



The Economic Benefits of Lifting the U.S. Crude Oil Export Ban: A Retrospective Analysis

July 2022





Study Overview

- **Purpose:** To assess the economic benefits of the 2015 policy change that lifted the export ban that applied to much of U.S. crude oil output.
- **Approach:** ICF analyzed the changes that have occurred in U.S. oil and gas markets since the policy change—the *Base Case (Actual)*— against a hypothetical scenario wherein the ban on U.S. oil exports was not lifted—the *Export Ban Case*. The analysis assesses impacts to:
 - U.S. Drilling Activity
 - U.S. Crude Oil, Natural Gas, and NGL Output
 - U.S. Crude Oil, Natural Gas, and NGL Imports/Exports
 - U.S. Producer Revenues
 - U.S. Consumer Fuel & Natural Gas Expenditures
 - U.S. Gross Domestic Product
 - U.S. Trade Balance
 - U.S. Oil & Gas Sector Employment and Incomes

Key Takeaways

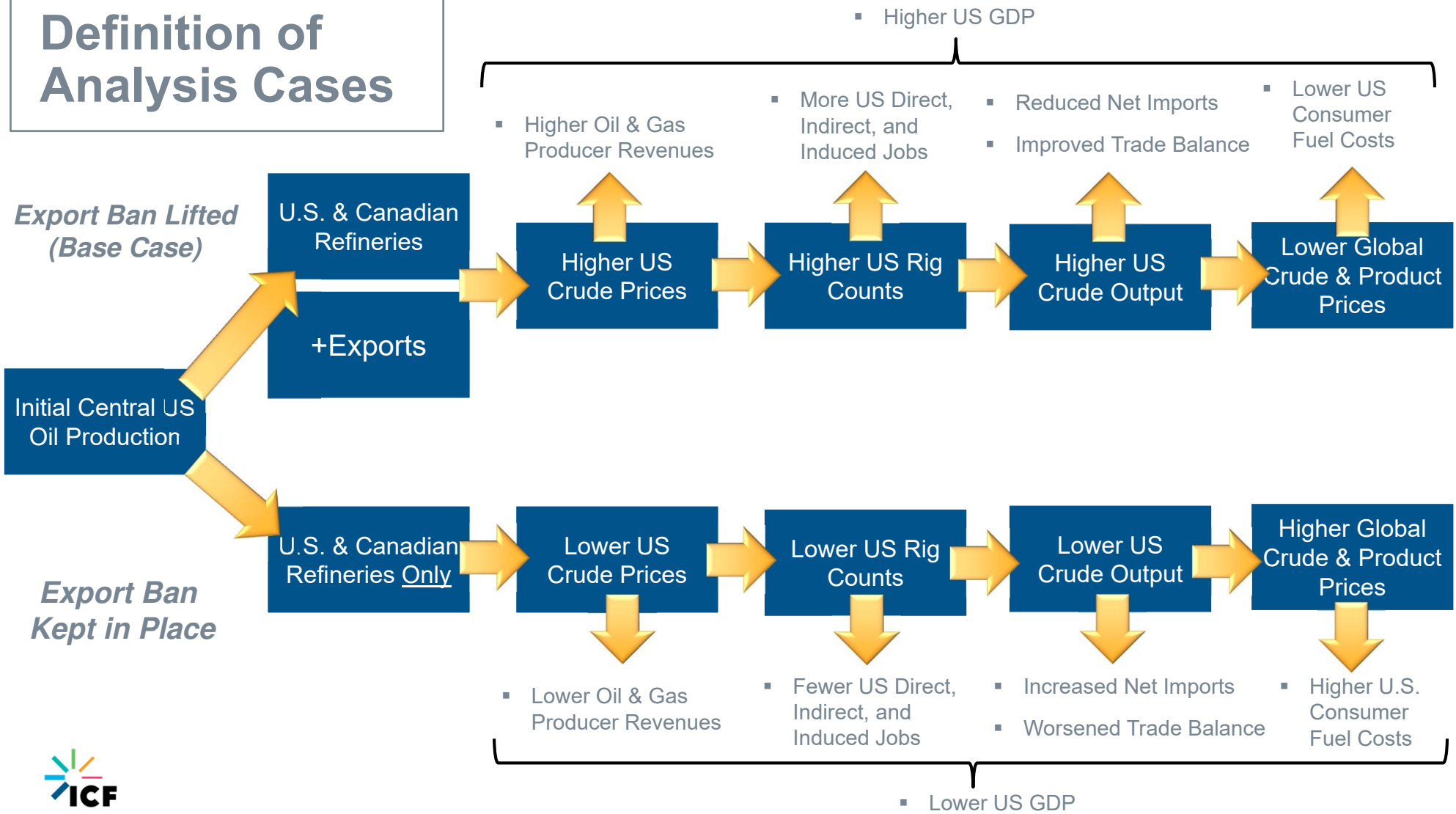
- **U.S. Crude Oil & Natural Gas Output Increases:** Lifting the crude oil export ban allowed U.S. oil prices to converge with international benchmarks, spurring more drilling activity and leading to higher crude oil production, as well as higher production of associated natural gas and NGLs that come from oil wells.
- **U.S. Refined Product Prices Decrease:** Higher U.S. oil production expanded global oil supply, reducing global crude oil and refined product prices. Because there is free trade in petroleum products, U.S. fuel consumers have benefited from these lower product prices.
- **U.S. GDP Increases:** The benefits of lower fuel costs for U.S. consumers and higher revenues for U.S. oil producers (due to higher output and higher domestic crude prices) outweigh revenue losses for U.S. refiners, resulting in a net benefit to U.S. GDP.
- **U.S. Trade Balance Improves:** Higher U.S. exports have improved the U.S. trade balance, reducing the U.S. trade deficit by a measurable amount.

Summary of U.S. Economic Benefits

U.S. Output Changes	Peak Year Avg.	Cumulative 6-Year
Shale Play Rig Count	+326 rigs	+126 rigs (Avg.)
Crude Oil Output	+1.5 million b/d	+1.8 billion bbls
Crude Oil Net Imports	-2.3 million b/d	-\$2.8 billion bbls
Dry Natural Gas Output	+4.2 Bcf/d	+4.8 Tcf
Natural Gas Liquid (NGL) Output	+0.5 million b/d	+0.5 billion bbls
U.S. Economic Changes	Peak Year Avg.	Cumulative 6-Year
Global Crude Oil Prices (Brent)	-3.94/bbl	-1.93/bbl
WTI-Brent Oil Price Differential	+\$14.88/bbl	+\$9.42/bbl (Avg.)
U.S. Gasoline Prices	-9.4 ¢/gallon	-4.6 ¢/gallon (Avg.)
Consumer Fuel & Natural Gas Costs	-\$30 billion	-\$92 billion
Direct & Indirect GDP	+\$44 billion	+\$114 billion
Direct, Indirect, and Induced GDP (1.4X)	+\$63 billion	+\$161 billion
Foreign Trade Balance	+\$67 billion	+\$178 billion
Direct Jobs (Avg.)	+53,000 jobs	+19,000 jobs (Avg.)
Direct, Indirect, and Induced Jobs (Avg)	+131,000 jobs	+48,000 jobs (Avg.)

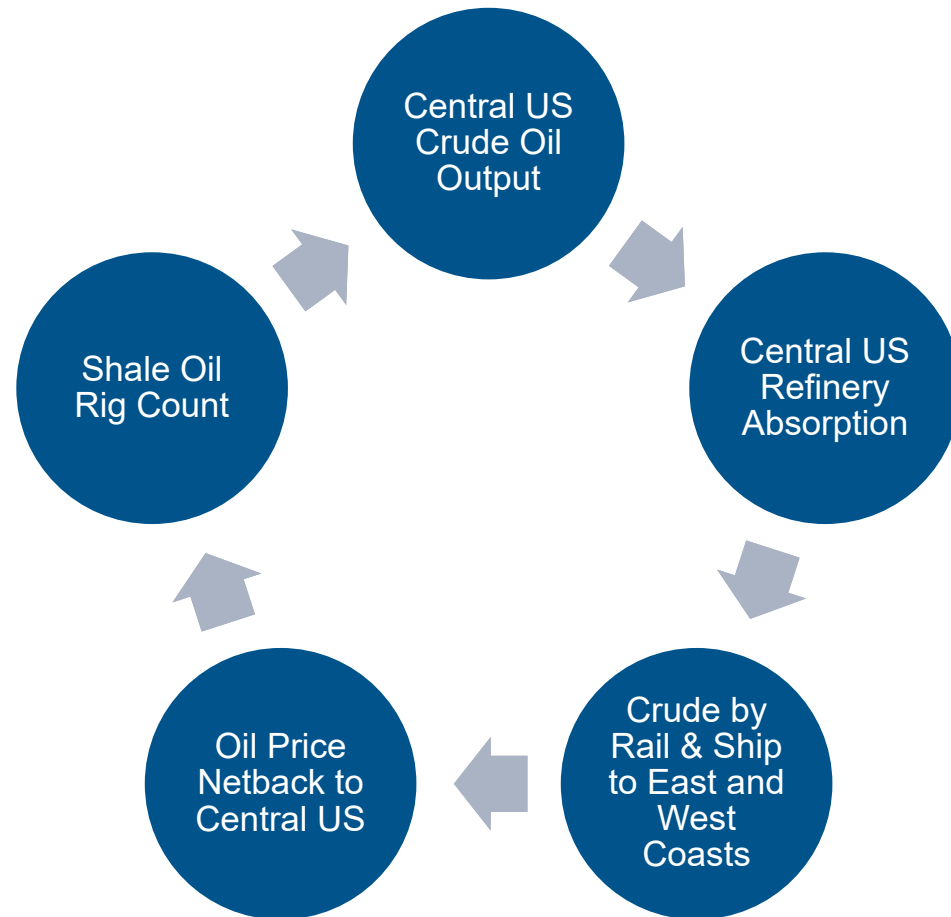
Note: Peak year impacts occurred in different years.

Definition of Analysis Cases



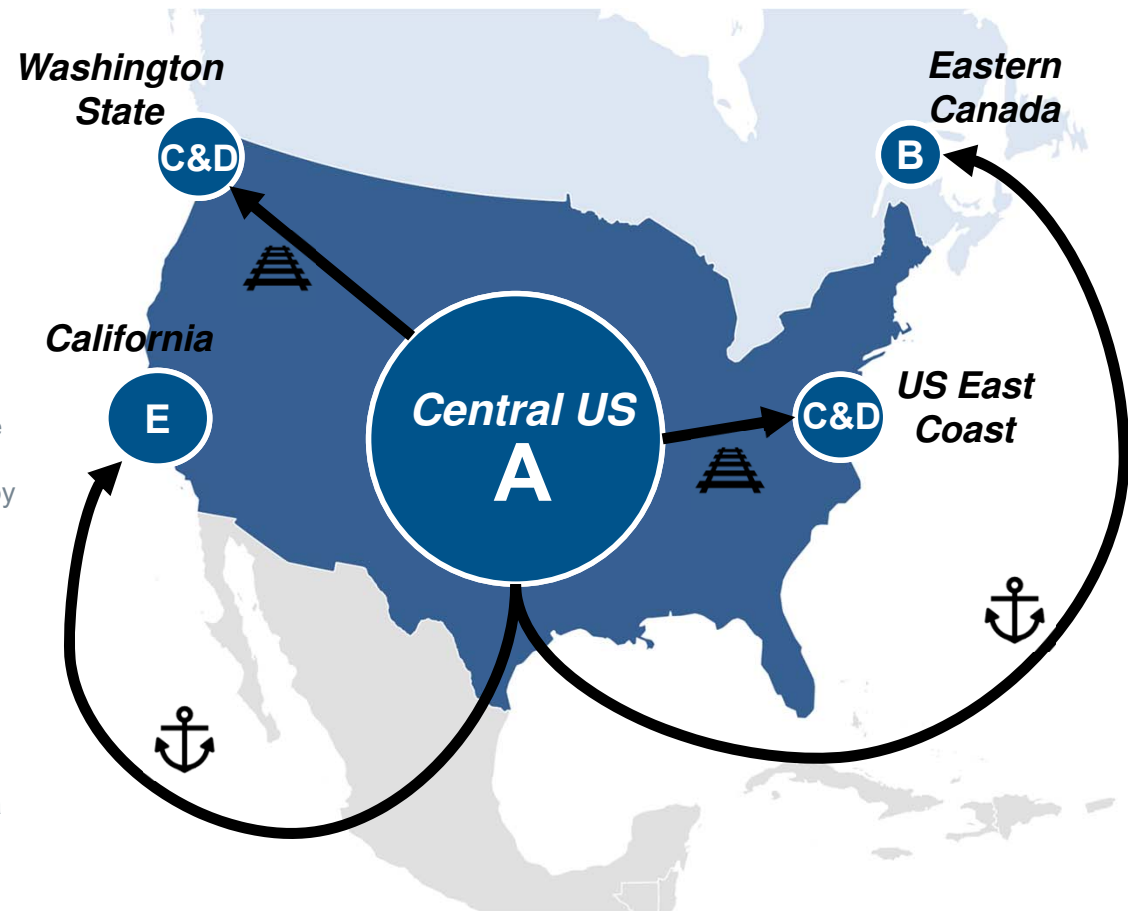
Shale Oil Model Overview

- As Central US (PADDs 2, 3, and 4) oil production surpasses Central US refinery absorption potential in the Export Ban Case, price discounts are needed to move oil to by rail or ship to refineries on the East and West Coasts.
- Lower netbacks to producers reduce future rig counts and lower new production vs. the Base Case (Actual).
- The model treats refinery crude oil demand as fixed (i.e., does not build additional refining or processing capacity to absorb surplus output).
- Model rebalances on a monthly basis.



Export Ban Case: Refinery Absorption of Central US Crude

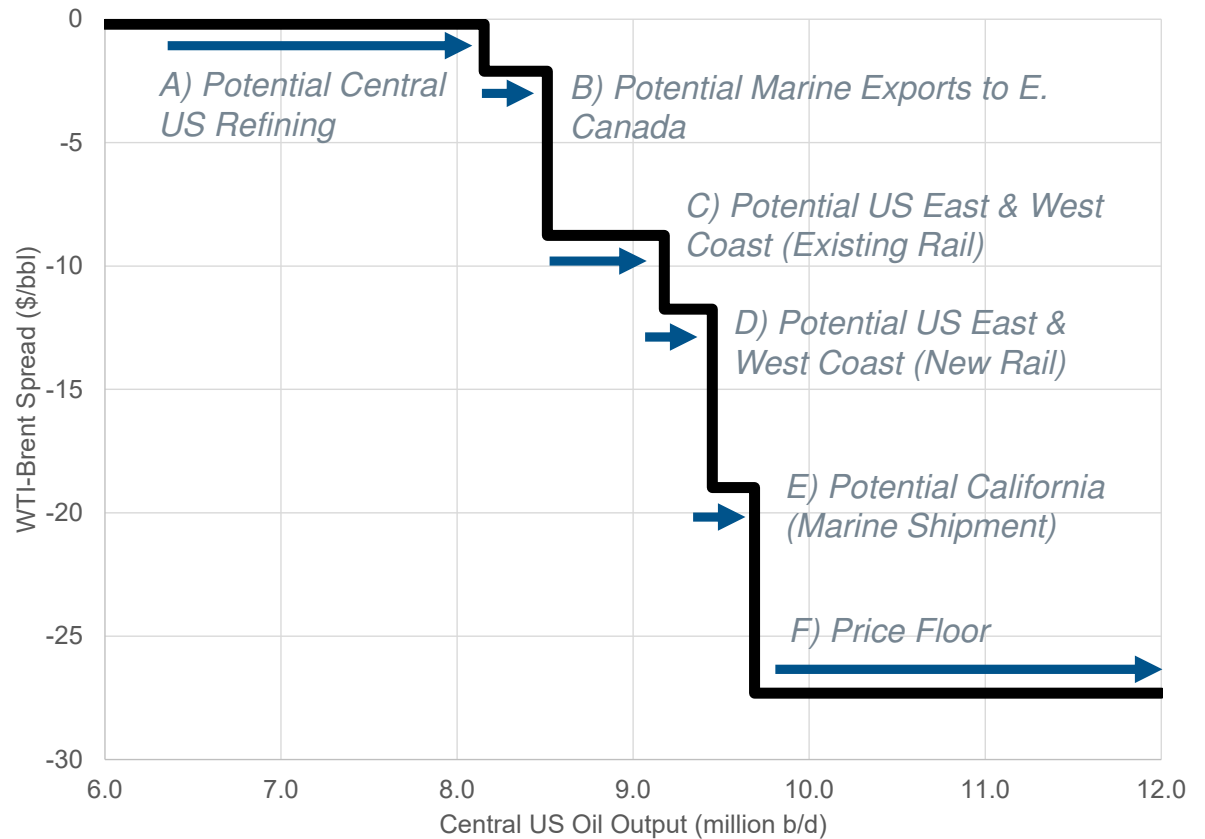
- A. **Central US** = Central US crude oil output backs out light and medium oil imports by marine vessel into Central US (PADDs 2, 3, and 4). All heavy oil imports and all Canadian imports by pipeline and rail continue.
- B. **Marine Exports to Eastern Canada** = US legally exports crude from Gulf Coast to Eastern Canada on foreign flagged vessels.
- C. **Existing Rail to East & West Coast** = existing rail infrastructure is used to move crude from the Central US to the East and West Coasts. Rail volumes back out light and medium crude imports by marine vessel. Canadian imports by pipelines continue.
- D. **New Rail to East & West Coasts** = expansion in Bakken rail volumes to US East and West Coasts until refinery downstream units cannot handle the additional light ends. Alaskan crude to Washington State is displaced to California and Hawaii.
- E. **Marine Vessel to California** = the Alaska Jones Act tanker fleet is used to ship crude from the Gulf Coast to California while Alaskan crude is legally exported to Asia on foreign-built, US-flagged and US crewed vessels. Maximum volumes to California are limited by the available capacity of Jones Act Aframax tankers. Crude-by-rail to California assumed not possible due to local opposition.



Oil Output-Price Curve

- Absorption potential in each market is limited by logistics constraints and month-to-month refinery demands.
- As Central US output increases in the Export Ban Case, greater discounts are needed to cover logistics costs to East and West Coast markets.
- Discounts vary month-to-month based on rail freight, diesel costs, tank car lease rates, the delivered cost of competing imports, and the spread between WTI and other Central US crudes at the railhead or marine dock.

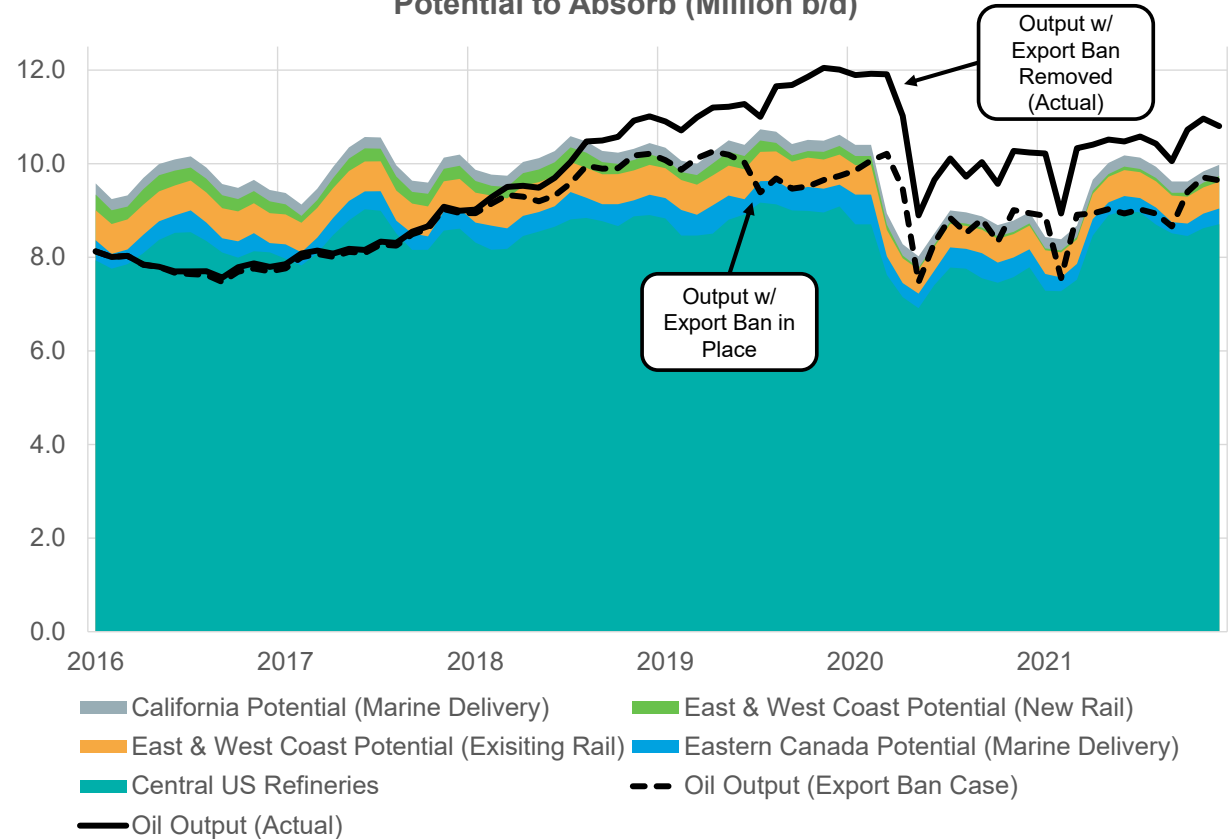
Central US Oil Output vs. WTI-Brent Discount, Average 2016



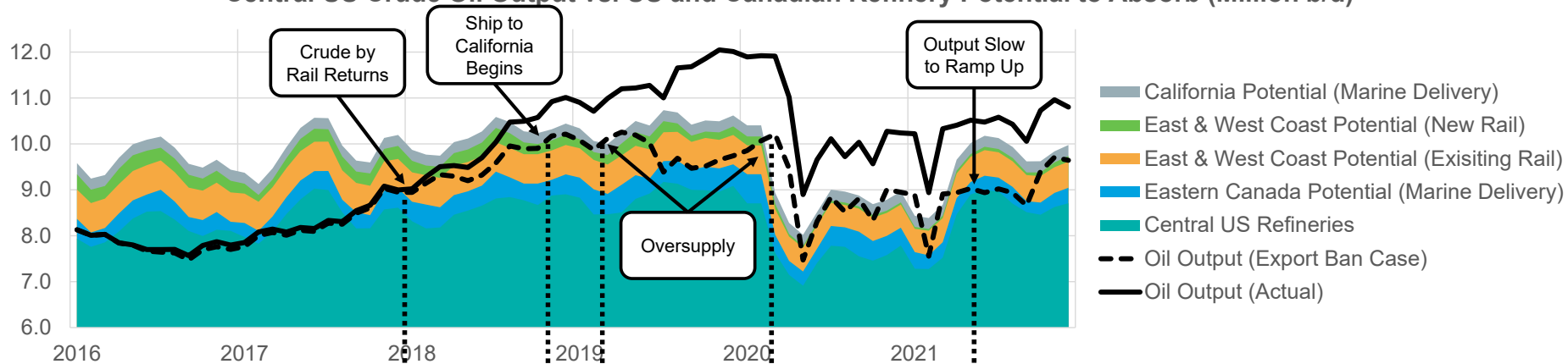
Oil Output vs. Potential to Absorb

- In the Export Ban Case, price discounts to move crude by rail and ship lower rig activity, creating a delta between Base Case (Actual) and Export Ban Case production (see [slide 13](#)).
- Export Ban Case Central US oil output exceeds Central US refinery absorption potential starting in Q4 2017 and existing rail potential to the East and West Coasts starting in Q1 2018.
- In early 2019, Export Ban Case output pushes toward the limit of US and Canadian potential to absorb, triggering sharp price declines (see [next slide](#)).

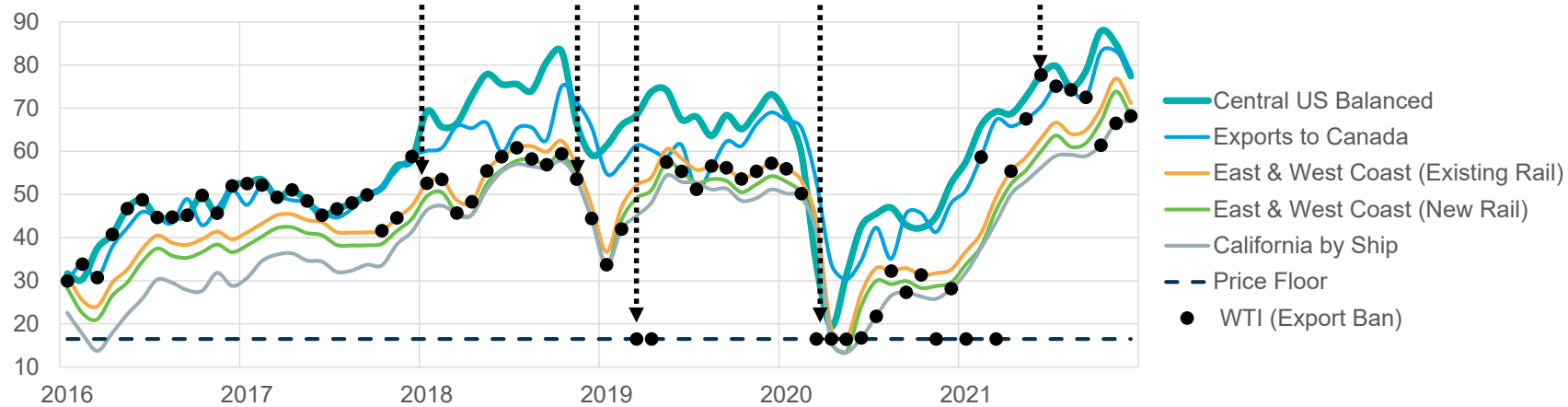
Central US Crude Oil Output vs. US and Canadian Refinery Potential to Absorb (Million b/d)



Central US Crude Oil Output vs. US and Canadian Refinery Potential to Absorb (Million b/d)

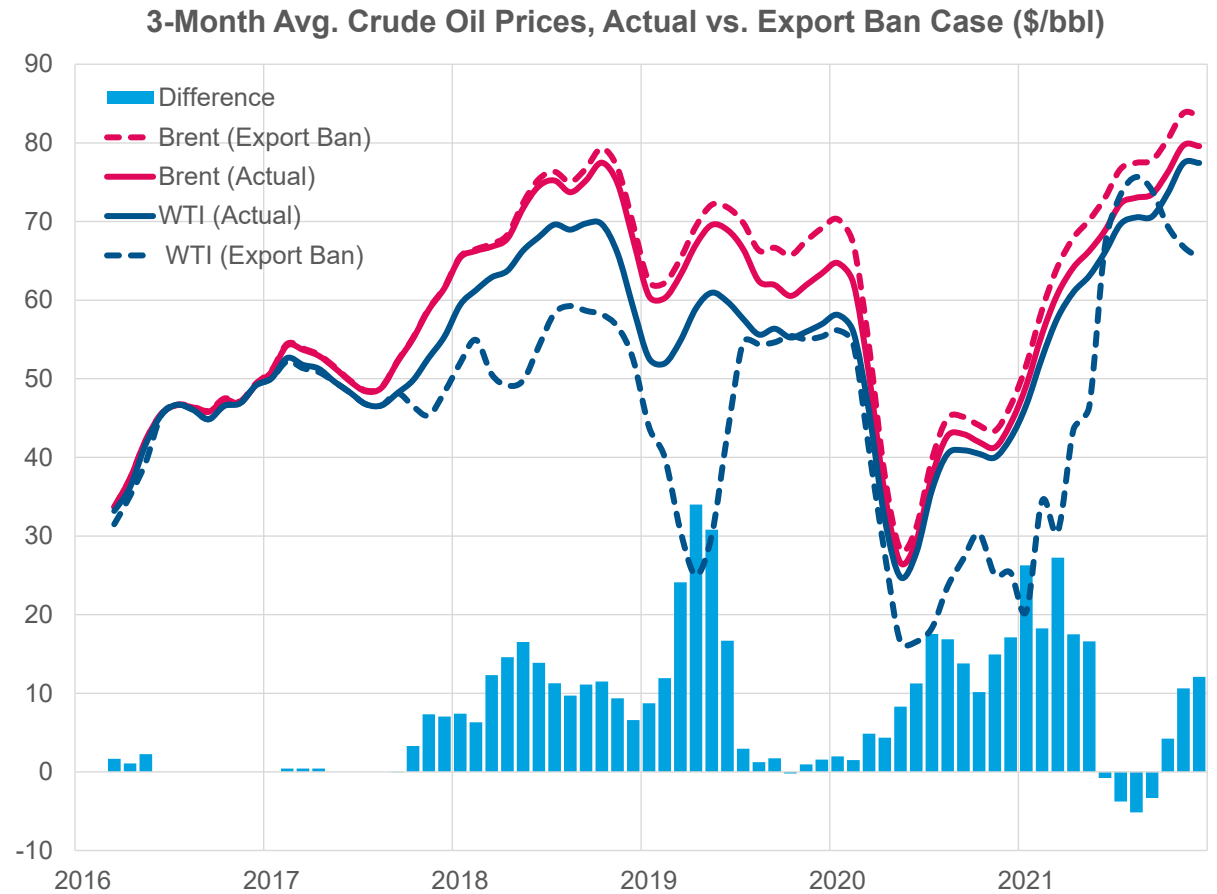


WTI Netbacks by Pathway (\$/bbl)



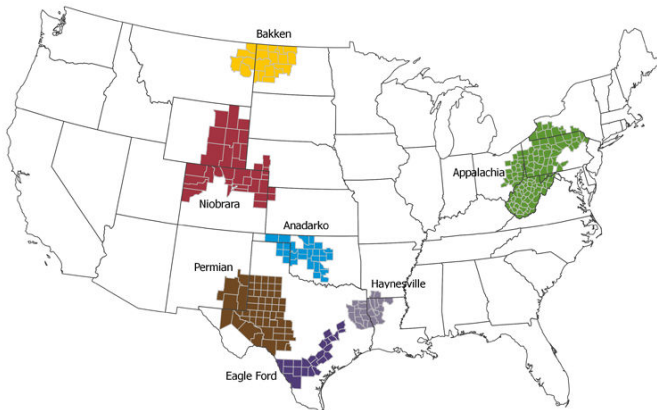
Benchmark Crude Oil Price Impacts

- As Central US oil output is pushed to the coasts in the Export Ban Case, WTI prices are discounted to cover transport costs by rail and ship.
- Export Ban Case WTI discounts vs. Base Case (Actual) blow out in 2018-19 and then again in 2020 and 2021 due oversupply conditions.
- Meanwhile, Export Ban Case Brent prices increase versus the Base Case (Actual) due to loss of US output from global supply.

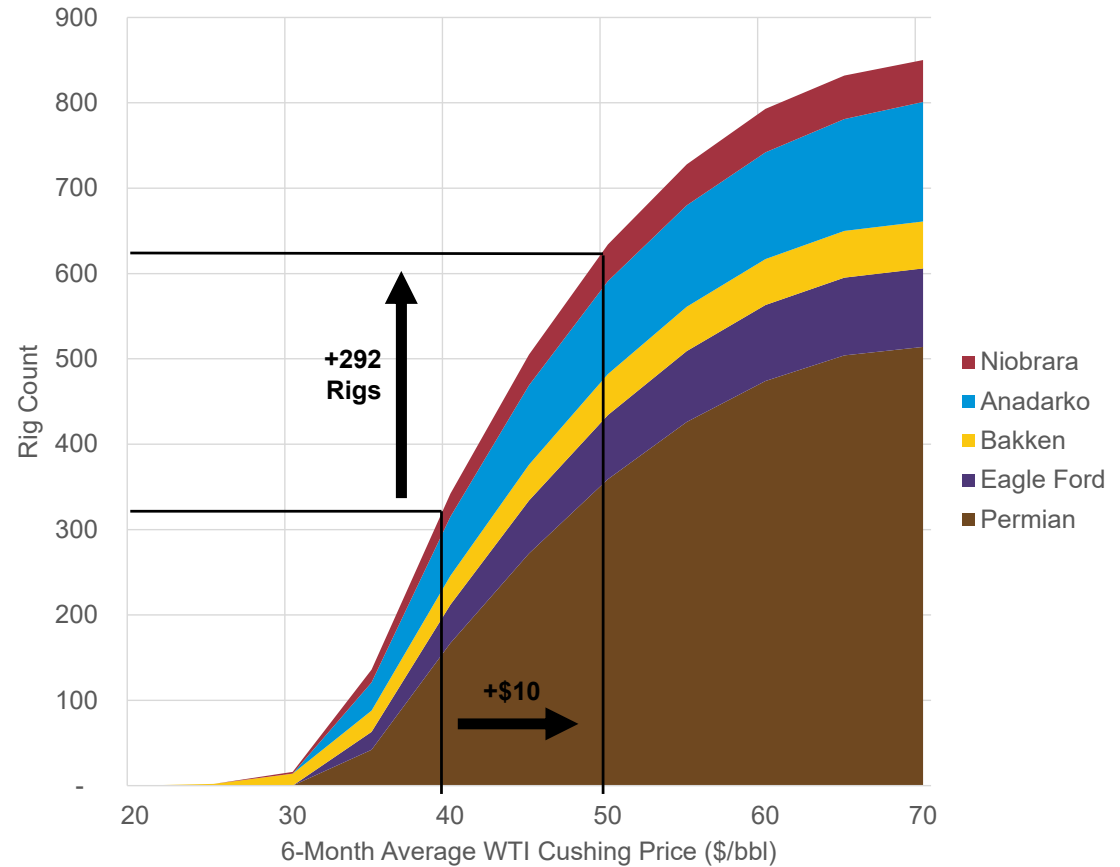


Oil Price-Rig Count Function

- ICF's shale oil output model adds or subtracts rigs from shale plays based on oil price changes.
- Rig counts are highly sensitive to oil price changes between \$30 and \$60 per barrel.
- At higher oil prices constraints on resources limit the ability to add more rigs and drill more wells. At lower oil prices nearly all shale rigs disappear.



U.S. Oil Shale Drilling Rigs by Play vs. 6-Month Avg. WTI Cushing Oil Price

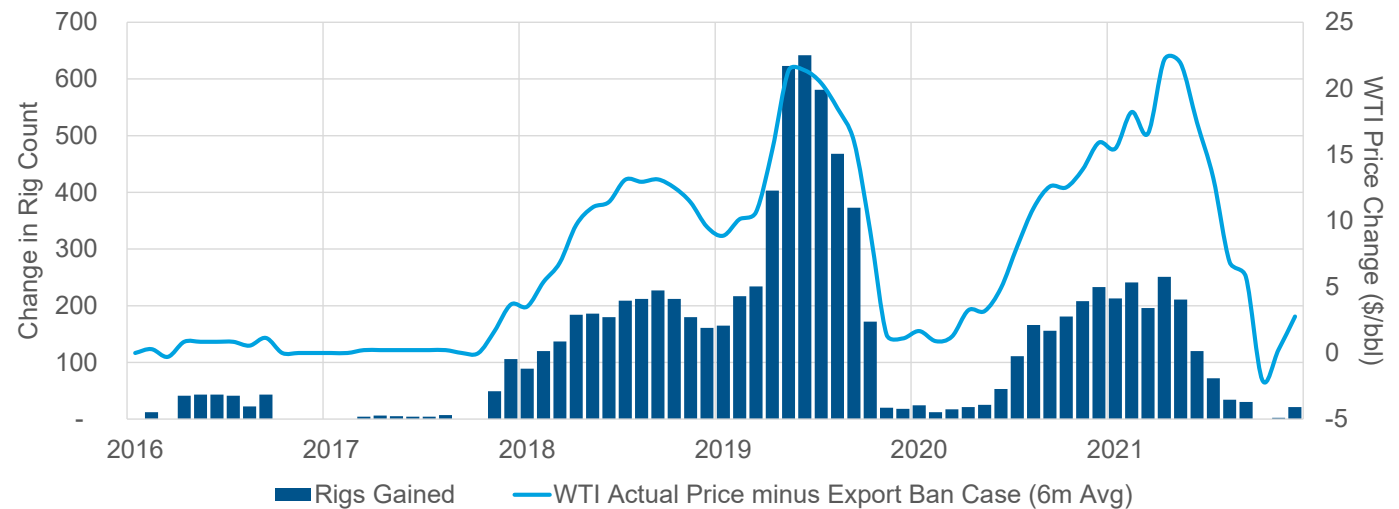


Note: The above chart includes the five oil-directed U.S. shale plays for the period Jan. 2016 through February 2020. The function changes in March 2020.

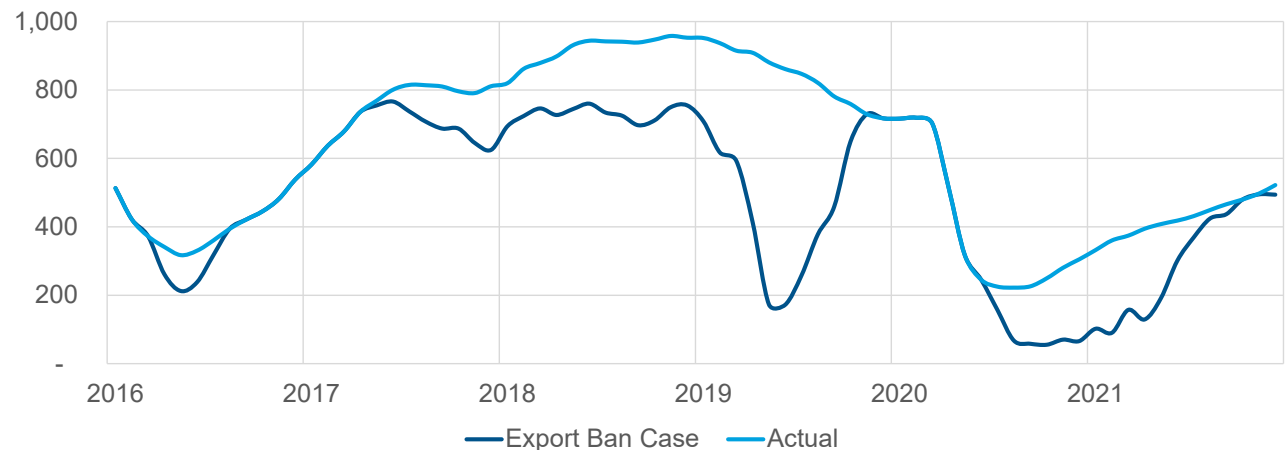
Shale Play Rig Count Impact

- Rig count gains are estimated for shale plays only. Drilling activity in non-shale areas (e.g., Offshore GOM, Alaska, etc.) are not as sensitive to short-term price fluctuations.
- Lifting the Export Ban resulted in peak US rig count gains of more than 600 rigs in mid-2019 but also allow for faster a rebound for U.S. oil producers after the 2020 COVID-19 lockdowns.

Rigs Gains & WTI Price Change, Actual vs. Export Ban Case

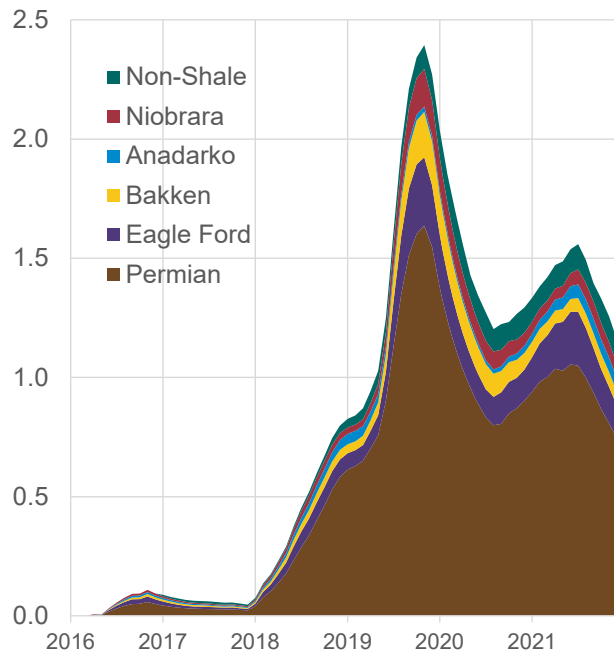


U.S. Shale Play Rig Count, Actual vs. Export Ban Case



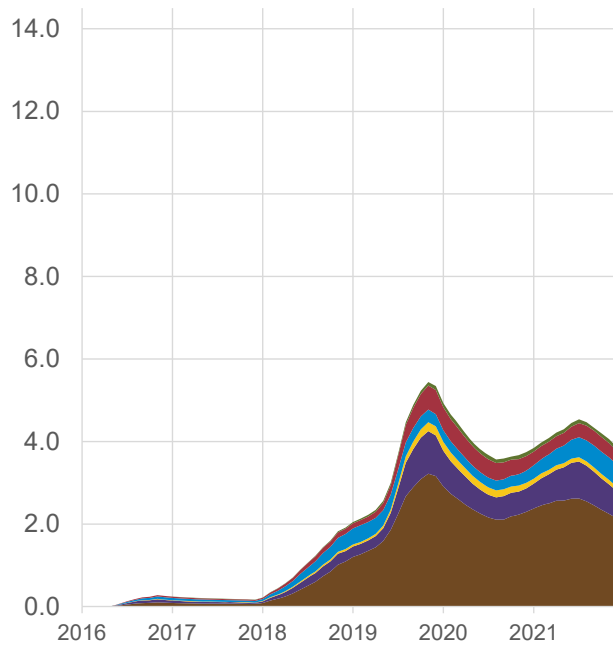
Output Impacts: Gains from Lifting the Oil Export Ban

**Crude Oil Output Gains
(Million Barrels per Day)**



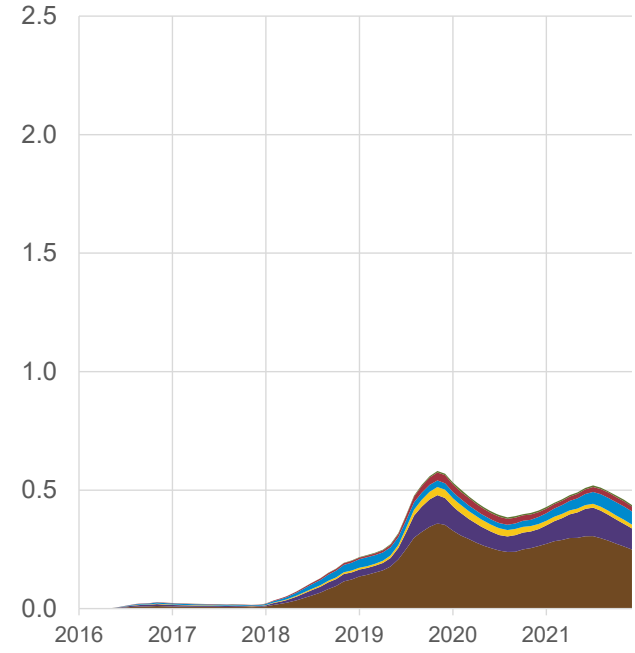
Peak Month Gain: +2.4 million b/d
Total Gain: +1.8 billion barrels

**Dry Natural Gas Output Gains
(Billion Cubic Feet per Day)**



Peak Month Gain: +5.4 Bcf/d
Total Gain: +4.8 trillion cubic feet

**NGL Output Gains
(Million Barrels per Day)**

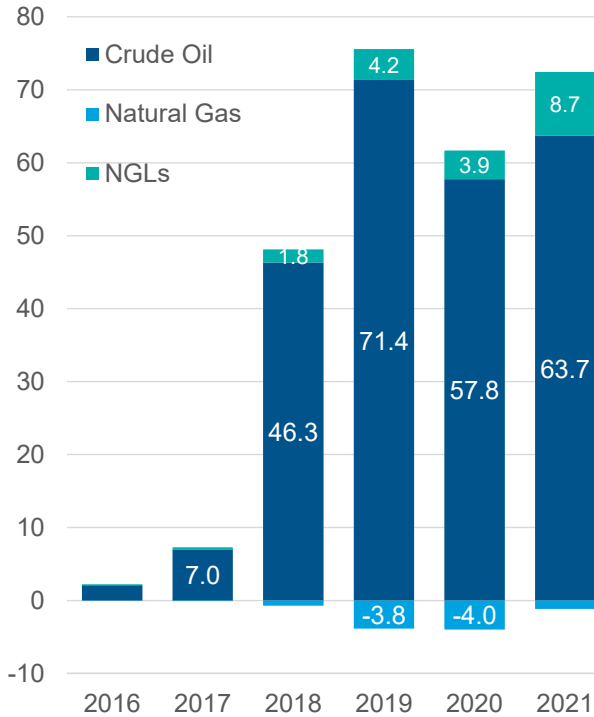


Peak Month Gain: +0.60 million b/d
Total Gain: +0.5 billion barrels

Producer & Consumer Impacts

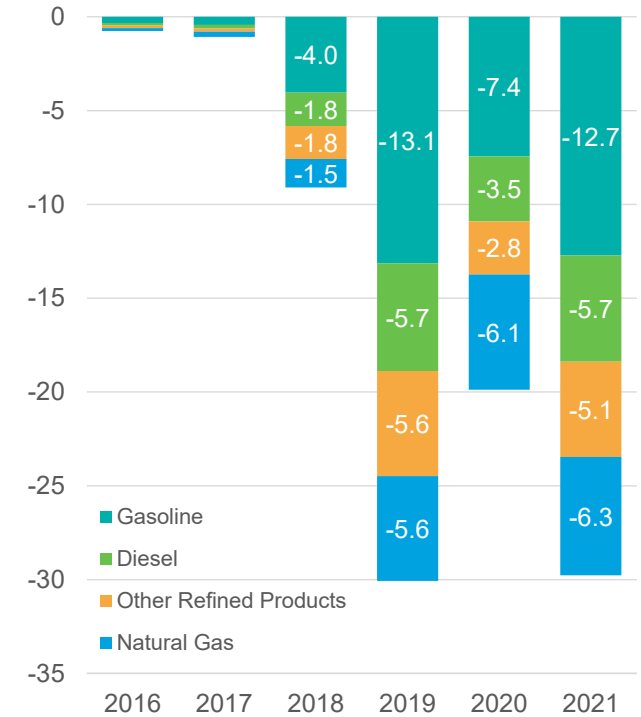
- Upstream oil and gas producer revenue gains include both crude oil output volume gains and gains due to higher prices on all Central US oil output.
- Natural gas revenue impacts are slightly negative on a net basis because output volume gains are offset by lower wellhead prices on all output.
- Refined product consumer expenditures are lower as increases in US oil output add to the global oil supply and lower globally-traded crude oil and refined product prices.
- Natural gas consumer prices are lower due to the impact of increased output on US prices.

Upstream Oil & Gas Producer Revenue Gains by Product (\$ billion, nominal)



Peak Gain: +\$72 billion (net)
Total Gain: +\$258 billion (net)

Change in Consumer Expenditures (\$ billion, nominal)



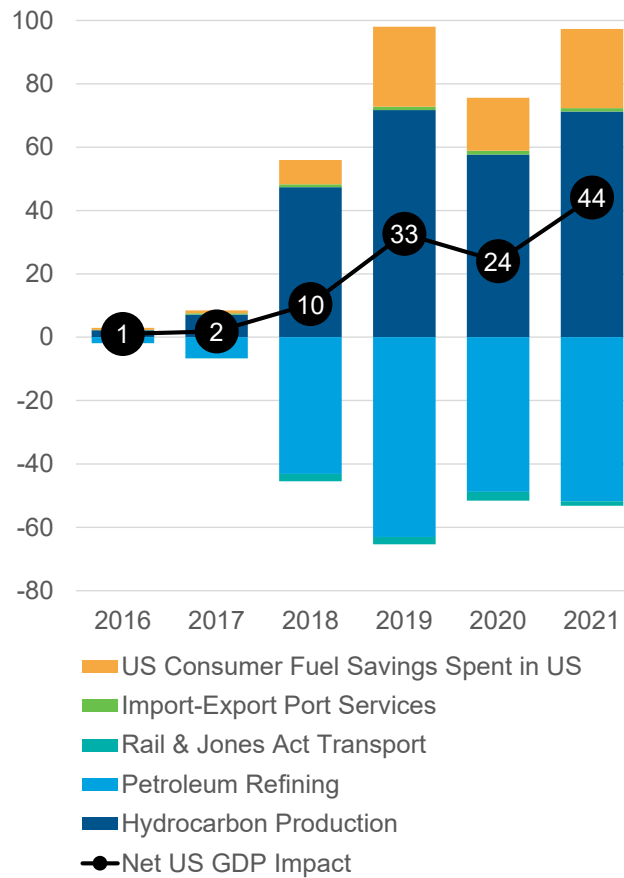
Peak Decrease: -\$30 billion
Total Decrease: -\$92 billion

U.S. GDP Impacts

- Direct & indirect GDP gains include increased revenues for oil & gas producers, import-export port services, and consumer fuel cost savings.
- Direct & indirect GDP losses include reductions to petroleum refinery margins and lower revenues for crude-by-rail and Jones Act vessel operators.
- Total GDP gains include a 1.4X “multiplier effect” reflecting the impact of increased direct and indirect personal incomes on the broader economy.

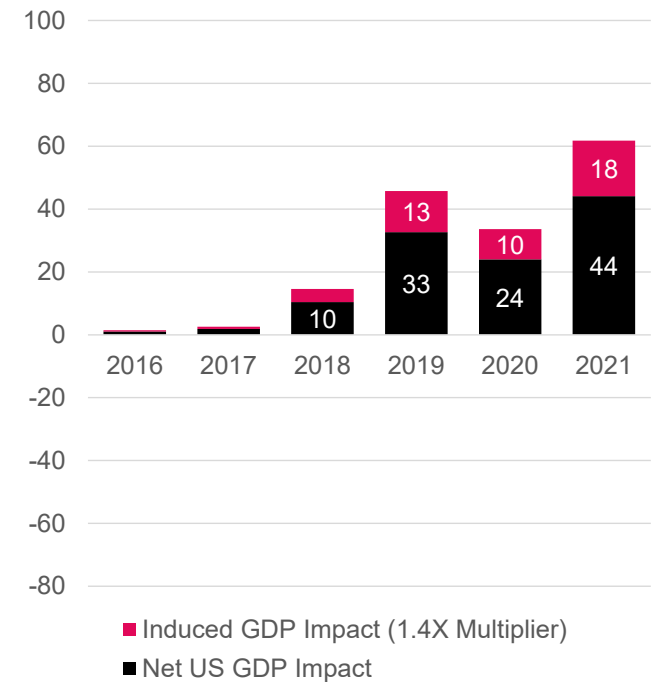


U.S. GDP Direct & Indirect Impacts by Sector (\$ billion, nominal)



Peak Impact: +\$44 billion
Total Impact: +\$114 billion

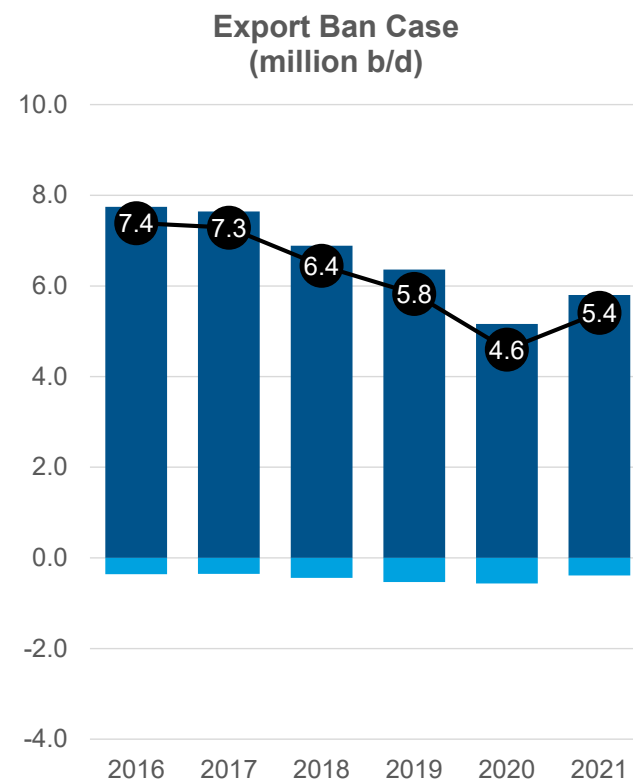
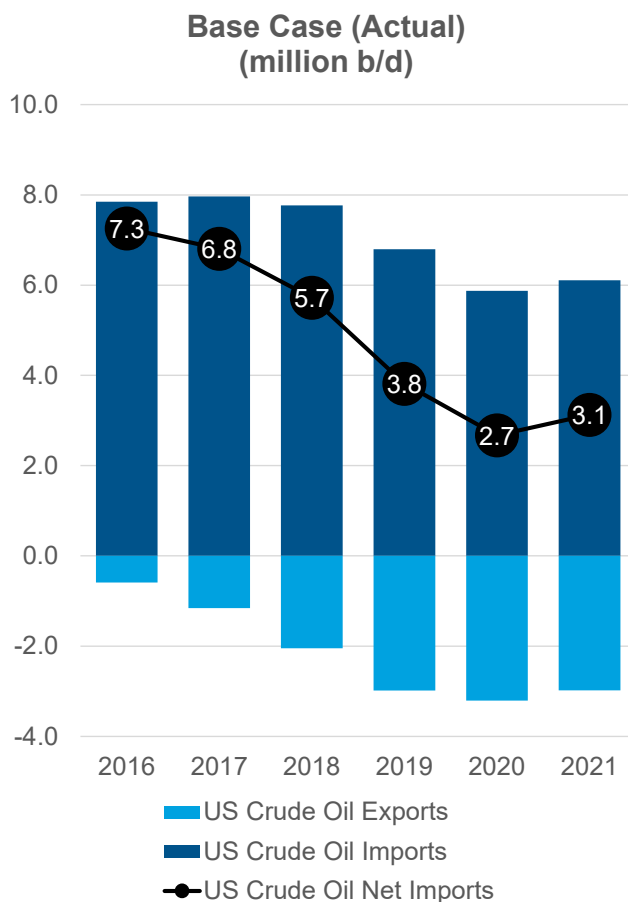
U.S. GDP Impacts Including Induced Effects (\$ billion)



Peak Impact: +\$63 billion
Total Impact: +\$161 billion

Crude Oil Trade Balance Impacts

- Lifting the ban on U.S. exports has resulted in higher overall trade volumes (both exports and imports) versus the Export Ban Case.
- On a net basis, lifting the ban has reduced U.S. crude oil net imports.

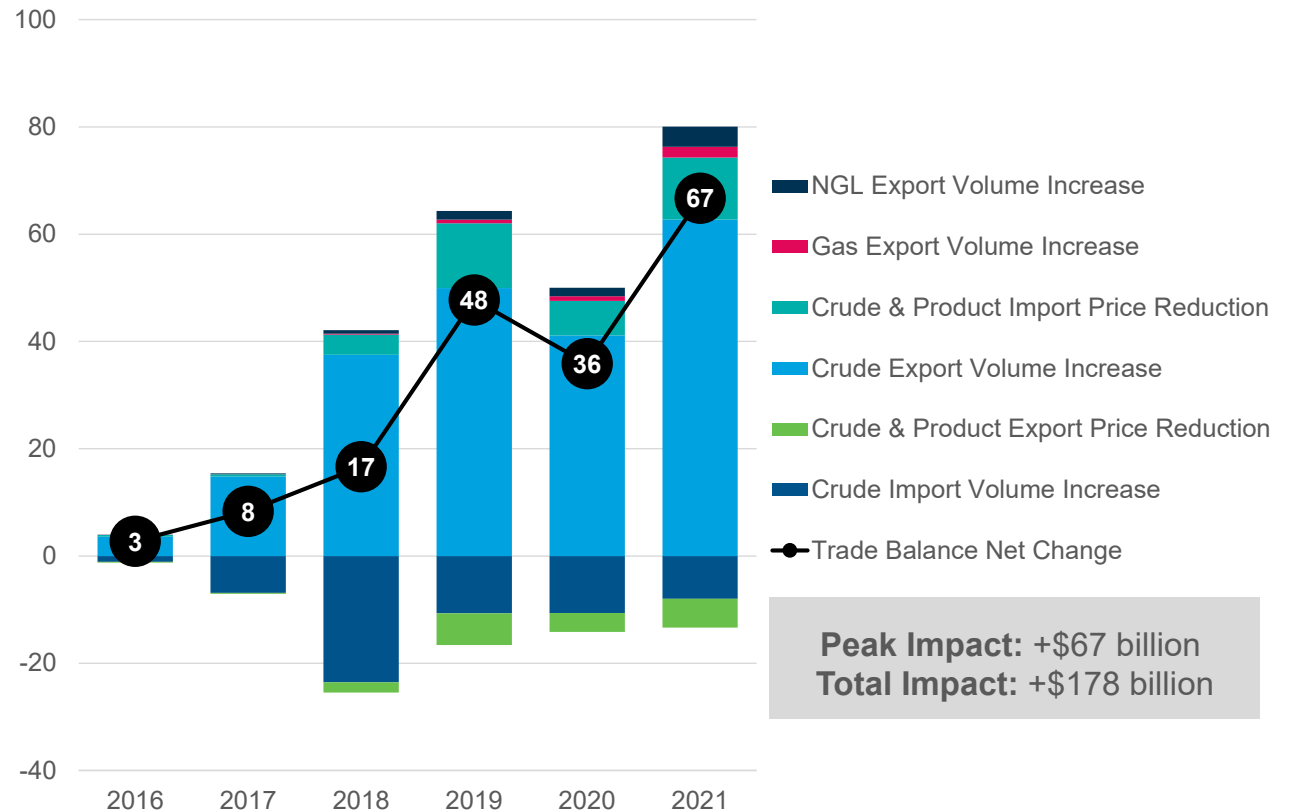


Net Imports
Peak Difference: -2.3 million b/d
Cumulative Difference: -2.8 billion bbls

U.S. Trade Balance Impact

- Lifting the export ban increased the volume of U.S. exports and imports, while also lowering the global price of crude oil and refined products exports and imports.
- The net effect was a positive increase in the U.S. trade balance.
- In 2021, the improvement in the trade balance accounted for an approximately 6.1% reduction in the U.S. trade deficit.

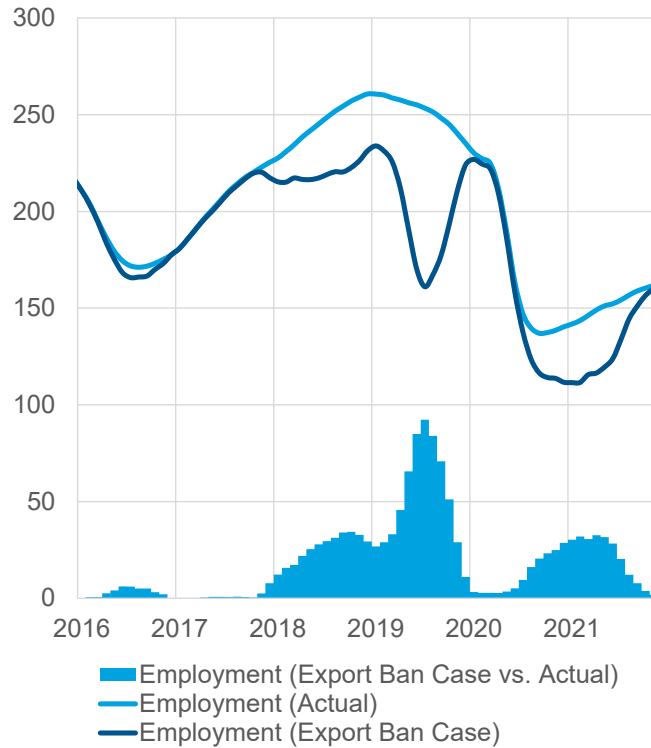
Change in U.S. Crude Trade Balance, Actual vs. Export Ban Case (\$ billion)



Direct Employment Impacts

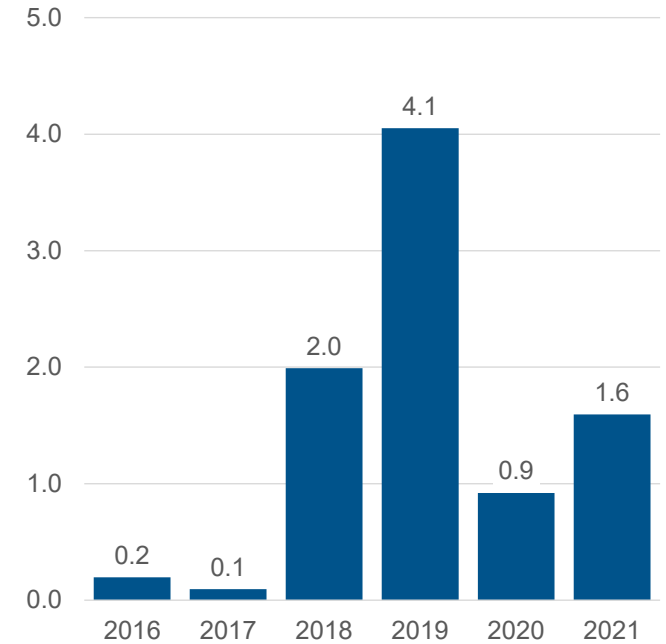
- Lifting the crude export ban has increased employment in the Upstream oil & gas support sector (e.g., petroleum engineers and geologists, industrial machinery installation and maintenance, derrick operators, rotary drill operators, roustabouts, and service unit operators).
- Employment increases result in higher total employee incomes in the sector.

U.S. Shale Oil Drilling Jobs, Actual vs. Export Ban Case (Thousand Employees)



Peak Month Gain: 92,000 jobs
Total Gain (Avg.): 19,000 jobs
Total Gain (Cumulative): 116,000 job-years

U.S. Shale Oil Drilling Employee Income Gains vs. Export Ban Case (\$ billion, nominal)

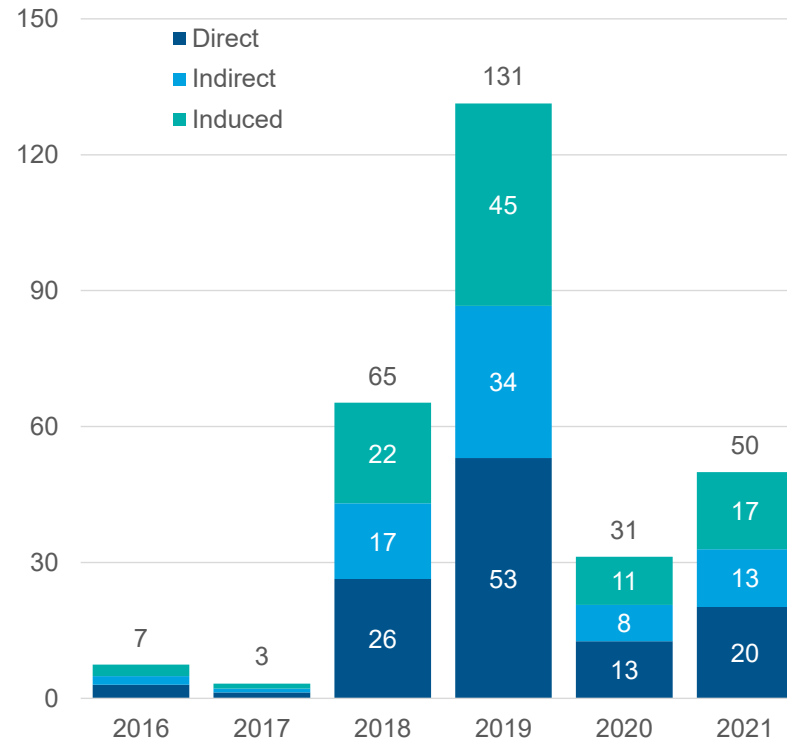


Peak Gain: \$4.1 billion
Total Gain: \$8.9 billion

Indirect and Induced Employment Impacts

- Indirect jobs are jobs created in other industries that support the functions of the upstream oil shale industry, such as frac sand suppliers, trucking, etc.
- Induced jobs are jobs created when direct and indirect employees spend their increased incomes on domestic goods and services, boosting employment in unrelated sectors.

Average Direct, Indirect, and Induced Jobs Gains, Actual vs. Export Ban Case (Thousands)



Peak Gain: 131,000 jobs
Total Gain (Avg): 48,000 jobs
Total Gain (Cumulative): 257,000 job-years

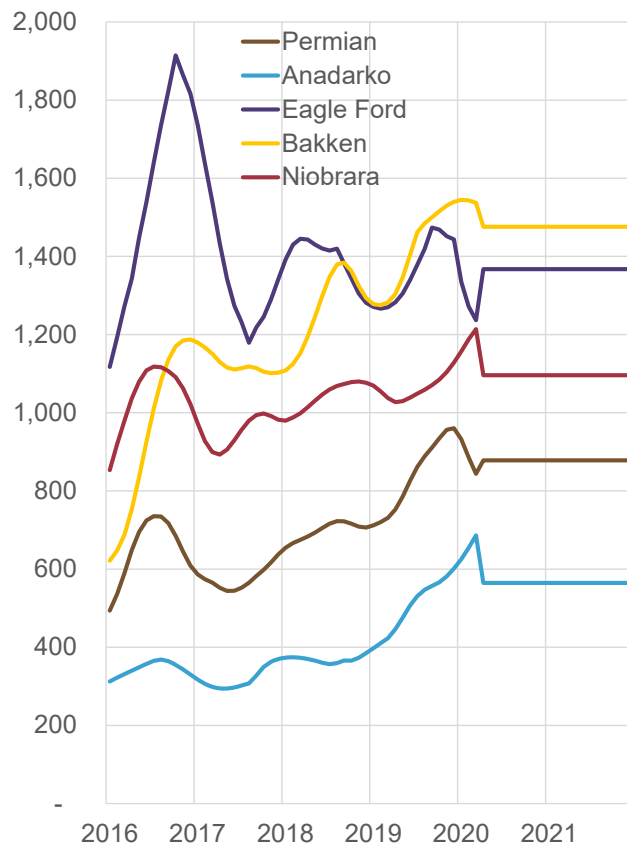


Appendix: Model Methodology

Modeling Oil Output Based on Rig Counts

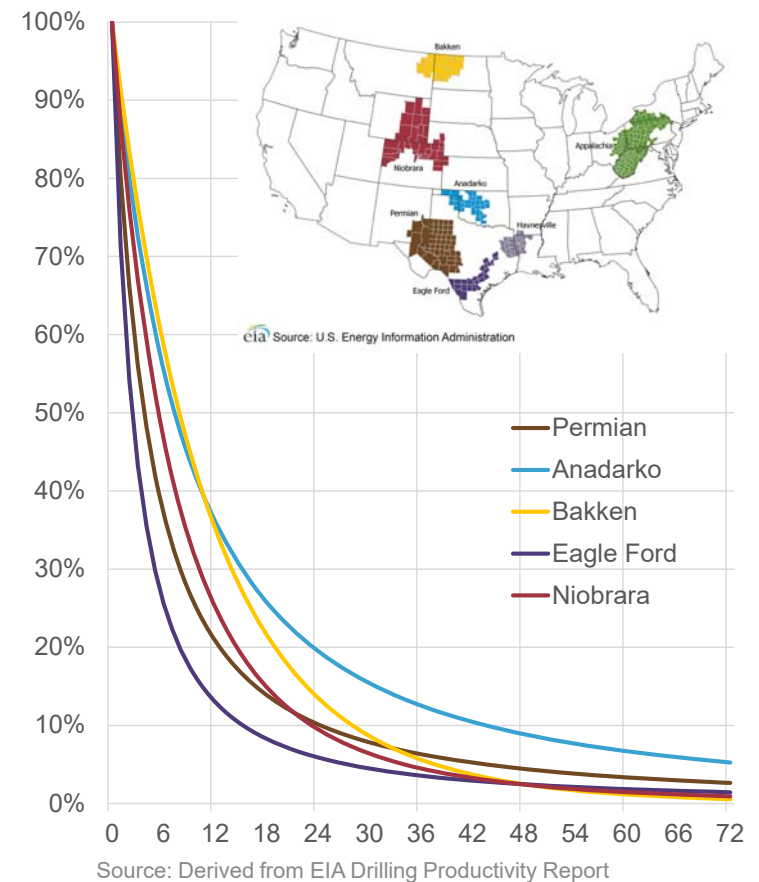
- Oil production impacts were estimated using initial and first-month oil production per rig and oil well decline curves from EIA's Drilling Productivity Report.
- Over time both initial oil production and initial well decline rates have increased, meaning that changes in rig activity have a larger impact on output.

Average First-Month Oil Production per Rig



Note: First-Month production per rig is kept flat after February 2020 due to the impact of well shut-ins and completions of drilled but uncompleted wells on this metric.

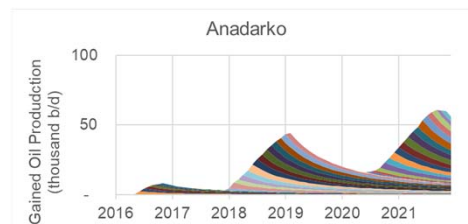
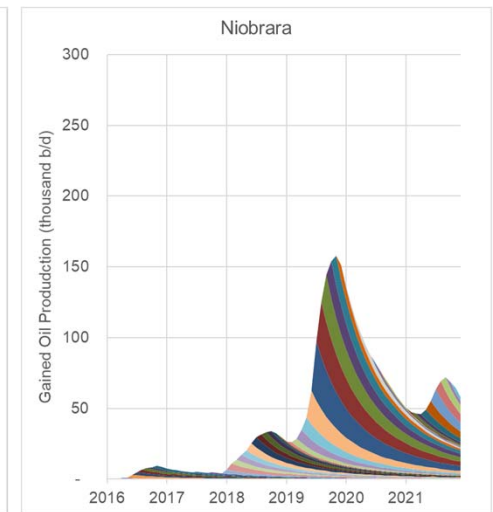
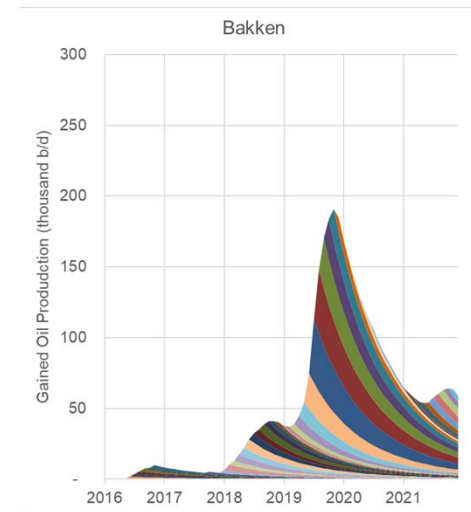
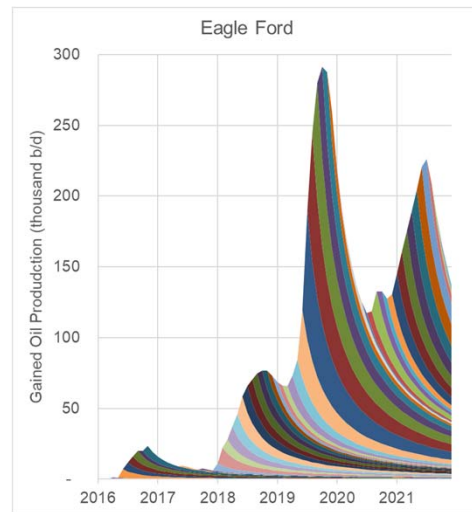
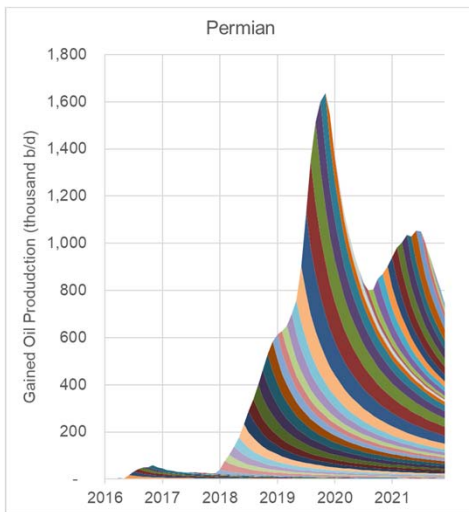
Oil Well Decline Curves by Shale Play and Month of Production, January 2016



Source: Derived from EIA Drilling Productivity Report

Crude Oil Output Impacts by Play

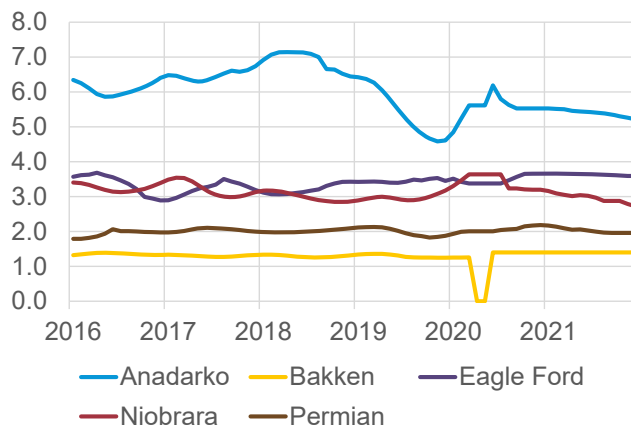
- Oil output gains were developed for each of the five oil-focused shale plays.
- Overall crude oil output gains are driven by production in the Permian Basin due to the high level of rig activity in the region during the time period observed.



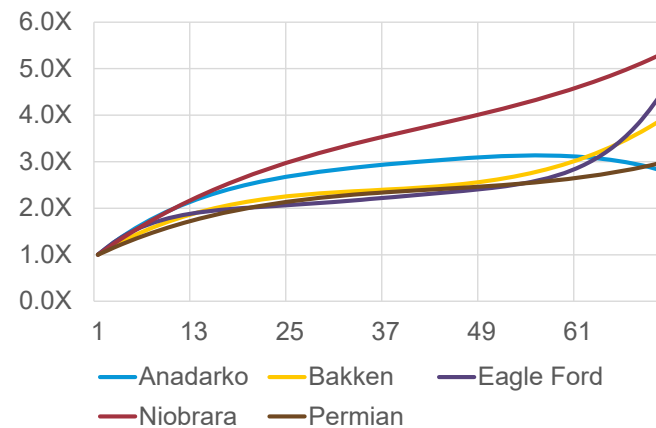
Natural Gas & NGL Parameters

- Several parameters were used to estimate impacts for associated gas and NGL production based on crude oil output changes.

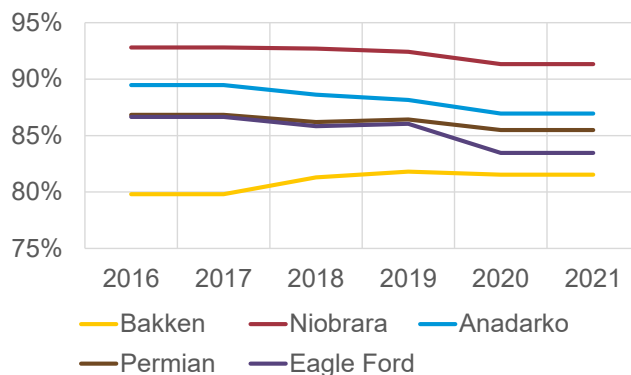
1st Month Gas-to-Oil Ratio by Play (MMcf per Barrel)



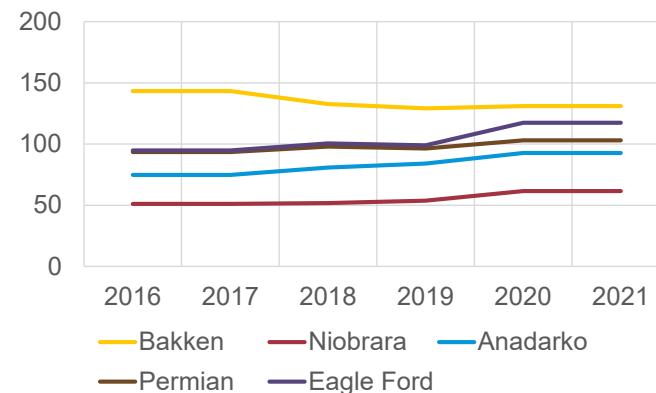
Gas-to-Oil Ratio Growth by Month of Production



Gas Captured per Oil Well (Ratio of Marketed Gas to Gross Withdrawals)



NGL Yields (Bbls per MMcf of Gas Processed)



Source: Derived from EIA Drilling Productivity Report and other EIA datasets