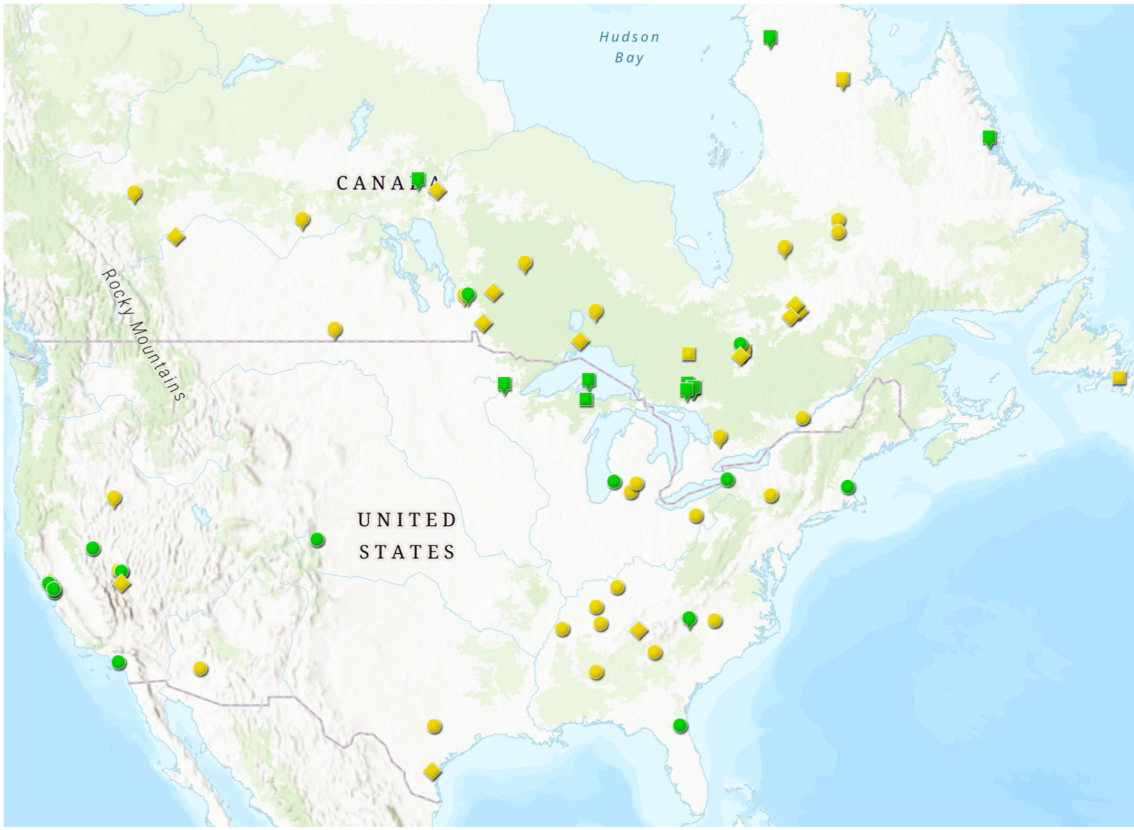
Mineral Supply Chain Needed to Serve Growing NA Battery and EV Market

- At one time (early 1970s), the US dominated global supply of lithium
- Lithium can be extracted from brines or granite pegmatite ores
- North American projects for mining and/or processing for various energy transition minerals are under development in several areas, including Ontario, North Carolina, Minnesota, and Nevada
- This represents an opportunity for rail



Source: CICenergiGUNE, March 2022

PLG ETM and Battery Plant Database



Legend

Battery Plants- Not operational

Battery Plant- Operational

Processing Facility- Project in Progress

- Lithium Processing Facility
- Nickel Processing Facility

Processing Facility- Operational

- Nickel Processing Facility

Mine- Operational

- Lithium Mine
- Nickel Mine

Mine- Project in Process

- Lithium Mine
- Nickel Mine

- Yes, there is a role for rail in "onshoring" EV battery production in North America

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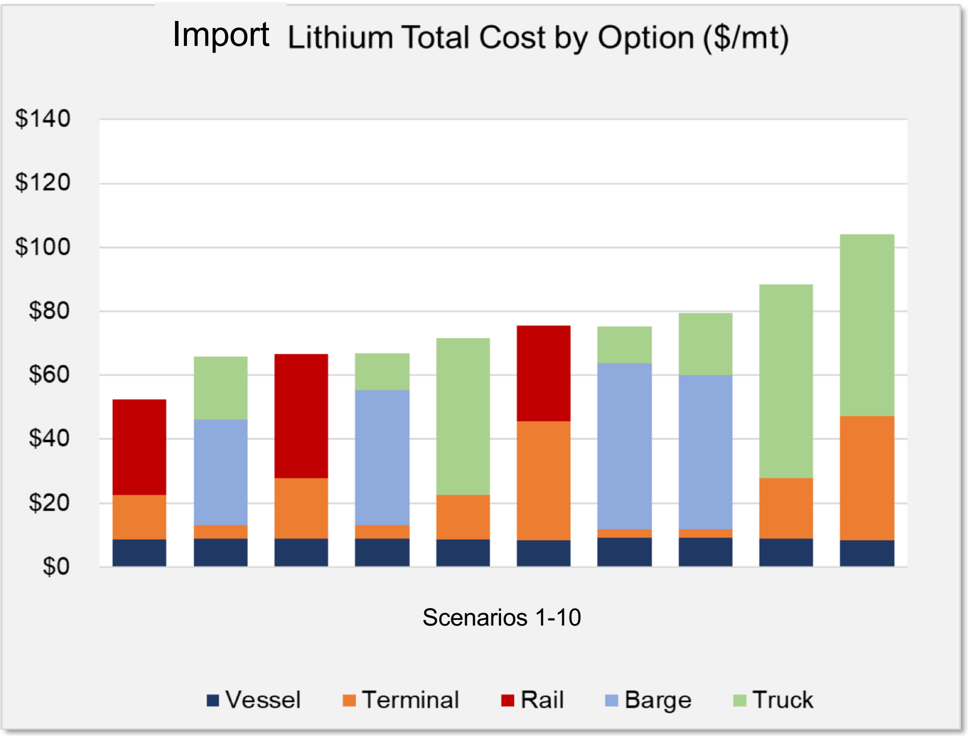
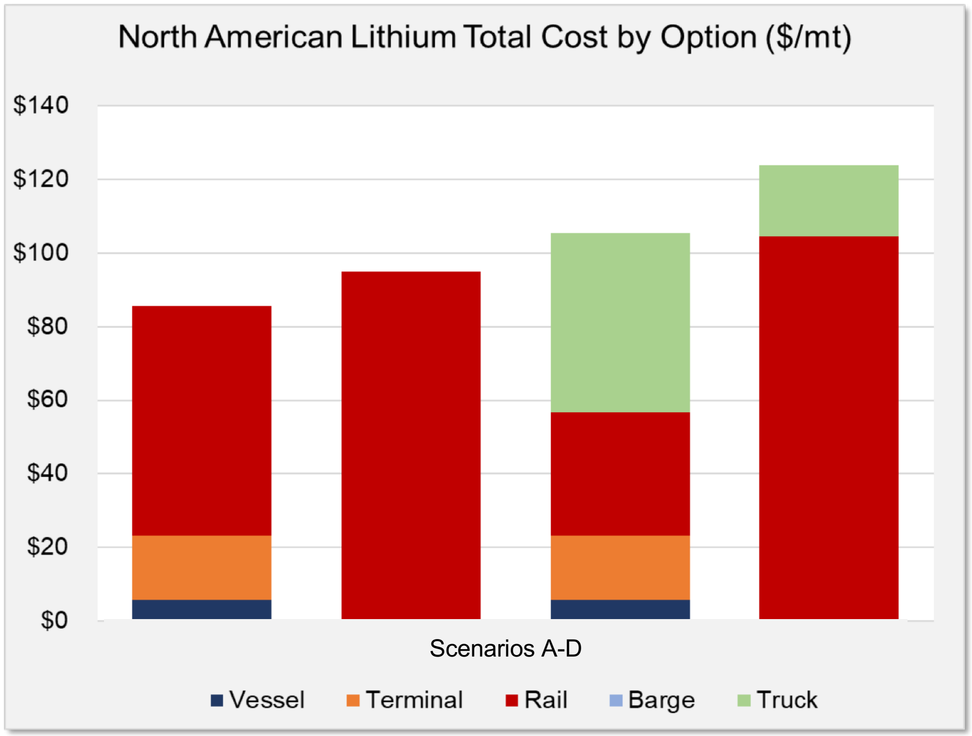
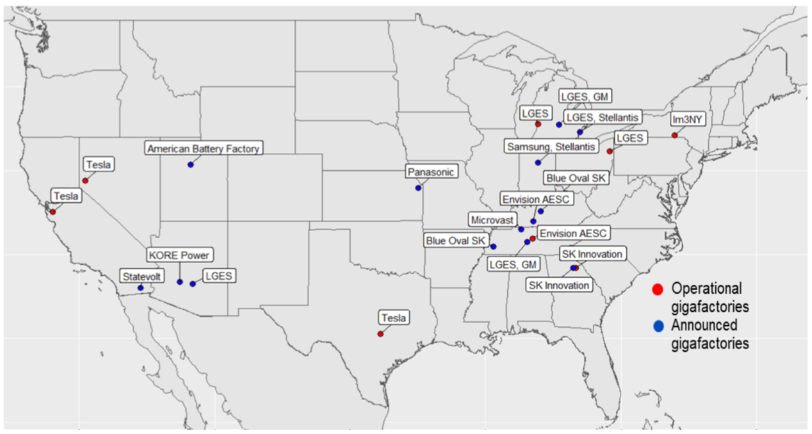
Total Cost to Serve Analysis Across Multiple O-D Pairs Proving Rail Has a Role To Play In Domestic Battery Manufacturing

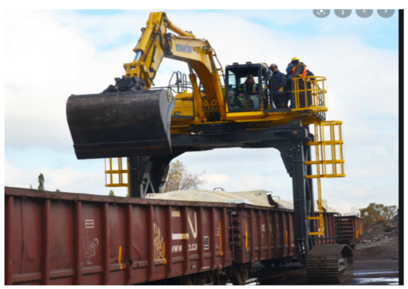


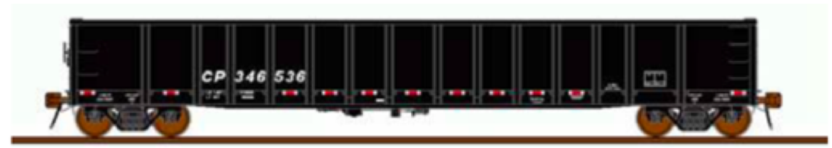


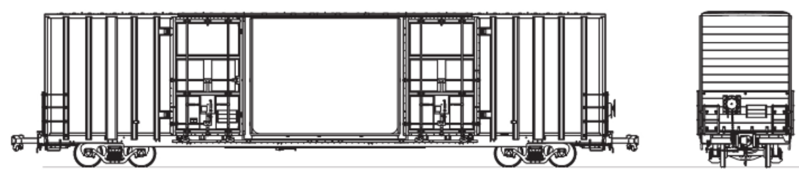
Potential Car Types to Support Domestic Critical Minerals and Battery Manufacturing Supply Chain

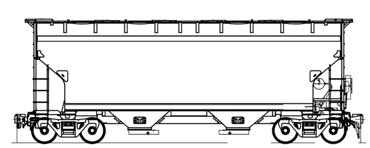


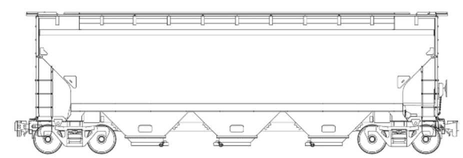
Source: Dallas Fed, October 2022





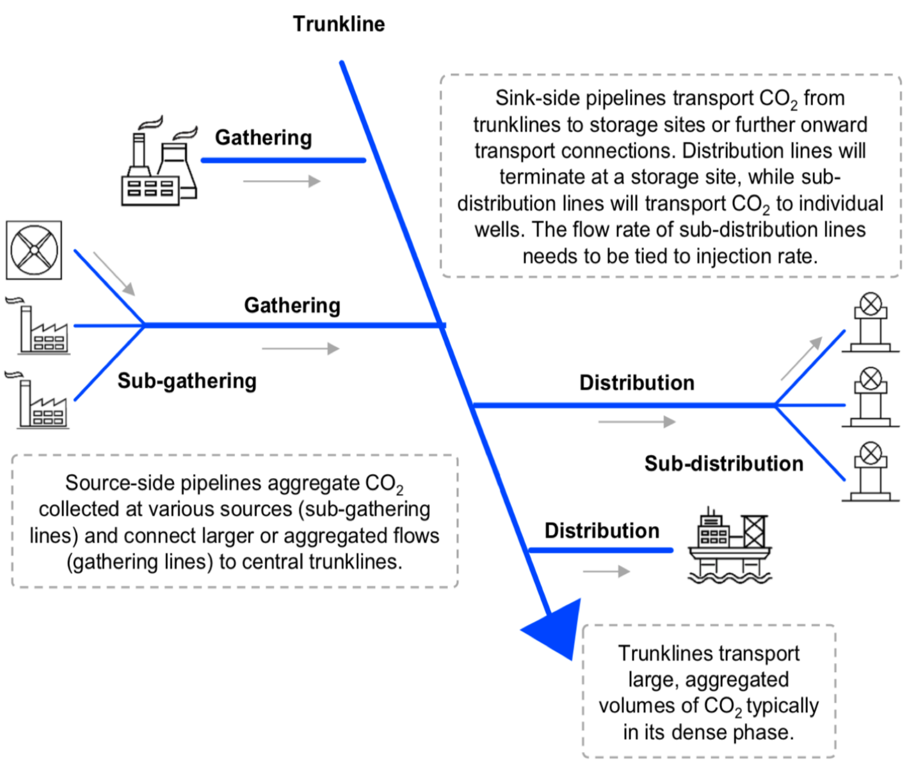






Carbon Capture & Sequestration for Industrial Emissions

Figure 5.30 CO_2 pipeline network



Source: IEA, January 2023

- Creates "blue" variation of products from energy intensive processes using natural gas by capturing CO2 emissions
- Focus on industrial clusters, including clean hydrogen hubs
- Significant tax incentives under IRA of $77/ton
- Potential new rail opportunity
- Ethanol production generates a high purity CO2 that lends itself to carbon-capture projects

Source: Heartland Greenway

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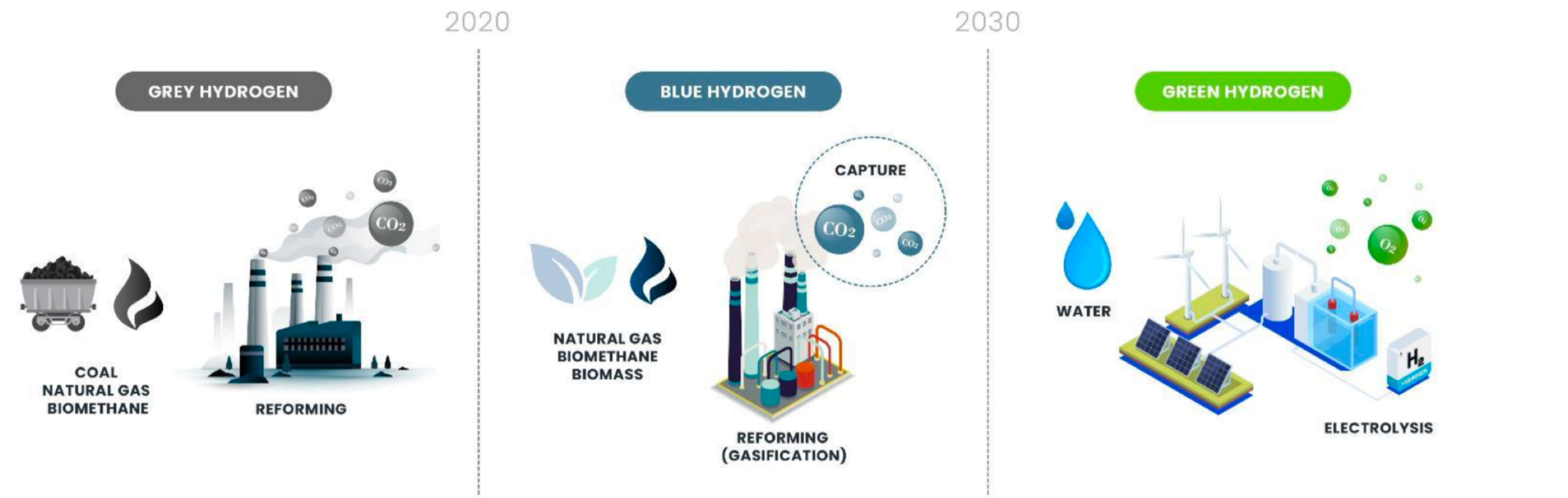
Understanding Grey, Blue, and Green Hydrogen

Hydrogen (H2) has been the ‘fuel of the future’ for many years.



Grey Hydrogen ~ 91% of U.S. Production

- Made by Steam Methane Reforming (SMR) with coal, biomethane, and natural gas as feedstocks
- Used mainly for petrochemical & industrial applications
- Produced by large Industrial Gas Companies (IGC)

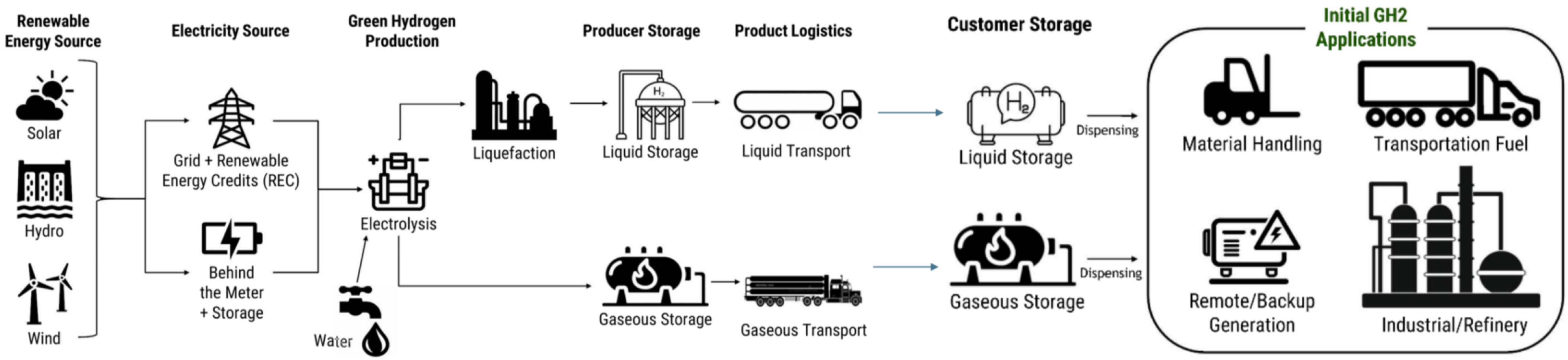
Blue Hydrogen ~8% of U.S. Production

- Usually made by SMR with Carbon Capture and Storage (CCS) used to reduce carbon emissions
- Effectiveness of carbon capture varies by method

Green Hydrogen is < 1% of U.S. Production

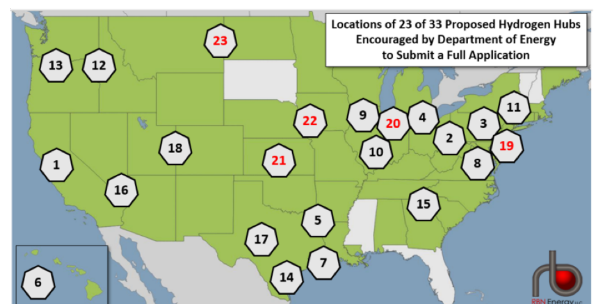
- Made by Electrolysis from water
- Feedstock is renewable electricity with little/no carbon content

Green Hydrogen as a Path to Decarbonization for a Multitude of Applications



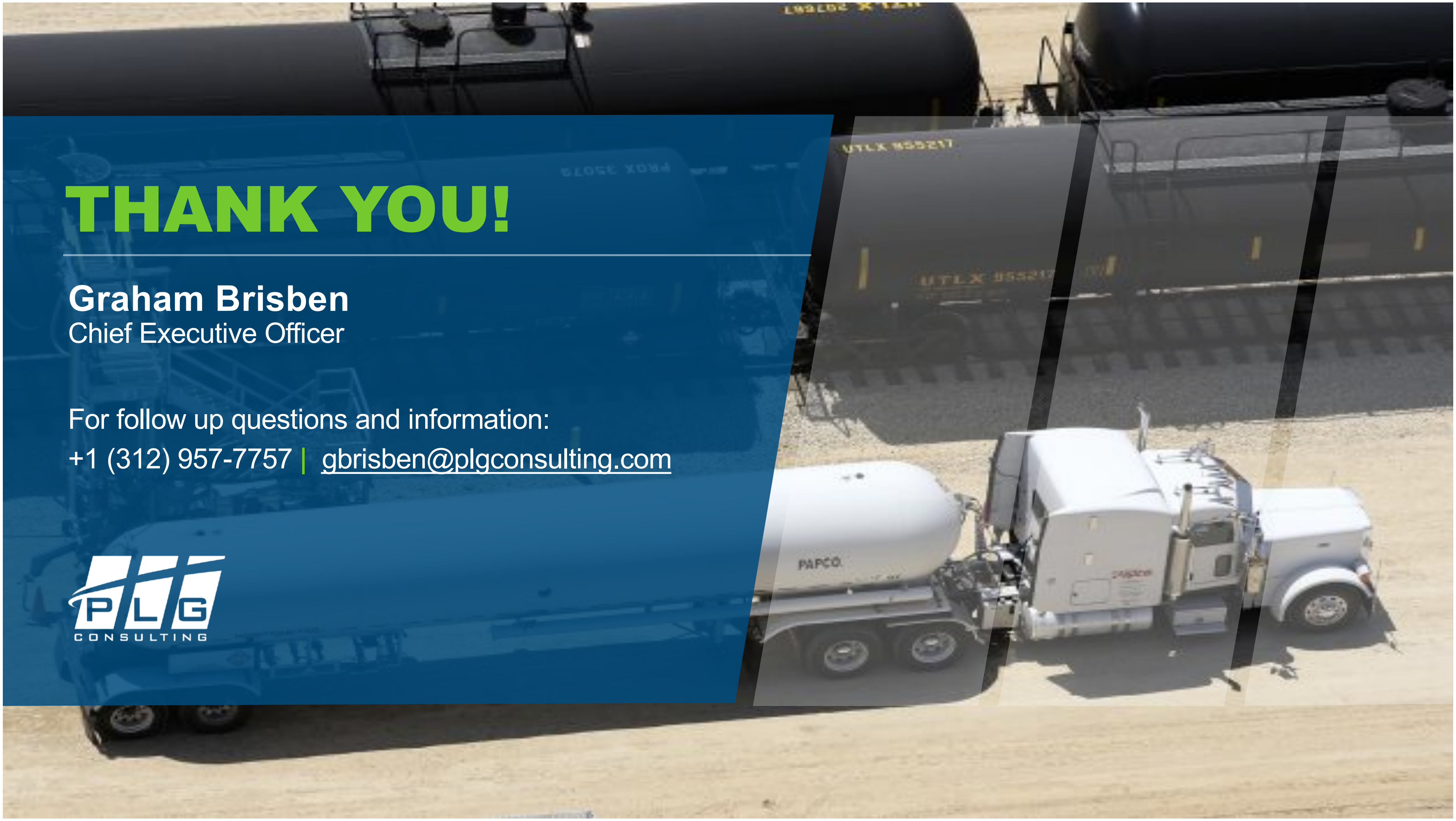
Source: GH2 Advisor

- Key beneficiary of IRA incentives, due to its versatility and "stackable" tax credits including \$3/kg PTC
- Can be used for electricity generation, process fuel, transportation, conversion to ammonia, and to charge batteries
- May "win" heavy duty/Class 8 alternative fuel race - 3x energy density of diesel fuel; longer range than EV options
- Ties into Bipartisan Infrastructure Law \$8B funding for regional clean hydrogen hubs



Project	States Involved	Project	States Involved
1. Alliance for Reliable Clean Hydrogen Energy Systems	CA	13. Pacific Northwest Hydrogen Hub	OR, WA
2. Appalachian Regional Clean Hydrogen Hub	KY, OH, WY	14. Horizons Clean Hydrogen Hub (Corpus Christi)	TX
3. Decarbonization Network of Appalachia	PA	15. Southeast Hydrogen Hub	AL, GA, KY, NC, SC, TN
4. Great Lakes Clean Hydrogen	IN, MI, OH, PA	16. Southwest Clean Hydrogen Innovation Network	AZ, NV
5. HALO Hydrogen Hub	AR, LA, OH	17. Trans Permian H2Hub	LA, TX
6. Hawaii Pacific Hydrogen Hub	HI	18. Western Interstate Hydrogen Hub	CO, NM, UT, WY
7. HyVelocity Hub	LA, TX	19. Mid-Atlantic Clean Hydrogen Hub	DE, NJ, PA
8. Mid-Atlantic Hydrogen Hub	DC, MD, VA	20. Indiana Coalition	IN
9. Midwest Alliance for Clean Hydrogen	IL, MI	21. HARVEST Hydrogen Hub Coalition	KS
10. Midwestern Hydrogen Coalition	IL, IN, KY, MI, MN, OH, WI	22. Mid-Continent Clean Hydrogen Hub	NE, IA, MO
11. Northeast Region Hydrogen Hub	CT, MA, ME, NJ, NY, RI	23. Heartland Hydrogen Hub	ND, MN, MT, WI
12. Obsidian Pacific Northwest Hydrogen Hub	ID, OR, WA		

Source: RBN, February 2023



THANK YOU!

Graham Brisben
Chief Executive Officer

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