

# Pennsylvania's Energy Exploration

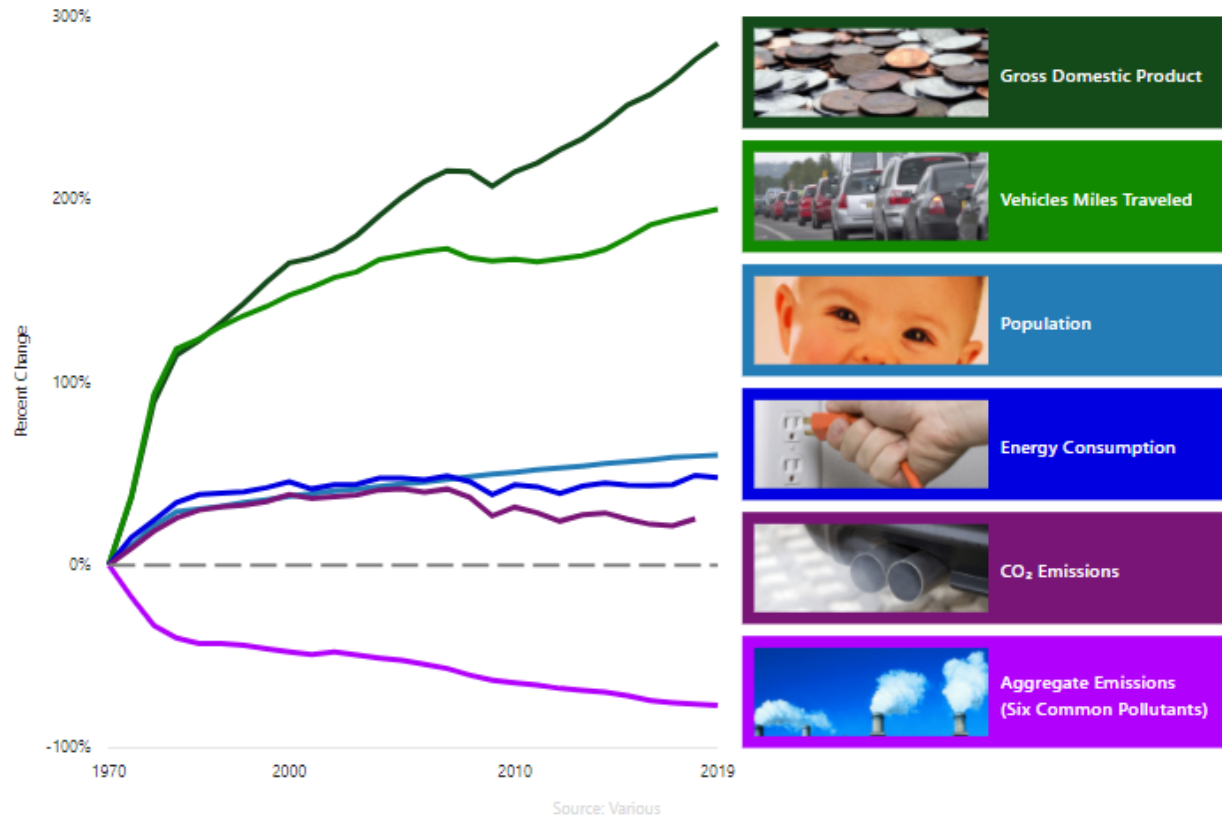
The burgeoning shale sector has:

- Improved air quality across the state and helped the USA lead the world in GHG reductions
- Brought on a manufacturing renaissance
- Bolstered global energy security for the United States and its allies

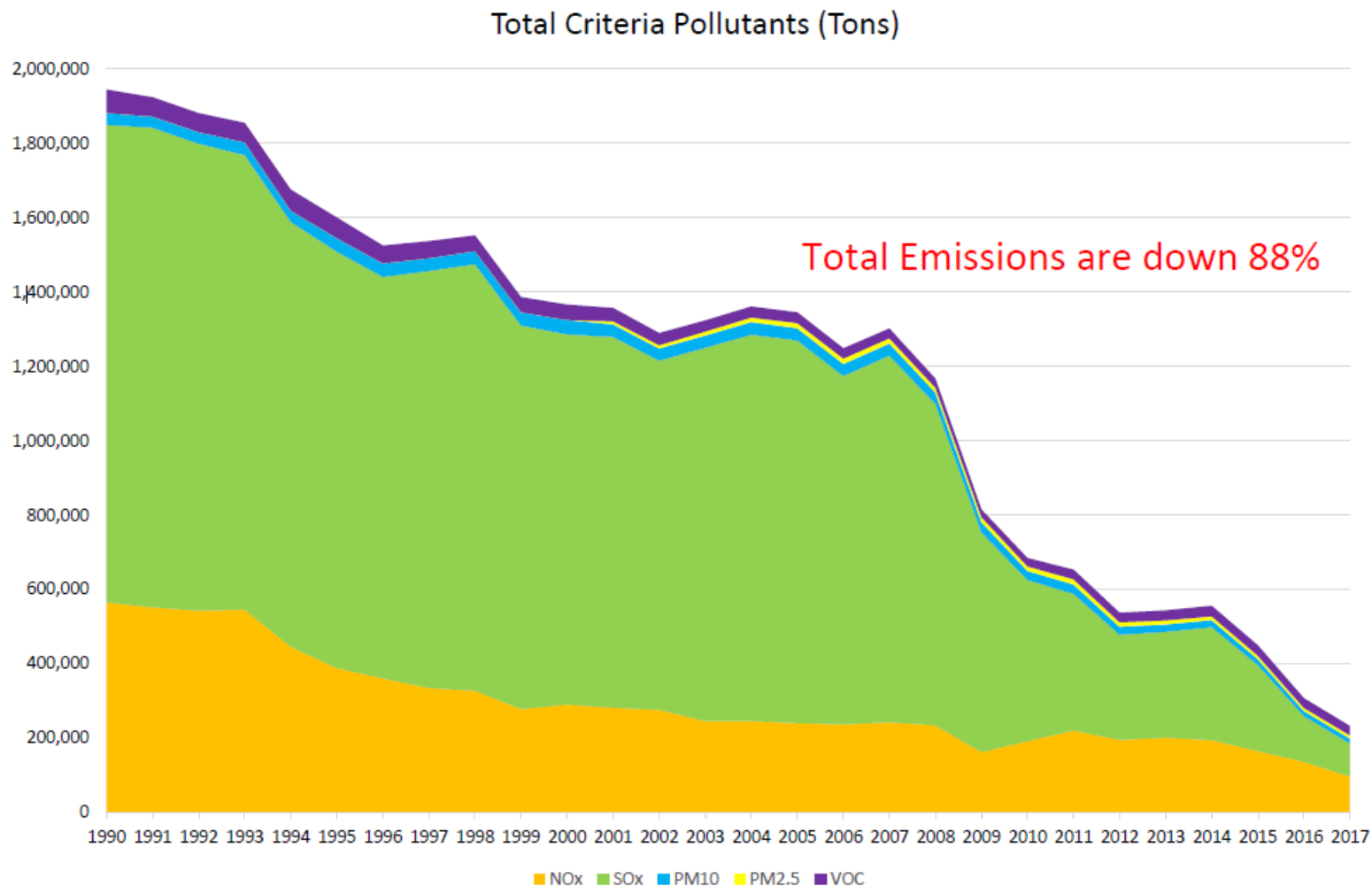
# Long-term Trends in Air Quality and Economic Growth

Comparison of Growth Areas and Declining Emissions  
1970-2019

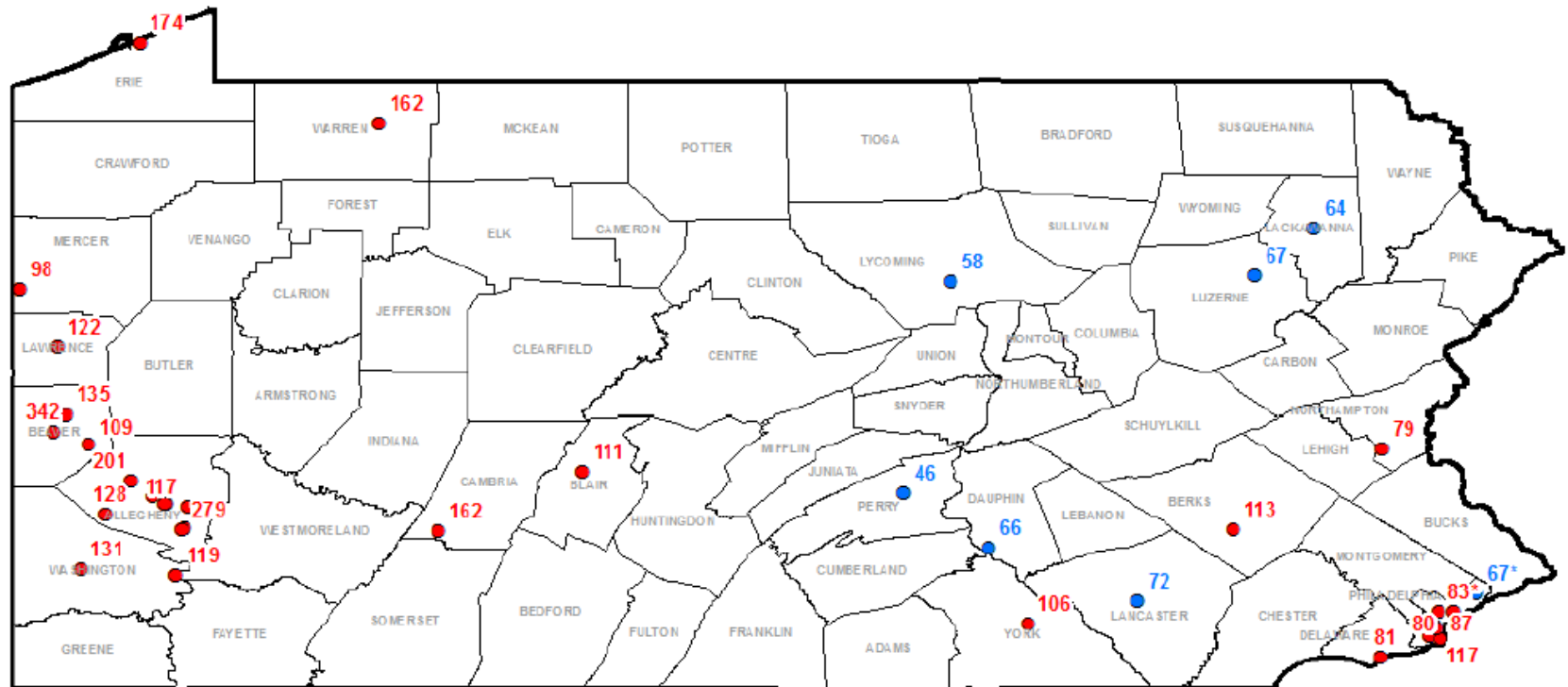
000



# DEP Data: NAAQS Criteria Emissions Reductions



# 1991 State of Air Quality – 1-hour SO<sub>2</sub>



Appearing in Red - 1991 1-Hour SO<sub>2</sub> Design Value above 75 ppb (2010 SO<sub>2</sub> Standard)

Appearing in Blue - 1991 1-Hour SO<sub>2</sub> Design Value at or below 75 ppb (2015 SO<sub>2</sub> Standard)

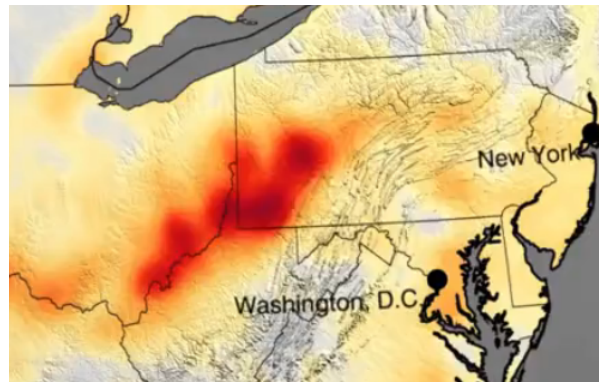
[illegible]

Appearing in Blue - 2017 1-Hour SO<sub>2</sub> Design Value at or below 75 ppb (2010 SO<sub>2</sub> Standard)

# NASA Satellite Data on Ambient SO<sub>2</sub> Concentrations



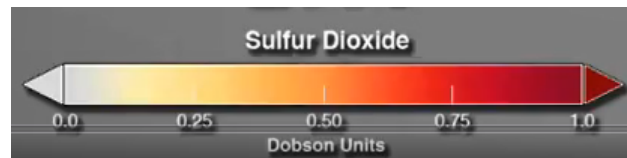
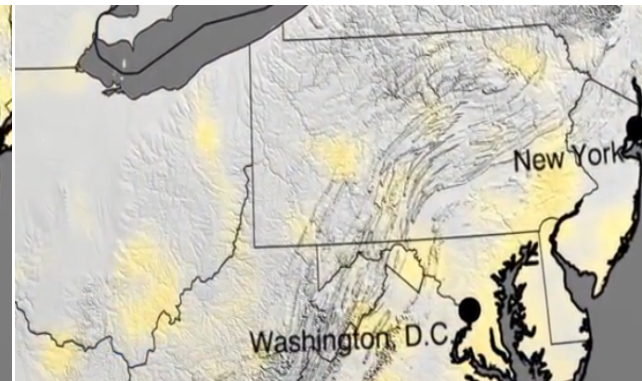
**2005**



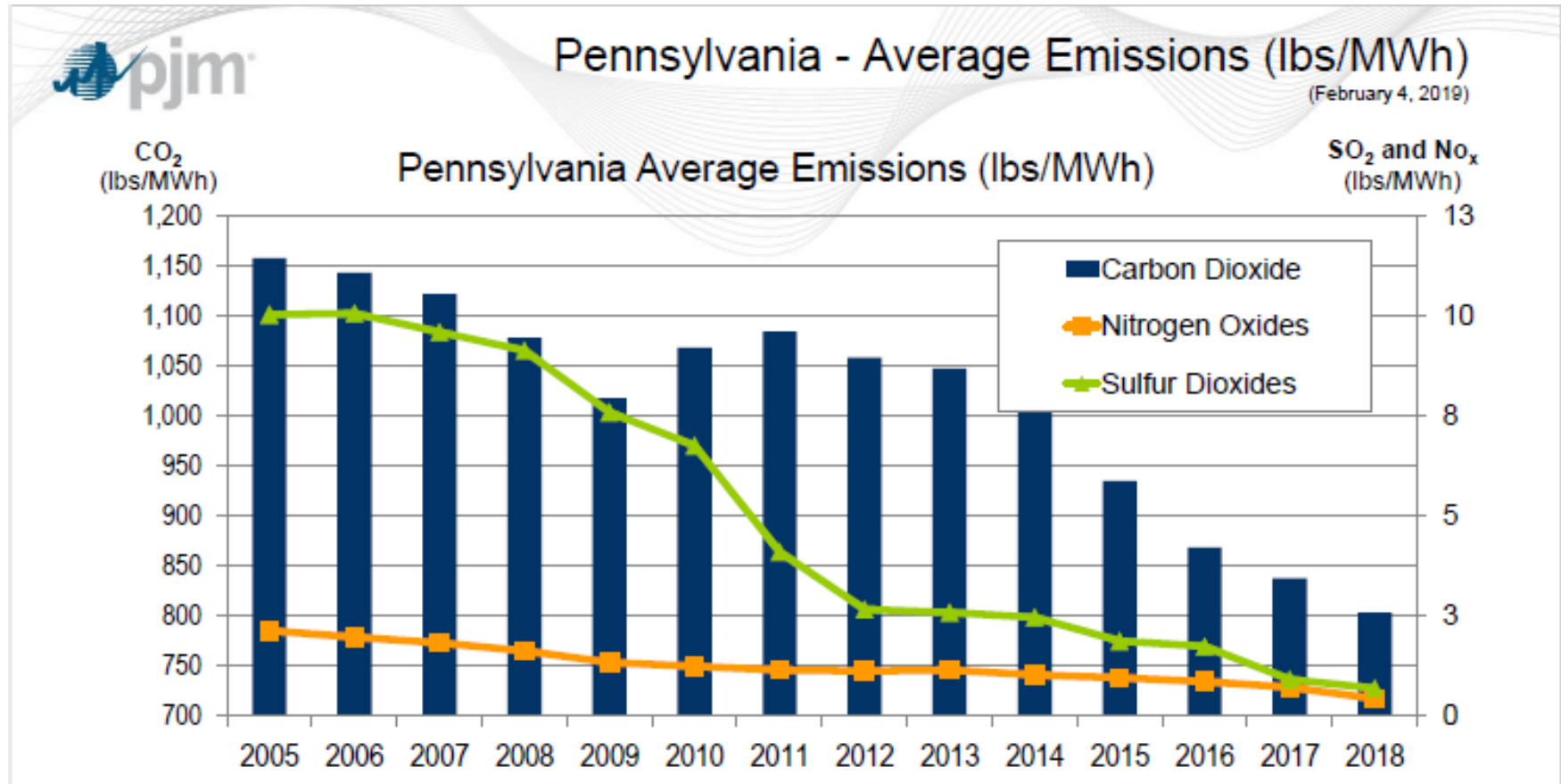
**2012**



**2019**



# Greenhouse Gas Emissions

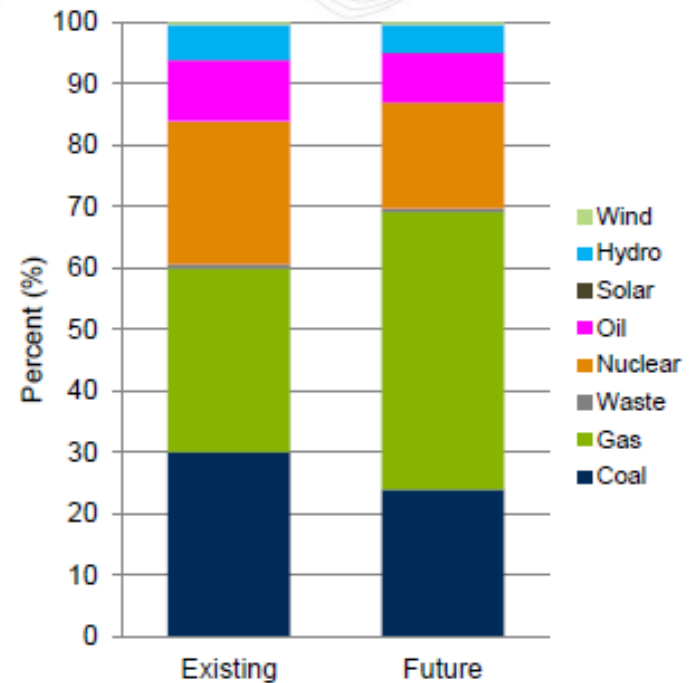
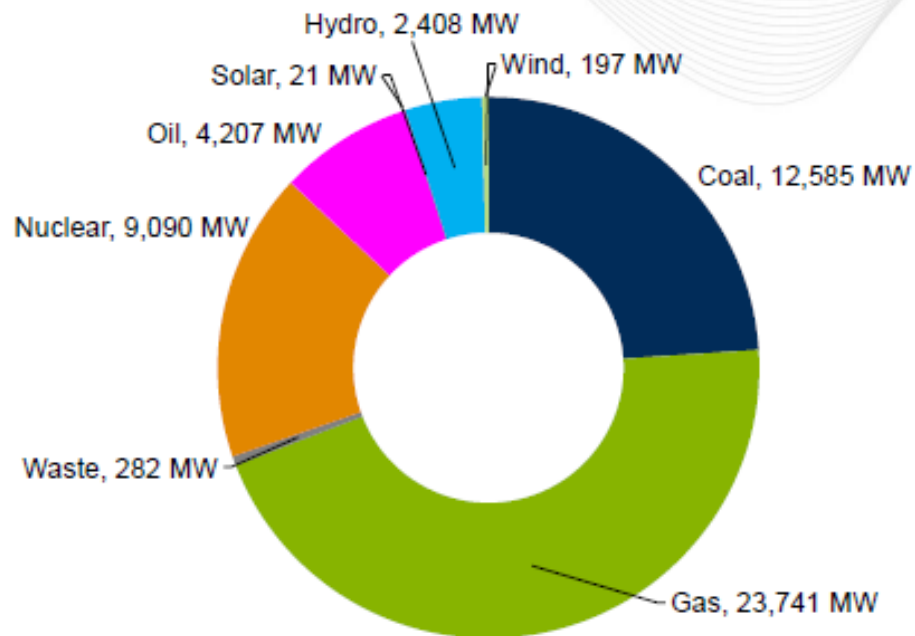


# Greenhouse Gas Emissions



## Pennsylvania – Future Capacity Mix

Based on known queued interconnection requests and deactivation notices through December 31, 2022, adjusted to reflect the probability of commercialization as indicated by historical trends specific to an interconnection request's state/zonal location and fuel type.





# Greenhouse Gas Emissions

## Annual CO<sub>2</sub> emissions

Carbon dioxide (CO<sub>2</sub>) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.



☐ Add country ☒ Relative change



Source: Global Carbon Project; Carbon Dioxide Information Analysis Centre (CDIAC)

Note: CO<sub>2</sub> emissions are measured on a production basis, meaning they do not correct for emissions embedded in traded goods.

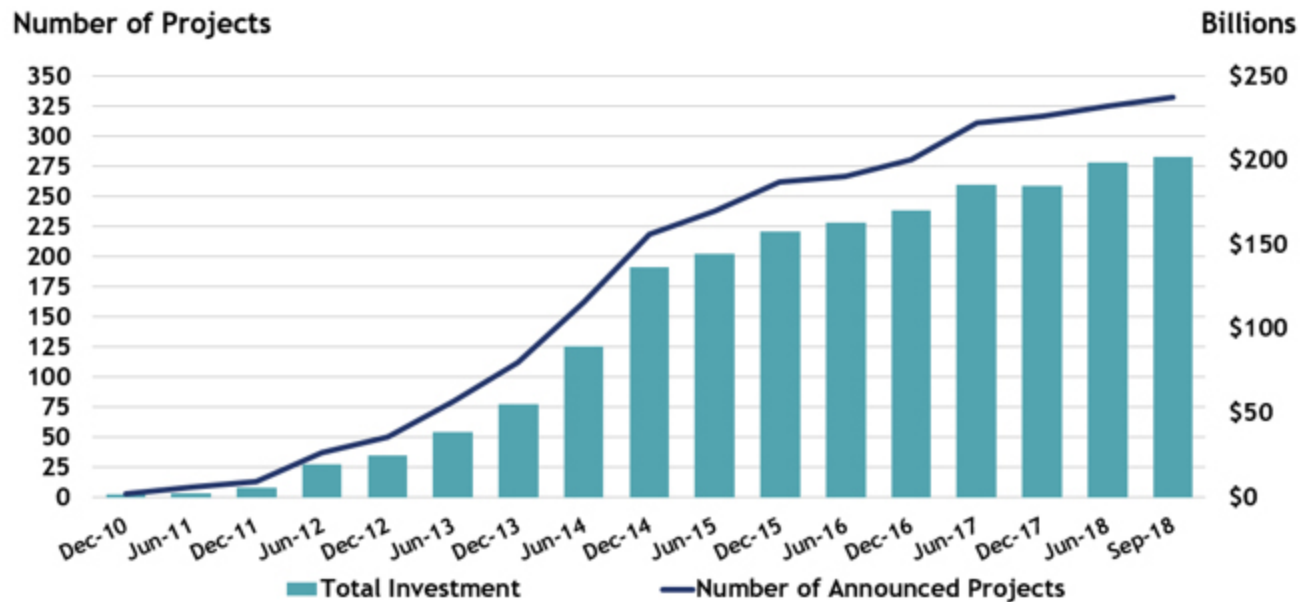
CC BY

The **United States** saw the largest decline in energy-related CO<sub>2</sub> emissions in 2019 on a country basis – a fall of 140 Mt, or 2.9%, to 4.8 Gt. US emissions are now down almost 1 Gt from their peak in the year 2000, the largest absolute decline by any country over that period.

International Energy Agency, Feb. 11, 2020

# Manufacturing Renaissance

## Cumulative Announced Chemical Industry Investments from Shale Gas



Source: ACC analysis

# Manufacturing Renaissance

Since 2010, **333 chemical industry projects** cumulatively valued at **\$202 billion** have been announced.

American Chemistry Council

Between the end of the Great Recession, in June 2009 and 2019, net fixed investment in the oil and gas extraction sector represented **more than two-thirds** of total US net industrial investment. In another measure, between 2009 and 2019, the increases in oil and gas have accounted for **30 percent** of the cumulative growth in US industrial production.

In practical terms, that means money flowing into paychecks throughout the country.

Daniel Yergin, *The New Map*

# Manufacturing Renaissance



TODAY IN THE SKY

## Pittsburgh's resurgent airport plans sleek new \$1 billion terminal

[Ben Mutzabaugh](#) USA TODAY

# Manufacturing Renaissance



**The Times**

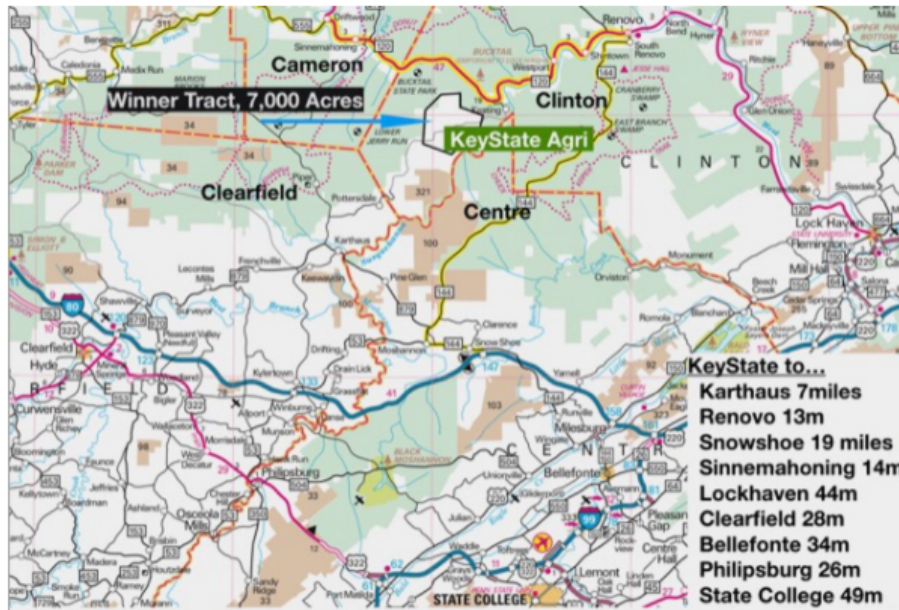
**Shell CEO: Cracker plant project ahead of schedule, within budget**



# Manufacturing Renaissance

## Nearly \$500 million natural gas synthesis plant planned in western Clinton County

Updated Feb 24, 2020; Posted Feb 24, 2020



“A natural gas synthesis plant uses the methane in natural gas as a feedstock to produce a range of products used in agriculture, industry, medicines and transportation...”

“The majority of carbon dioxide generated in gas synthesis processes is captured and used in making other products.”



# Manufacturing Renaissance

## THE WALL STREET JOURNAL. Steel Finds Sweet Spot in the Shale

Natural-Gas Boom Begets Low Prices for Fuel, Strong Demand for Piping—a Double Boon for Mills



### Mon Valley Works \$1.5 Billion Investment

United States Steel Corporation is investing approximately \$1.5 billion in the place where our reputation as a trusted industry leader was first forged more than a century ago: our Mon Valley Works near Pittsburgh. The investment involves the construction of a cutting-edge, sustainable endless casting and rolling facility at Mon Valley's Edgar Thomson Plant in Braddock, Pa., – the first of its kind in the United States – and a new cogeneration facility with state-of-the-art emissions control technology at the nearby Clairton Plant in Clairton, Pa.



## Forge the Future:

Pennsylvania's Path to an Advanced,  
Energy-Enabled Economy



## Phase I Report

### By 2025:

+\$60 billion, +6-9% growth in  
annual state GDP

+100,000 jobs

90% increase in gas demand

\$2-3 billion in increased state  
revenue collections

[pachamber.org](http://pachamber.org)



## Phase I Report

### Overview of the opportunity – Harnessing Pennsylvania's low-cost energy to promote economic growth and competitiveness

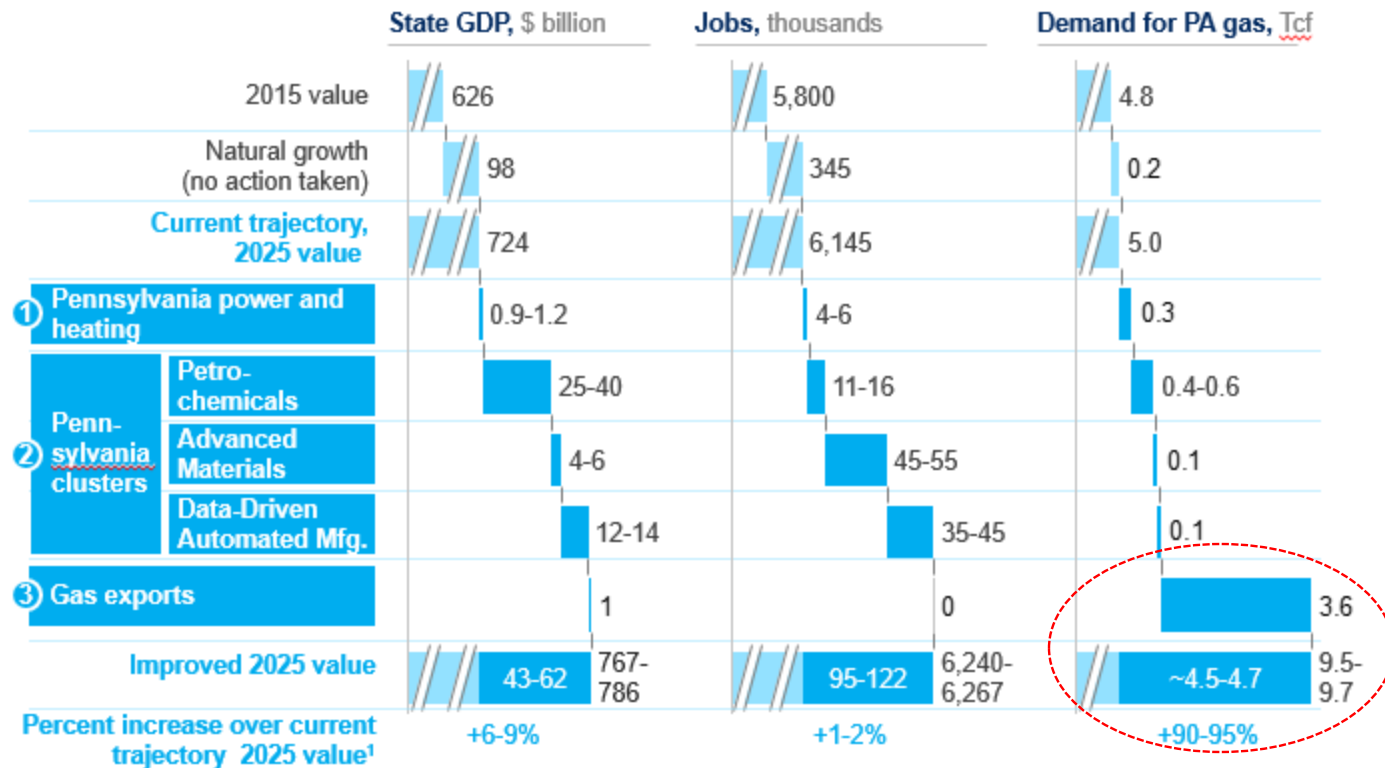
End-state objective by 2025

①	Pennsylvania power and heating			<ul style="list-style-type: none"><li>▪ Build ~6,000 MW of new natural gas power in Pennsylvania</li><li>▪ Convert ~500,000 homes heating from fuel oil to natural gas</li><li>▪ Install ~2,200 MW of distributed combined heat and power</li></ul>
	②	Petrochemicals		<ul style="list-style-type: none"><li>▪ Build a world-class petrochemical hub with 3-5 ethane crackers, 3-5 PDH plants, 2-3 ammonia plants and inorganic chemical plants</li><li>▪ Expand into high-value specialty plastics manufacturing</li></ul>
		Advanced materials		<ul style="list-style-type: none"><li>▪ Be the leading materials supplier for US northeast infrastructure growth (2-3% annual growth), harnessing historical strength in steel, aluminum, cement, and glass</li><li>▪ Establish the commercial hub of advanced materials technology (e.g., fiberglass, advanced cement) drawing on R&amp;D leadership</li></ul>
		Data-driven automated manufacturing		<ul style="list-style-type: none"><li>▪ Achieve national Top 3 position in data-hungry advanced manufacturing focusing on Pennsylvania leadership in robotics, artificial intelligence, and additive manufacturing</li><li>▪ Develop data center network (6-8 major centers) harnessing low-cost power, preparing for worldwide rollout of data-hungry Internet of Things</li></ul>
③	Gas exports			<ul style="list-style-type: none"><li>▪ Expedite key pipelines (including Transco, Texas Eastern, Columbia Gulf, PennEast/UGI) to increase gas exports by 3.6 Tcf by 2025, ensuring stable gas production needed for Pennsylvania long-term competitiveness and investor confidence</li></ul>

## Potential impact of energy-driven economic growth in Pennsylvania

■ Energy-driven economic growth

### Pennsylvania growth from 2015 to 2025



<sup>1</sup> 2015-2025 CAGR increase due to economic development: GDP = ~0.9%, jobs = ~0.2%, gas demand = ~6.7%

SOURCE: EIA; BEA (Moody's Analytics); team analysis

**PA Chamber**<sup>®</sup>  
of Business and Industry

**PA Chamber**<sup>®</sup>  
of Business and Industry

[pachamber.org](http://pachamber.org)

# Energy Security



“An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interest of the United States of America and such an assault will be repelled by any means necessary, including military force.”

President Jimmy Carter, 1980

# Energy Security



## Petronet LNG to sign \$2.5 billion U.S. gas deal during Trump's India visit

By Nidhi Verma

3 MIN READ



NEW DELHI (Reuters) - India's top gas importer Petronet LNG [PLNG.NS](#) and U.S. liquefied natural gas (LNG) developer Tellurian Inc [TELL.O](#) are preparing to sign a \$2.5 billion deal during President Donald Trump's maiden visit to New Delhi later this month, two sources familiar with the matter said.

# Energy Security



## LNG Monthly

Published February 2020



Map shows Countries of Destination of Exports of Domestically-Produced LNG  
(February 2016 through December 2019)

### 1b. Shipments of Domestically-Produced LNG Delivered – by Country (Cumulative from February 2016 through December 2019)

Country of Destination	Region	Number of Cargos	Volume (Bcf of Natural Gas)	Percentage of Total U.S. LNG Exports (%)
1. South Korea*	East Asia and Pacific	191	662.6	17.5%
2. Mexico*	Latin America and the Caribbean	145	493.4	13.0%
3. Japan*	East Asia and Pacific	114	390.8	10.3%
4. China	East Asia and Pacific	64	218.0	5.7%
5. Spain*	Europe and Central Asia	65	209.3	5.5%
6. India*	South Asia	54	186.9	4.9%
7. Chile*	Latin America and the Caribbean	60	186.7	4.9%
8. United Kingdom	Europe and Central Asia	53	173.1	4.6%
9. France*	Europe and Central Asia	41	136.1	3.6%
10. Jordan*	Middle East and North Africa	34	117.3	3.1%
11. Brazil*	Latin America and the Caribbean	46	116.8	3.1%
12. Argentina*	Latin America and the Caribbean	39	99.8	2.6%
13. Netherlands*	Europe and Central Asia	29	96.6	2.5%
14. Italy	Europe and Central Asia	30	95.9	2.5%
15. Portugal*	Europe and Central Asia	28	89.1	2.3%
16. Turkey*	Europe and Central Asia	27	87.4	2.3%
17. Taiwan*	East Asia and Pacific	17	53.1	1.4%
18. Kuwait	Middle East and North Africa	14	47.6	1.3%
19. Poland	Europe and Central Asia	13	44.7	1.2%
20. Pakistan	South Asia	13	42.9	1.1%
21. United Arab Emirates	Middle East and North Africa	12	41.0	1.1%
22. Singapore*	East Asia and Pacific	11	35.1	0.9%
23. Dominican Republic*	Latin America and the Caribbean	12	27.8	0.7%
24. Belgium	Europe and Central Asia	7	23.9	0.6%
25. Greece*	Europe and Central Asia	6	18.4	0.5%
26. Panama*	Latin America and the Caribbean	7	17.0	0.4%
27. Egypt	Middle East and North Africa	5	16.9	0.4%
28. Jamaica*	Latin America and the Caribbean	7	15.2	0.4%
29. Colombia*	Latin America and the Caribbean	7	11.6	0.3%
30. Lithuania	Europe and Central Asia	3	10.3	0.3%
31. Thailand	East Asia and Pacific	3	9.7	0.3%
32. Malta*	Europe and Central Asia	3	4.2	0.1%
33. Malaysia	East Asia and Pacific	1	3.7	0.1%
34. Bangladesh	South Asia	1	3.4	0.1%
35. Israel	Middle East and North Africa	1	3.3	0.1%
<b>Total Exports by Vessel</b>		<b>1,163</b>	<b>3,789.5</b>	