NRDC-NEMS Analysis of a Moratorium on New Offshore Leasing in the Gulf of Mexico

Prepared for the Natural Resources Defense Council (NRDC)

September 1, 2022

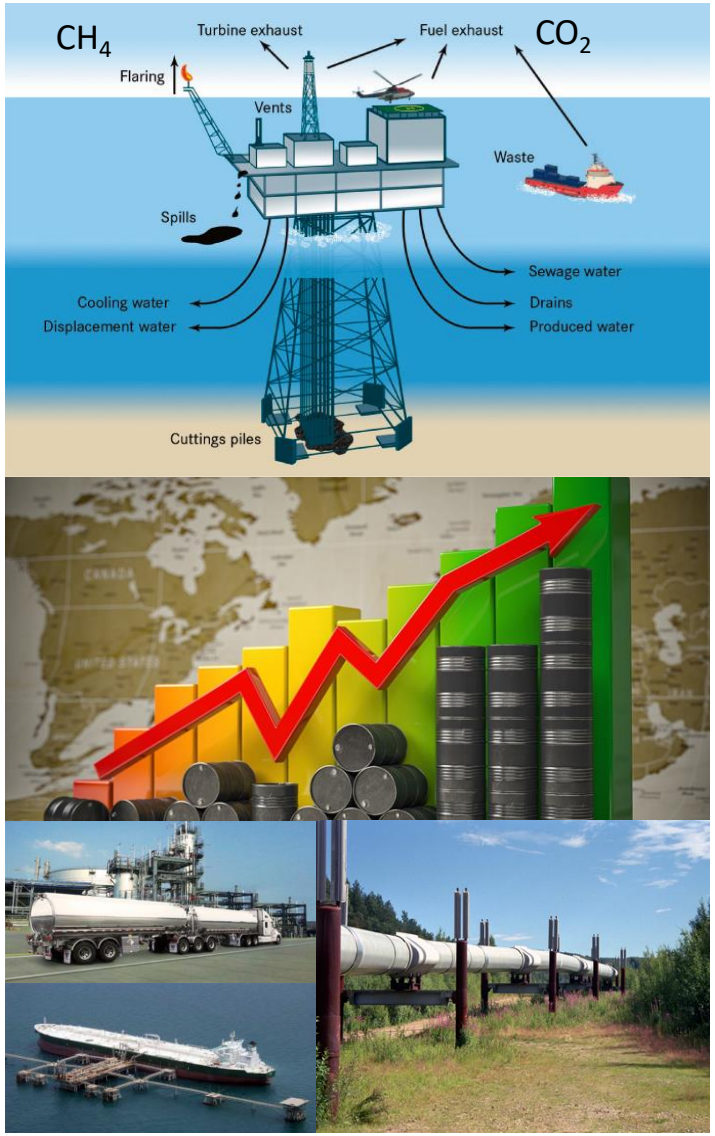
Project Goal

For the period through 2050, assess the impact of stopping new offshore oil and gas leasing after January 2021 in the Gulf of Mexico (GOM), while continuing onshore and offshore leases prior to January 2021 on:

(1) Production and price of crude oil and natural gas;

(2) Price of gasoline, diesel; and

(3) Emissions of carbon dioxide (CO_2) and methane (CH_4)



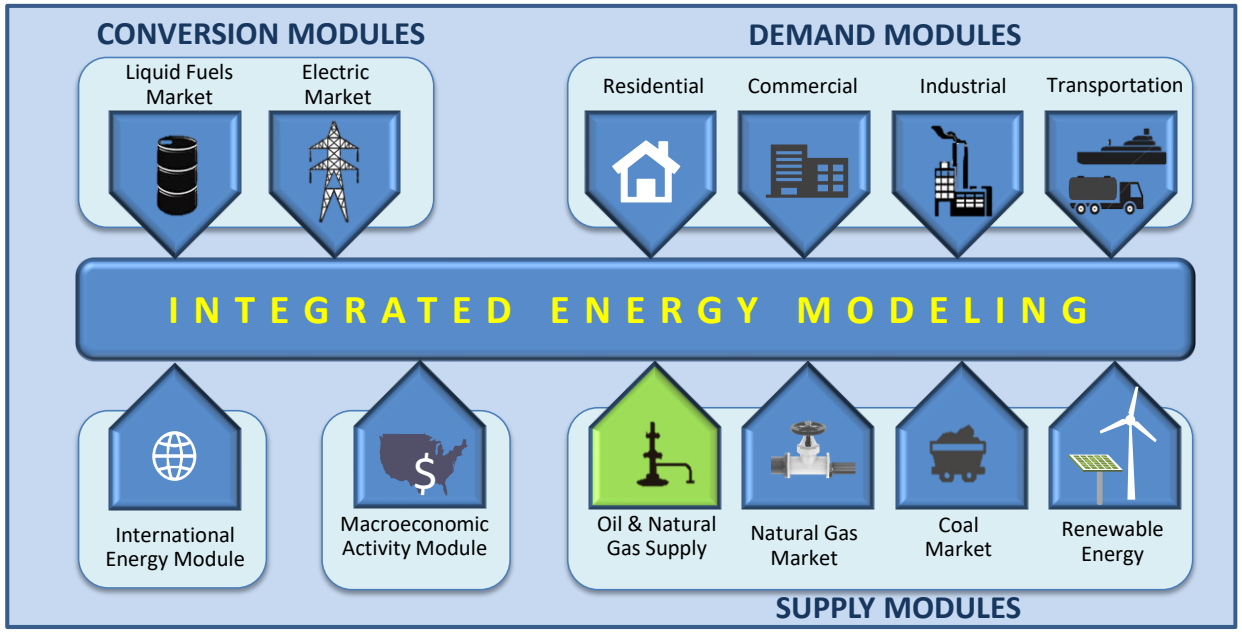
Source: [1](), [2](), [3](), [4](), [5]()

Project Approach

- Used a customized NRDC version of the U.S. Energy Information Administration (EIA) National Energy Modeling System (NEMS), called here NRDC22-NEMS[1], and ran the following scenarios:
  1- Reference
  2- No New Offshore Leasing
  3- No New Offshore Leasing and Low Oil Demand

- Metrics of interest for the analysis include:
  - Crude oil and natural gas production from U.S. and GOM
  - Domestic price of oil and natural gas
  - Carbon dioxide and methane emissions from oil and gas production, distribution, and consumption (including expressed as CO_2 equivalents)

- Analysis time frame is from 2021 to 2050.



National Energy Modeling System (NEMS)

[1] *NRDC22-NEMS was developed by OnLocation for use in this analysis and is based on the AEO 2022 version of NEMS.*

Description of Scenarios

1. **Reference Case (Ref)**

   Business-as-usual, given known technological and demographic trends as well as policies and regulations used in the *Annual Energy Outlook 2022* (AEO2022) Reference Case, while including the international feedback to crude oil and natural gas imports, exports, and prices.

2. **No New Offshore Leasing Scenario**

   Build off the 'Reference Case' and includes an issuance of no new offshore leases in the GOM after January 2021 (i.e., no Lease Sale 257), while allowing onshore and offshore drilling to continue for leases before January 2021.

3. **No New Offshore Leasing & Low Oil Demand Scenario**

   Build off the 'No New Offshore Leasing Scenario' and includes Corporate Average Fuel Economy (CAFE) standard and Zero Emission Vehicle (ZEV) updates in the transportation sector to represent oil demand under more recent policies not yet reflected in the AEO2022 reference case.

No New Offshore Leasing & Low Oil Demand Scenario Assumptions

1. CAFE Standard in the Transportation Light Duty Sector

The new NHTSA CAFE rule is applied to model years 2024–2026 passenger cars and light trucks. The new standard would increase fuel economy stringency at a rate of 8% per year rather than the 1.5% year set in the Safer Affordable Fuel-Efficient (SAFE) rule previously. After 2026, fuel economy standards are assumed to rise at 3% per year from 2027 to 2040.

2. ZEV Program in the Transportation Light Duty Sector

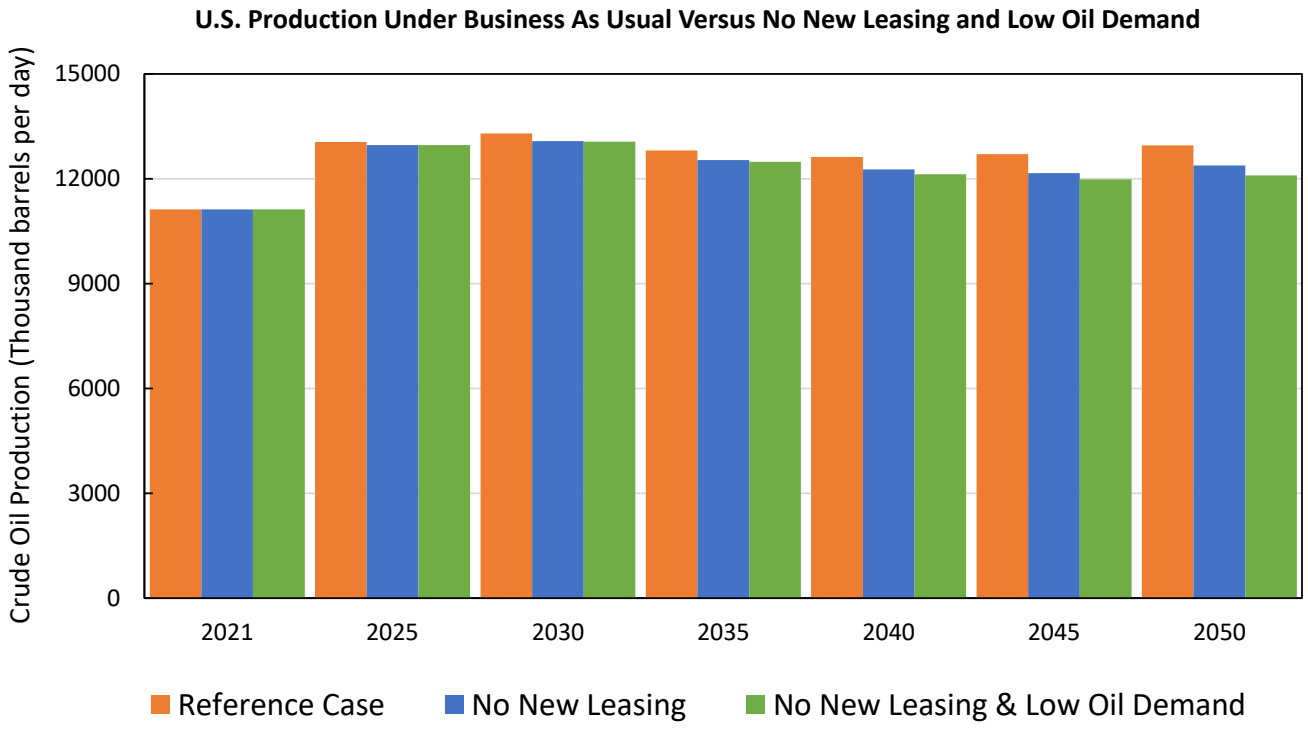
The Zero Emission Vehicle (ZEV) Program for light duty vehicles in California and 16 other states (CT, ME, MD, MA, NJ, NY, OR, WA, RI, VT, VA, MN, DE, CO, NV, NM). State-level ZEV targets are aggregated to their respective Census Divisions. For CA, NY, VA, and WA that have a high number of vehicles and have already passed legislation with more ambitious targets, we set ZEV requirements of 100% by 2035 for CA, NY, and VA and 100% by 2030 for WA. For the other 13 states, we adopted the ZEV mandates enacted before the SAFE rule preemption (16% EV and 6% PHEV) as modeled previously by EIA for Section 177 of the Federal Clean Air Act.

3. ZEV Program in the Transportation Medium-Heavy Duty Sector

The new Advanced Clean Trucks (ACT) rule for Medium-Heavy Duty Vehicles (MHDVs) requires 100% medium and heavy-duty ZEV sales by 2045 for CA and NY. For simplicity, this target is assumed for other states of MA, NJ, OR, WA that have already adopted the rule or considered similar actions. MHDV sales requirements are modeled at the regional level.

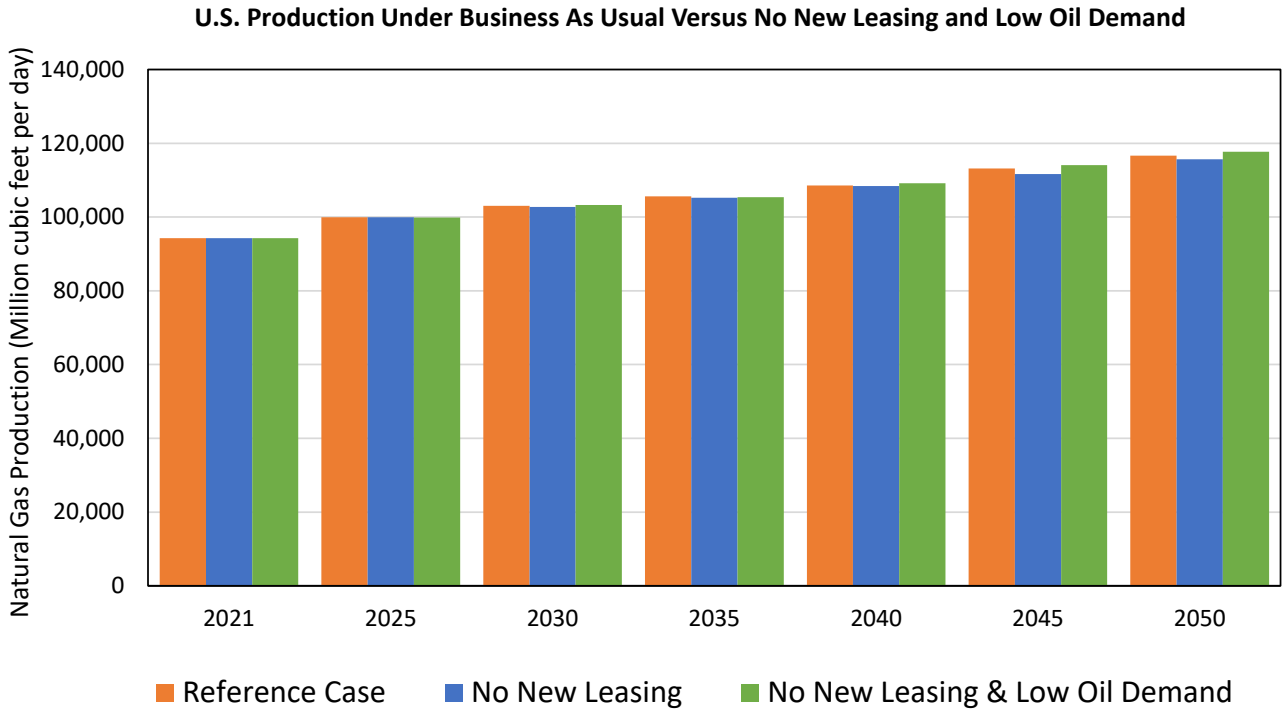
Crude Oil Domestic Production Changes

- Annual domestic production of crude oil starts to decrease from 2024 (52,000 b/d (barrels/day) reduction) to 2035 (280,000 b/d reduction) and 2050 (570,000 b/d reduction) in ‘No new leasing’ scenario relative to the reference case.
- Annual domestic production of crude oil starts to decrease from 2024 (52,000 b/d (barrels/day) reduction) to 2035 (320,000 b/d reduction) and 2050 (860,000 b/d reduction) in ‘No new leasing & low oil demand’ scenario.
- Total U.S. crude oil production is 2.2% and 4.4% lower in 2035 and 2050 in ‘No new leasing’ scenario relative to the Reference Case, respectively.
- Total U.S. crude oil production reductions of 2.5% and 6.7% in 2035 and 2050 in ‘No new leasing & low oil demand’ scenario relative to the Reference Case, respectively, are a bit larger due to lower crude oil prices that make production less attractive.



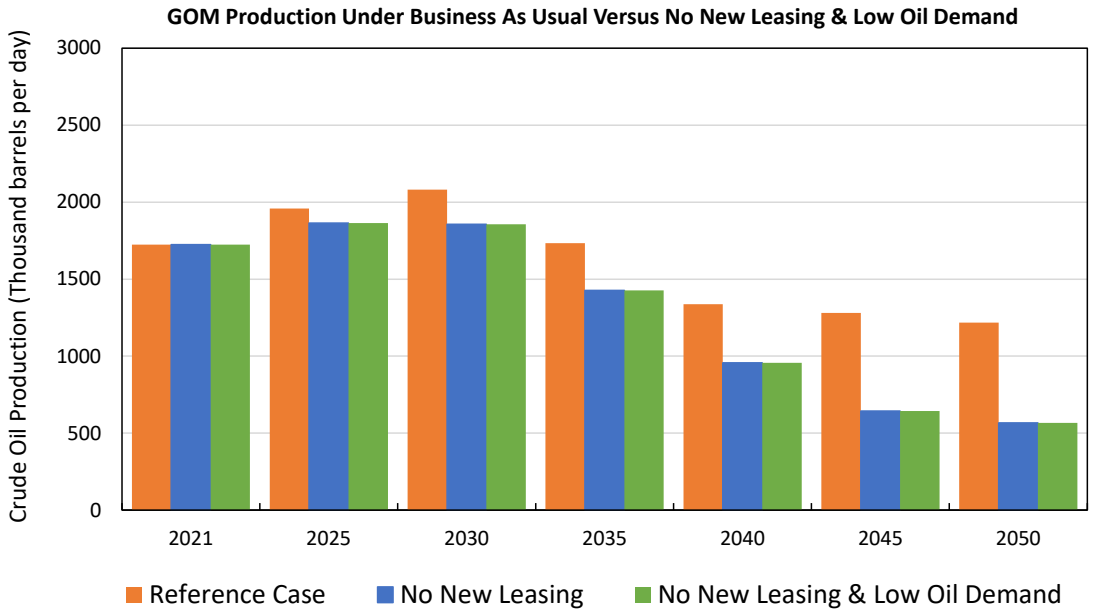
Natural Gas Domestic Production Changes

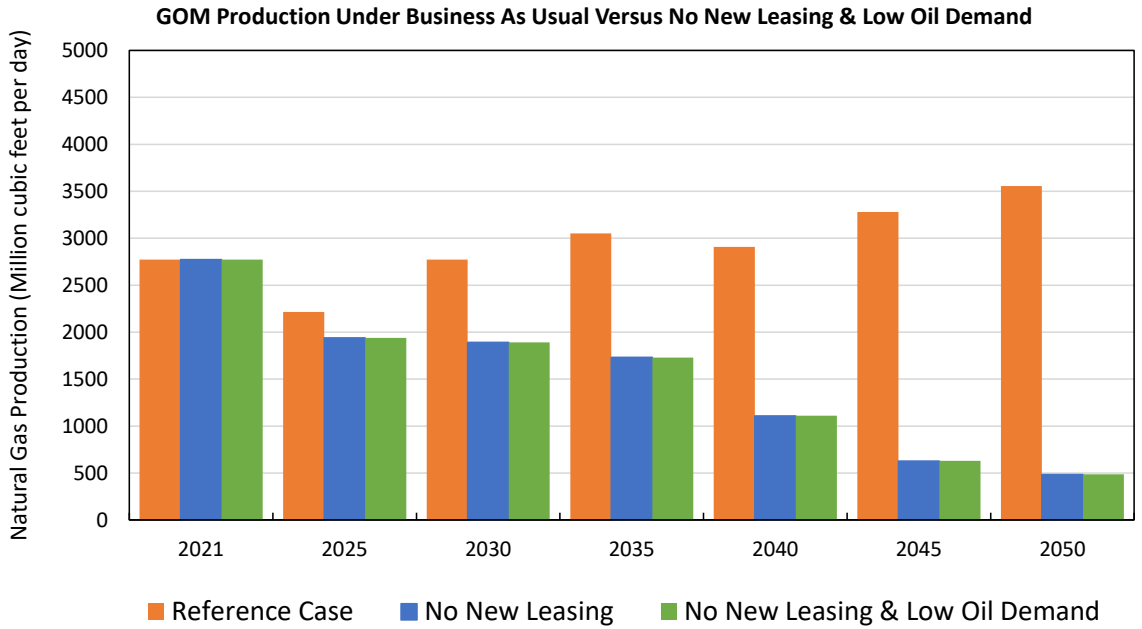
- Annual natural gas production starts to decrease in 2024 by 65 MMcf/d (Million ft^3/day) and increases to a reduction of 1000 MMcf/d by 2050 in the 'No new leasing' scenario compared to the Reference Case.
- Total U.S. natural gas production is 0.3% and 1% lower in 2035 and 2050 in 'No new leasing' relative to the Reference Case, respectively.
- In 'No new leasing & low oil demand' scenario, annual natural gas production starts to decrease in 2024 by 140 MMcf/d through 2028 to a reduction of 200 MMcf/d.
- In response to more stringent fuel economy standards and ZEV mandates in the transportation sector, the market penetration of electric vehicles (EVs) and electricity generation from natural gas increases. This results in increasing natural gas production starting in 2029. Annual natural gas production is 20 and 1400 MMcf/d higher in 'No new leasing & low oil demand' scenario than the Reference Case in 2029 and 2050.



Crude Oil and Natural Gas Domestic Production from Gulf of Mexico

- Annual crude oil production in GOM starts to decrease from 2024 (52,000 b/d reduction) through 2030 (225,000 b/d reduction), 2035 (300,000 b/d reduction), and 2050 (650,000 b/d reduction) in 'No new leasing' and 'No new leasing & low oil demand' scenarios compared to the Reference Case.
- Crude oil production from GOM in both 'No new leasing' and 'No new leasing & low oil demand' scenarios is 10%, 18%, and 54% lower than the Reference Case in 2030, 2035, and 2050, respectively.
- Annual natural gas production in GOM starts to decrease in 2024 by 150 MMcf/d (Million ft^3/day) to a reduction of 1,300 MMcf/d by 2035 and 3,070 MMcf/d by 2050 in 'No new leasing' and 'No new leasing & low oil demand' scenarios relative to the Reference.
- Natural gas production from GOM is 43% and 85% lower in 'No new leasing' and 'No new leasing & low oil demand' scenarios relative to the Reference Case in 2035 and 2050, respectively.





*It should be noted that Lease Sale 257 has now proceeded. Actual crude oil and natural gas production in GOM from a 'No new leasing' scenario that includes Lease Sale 257 would be higher than production values estimated in this analysis.

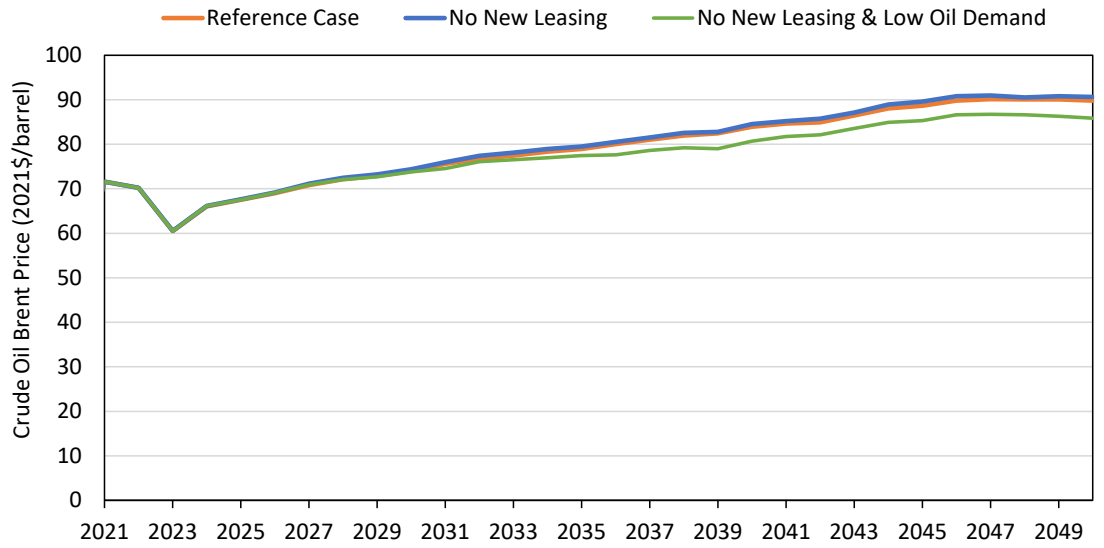
Crude Oil and Natural Gas Prices

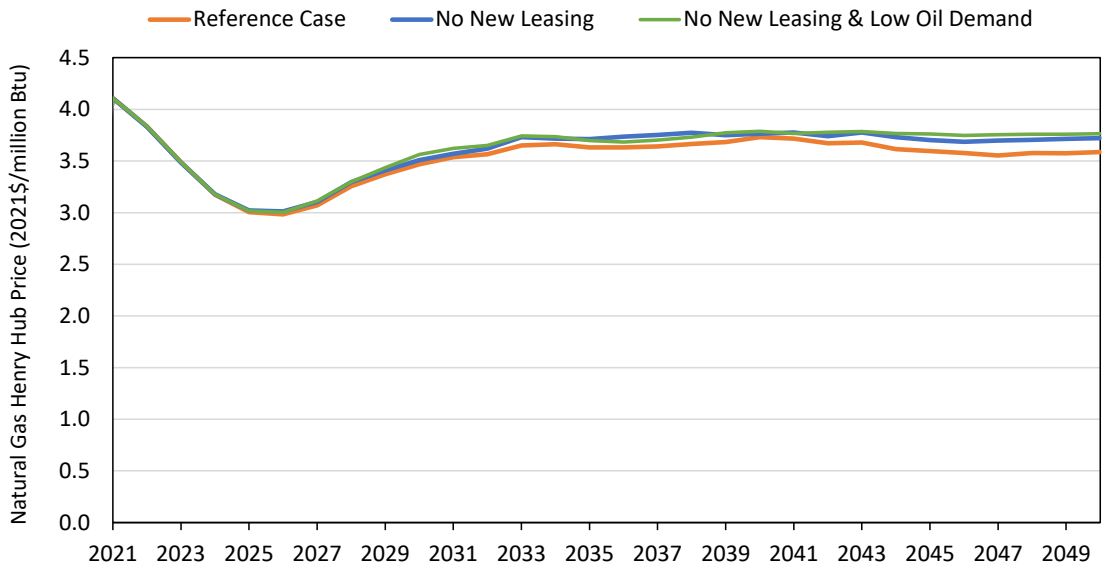
Brent crude oil prices:

- Reference and No new leasing: Decreases from $72/b in 2021 to $60/b in 2023 following historical and projected production and demand trends then steadily increases to $79/b by 2035 and $90/b by 2050.
- No new leasing with low oil demand: crude price decreases by $1.49/b by 2035 and $4/b by 2050 relative to the reference case due to lower oil demands in the transportation sector and estimated global market impacts.

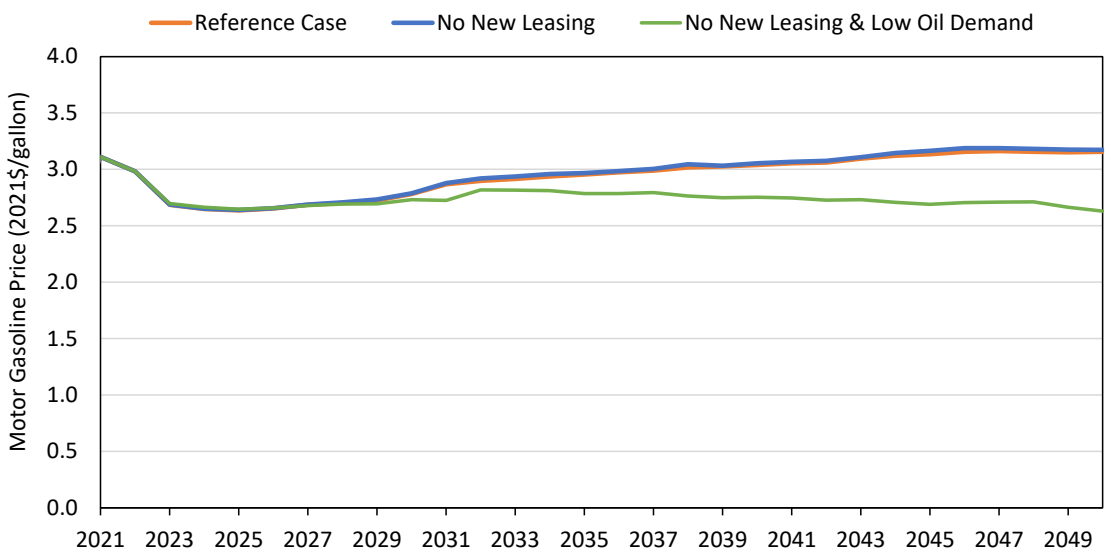
Henry Hub natural gas prices:

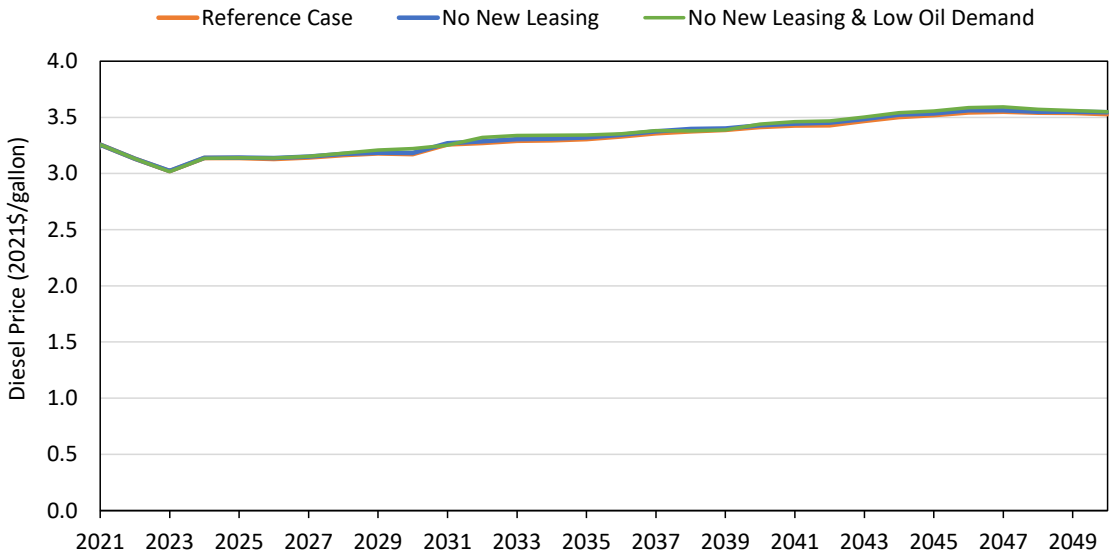
- Reference: Price decreases from $4.1/MMBtu in 2021 to $3.0/MMBtu in 2025 then rises to $3.6/MMBtu in 2035 and stays almost constant through 2050.
- No new leasing and No new leasing with low oil demand: Prices increase slightly by $0.2/MMBtu from 2030 to 2050 relative to reference.





Gasoline and Diesel Prices





- Gasoline price is $3.10/gallon in 2021 and decreases to $2.65/gallon in 2024 and gradually increases to $3.15/gallon in 2050 in Reference and 'No new leasing' scenarios.
- In 'No new leasing & low oil demand' scenario, gasoline prices follow the same quantity and trend as Reference and 'No new leasing' scenarios until 2030. From 2031 through 2050, gasoline prices are 10 to 50 cents/gallon lower than those prices in Reference Case due to higher EV adoption and lower gasoline consumption in the transportation sector.
- Diesel price starts at $3.25/gallon in 2021 and decreases to $3.00/gallon in 2023 then steadily increases up to $3.55/gallon by 2050 in all three scenarios.

Summary of Findings

		Reference Case (Ref)				
	Unit	2021	2035	2050	Change (2050-2021)	% Change relative to 2021
Emissions (Oil&gas) *						
CO2	Million metric ton	3,811	3,879	4,165	354	9.3%
CH4	Thousand metric ton	8,775	9,980	10,755	1,980	23%
CO2 equivalent	Million metric ton	4,031	4,129	4,434	403	10%
U.S. Domestic Production						
Oil	Thousand barrels per day	11,131	12,814	12,959	1,828	16%
Natural gas	Million cubic feet per day	94,250	105,601	116,691	22,441	24%
Price						
Oil (Brent)	2021$/barrel	71.6	79.0	89.8	18.2	25%
Natural gas (Henry Hub)	2021$/million btu	4.11	3.63	3.59	-0.52	-13%
Gasoline	2021$/gallon	3.11	2.95	3.15	0.05	1.5%
Diesel	2021$/gallon	3.26	3.31	3.53	0.27	8.3%

		No New Leasing				
	Unit	2021	2035	2050	Change (2050-2021)	% Change relative to 2021
Emissions (Oil&gas) *						
CO2	Million metric ton	3,811	3,869	4,134	322	8.5%
CH4	Thousand metric ton	8,775	9,962	10,715	1,940	22%
CO2 equivalent	Million metric ton	4,031	4,118	4,402	371	9.2%
U.S. Domestic Production						
Oil	Thousand barrels per day	11,131	12,535	12,384	1,252	11%
Natural gas	Million cubic feet per day	94,250	105,233	115,655	21,405	23%
Price						
Oil (Brent)	2021$/barrel	71.6	79.5	90.7	19.1	27%
Natural gas (Henry Hub)	2021$/million btu	4.11	3.71	3.72	-0.39	-9.4%
Gasoline	2021$/gallon	3.11	2.97	3.17	0.06	2.0%
Diesel	2021$/gallon	3.26	3.32	3.55	0.29	8.9%

		No New Leasing minus Ref			
	Unit	2030	2050	% Change in 2050 relative to Ref	Cumulative change from 2021 through 2050
Emissions (Oil&gas) *					
CO2	Million metric ton	-11	-31	-0.7%	-392
CH4	Thousand metric ton	-18	-41	-0.4%	-631
CO2 equivalent	Million metric ton	-11	-32	-0.7%	-408
U.S. Domestic Production					
Oil	Thousand barrels per day	-279	-575	-4.4%	-3130 million barrels
Natural gas	Million cubic feet per day	-368	-1,036	-0.9%	-4.8 trillion cubic feet
Price					
Oil (Brent)	2021$/barrel	0.55	0.84	0.9%	
Natural gas (Henry Hub)	2021$/million btu	0.08	0.14	3.8%	
Gasoline	2021$/gallon	0.01	0.02	0.6%	
Diesel	2021$/gallon	0.01	0.02	0.5%	

From 2021 through 2050 and compared to the Reference case, 'No new leasing' scenario results in cumulative reductions of:

- 3100 million barrels domestic oil production
- 5 trillion ft^3 domestic natural gas production
- 410 million metric ton CO_2 equivalent

* CO2 and CH4 emissions from oil/gas exploration and production outside U.S. associated with imported oil and gas are not included in this analysis.

Summary of Findings

		Reference Case (Ref)				
	Unit	2021	2035	2050	Change (2050-2021)	% Change relative to 2021
Emissions (Oil&gas) *						
CO2	Million metric ton	3,811	3,879	4,165	354	9.3%
CH4	Thousand metric ton	8,775	9,980	10,755	1,980	23%
CO2 equivalent	Million metric ton	4,031	4,129	4,434	403	10%
U.S. Domestic Production						
Oil	Thousand barrels per day	11,131	12,814	12,959	1,828	16%
Natural gas	Million cubic feet per day	94,250	105,601	116,691	22,441	24%
Price						
Oil (Brent)	2021$/barrel	71.6	79.0	89.8	18.2	25%
Natural gas (Henry Hub)	2021$/million btu	4.11	3.63	3.59	-0.52	-13%
Gasoline	2021$/gallon	3.11	2.95	3.15	0.05	1.5%
Diesel	2021$/gallon	3.26	3.31	3.53	0.27	8.3%

		No New Leasing & Low Oil Demand				
	Unit	2021	2035	2050	Change (2050-2021)	% Change relative to 2021
Emissions (Oil&gas) *						
CO2	Million metric ton	3,811	3,722	3,817	6	0.2%
CH4	Thousand metric ton	8,775	9,989	10,862	2,086	24%
CO2 equivalent	Million metric ton	4,031	3,972	4,089	58	1.4%
U.S. Domestic Production						
Oil	Thousand barrels per day	11,131	12,492	12,097	965	8.7%
Natural gas	Million cubic feet per day	94,250	105,398	117,687	23,437	25%
Price						
Oil (Brent)	2021$/barrel	71.6	77.5	85.8	14.2	20%
Natural gas (Henry Hub)	2021$/million btu	4.11	3.70	3.76	-0.34	-8.3%
Gasoline	2021$/gallon	3.11	2.79	2.63	-0.48	-15%
Diesel	2021$/gallon	3.26	3.34	3.55	0.29	9.0%

		No New Leasing & Low Oil Demand minus Ref			
	Unit	2035	2050	% Change in 2050 relative to Ref	Cumulative change from 2021 through 2050
Emissions (Oil&gas) *					
CO2	Million metric ton	-158	-347	-8.3%	-4,863
CH4	Thousand metric ton	9	106	1.0%	1,179
CO2 equivalent	Million metric ton	-157	-345	-7.8%	-4,833
U.S. Domestic Production					
Oil	Thousand barrels per day	-322	-862	-6.7%	-4230 million barrels
Natural gas	Million cubic feet per day	-203	996	0.9%	3.9 trillion cubic feet
Price					
Oil (Brent)	2021$/barrel	-1.489	-3.979	-4.4%	
Natural gas (Henry Hub)	2021$/million btu	0.066	0.179	5.0%	
Gasoline	2021$/gallon	-0.169	-0.526	-16.7%	
Diesel	2021$/gallon	0.036	0.023	0.6%	

From 2021 through 2050 and compared to the Reference case, 'No new leasing & low oil demand' scenario results in cumulative reductions of:

- 4200 million barrels domestic oil production
- 4800 million metric ton CO_2 equivalent

And cumulative increase of 4 trillion ft^3 domestic natural gas production

* CO2 and CH4 emissions from oil/gas exploration and production outside U.S. associated with imported oil and gas are not included in this analysis.