



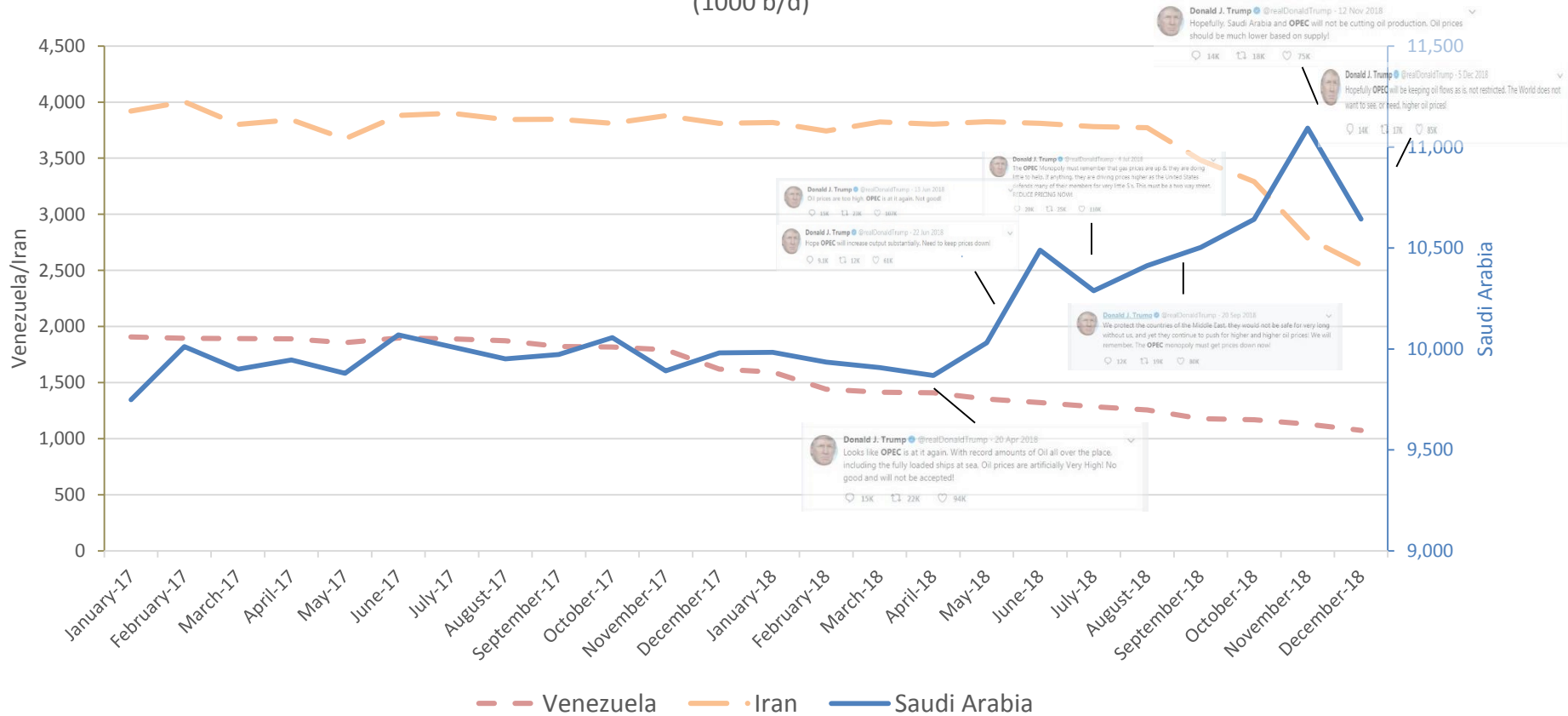
**Amy Myers Jaffe**  
**Director, Program on Energy Security and**  
**Climate Change**  
**Council On Foreign Relations**

**Presentation to U.S. House of Representatives**  
**Energy and Water Development Appropriations**  
**Subcommittee**

**February 7, 2019**

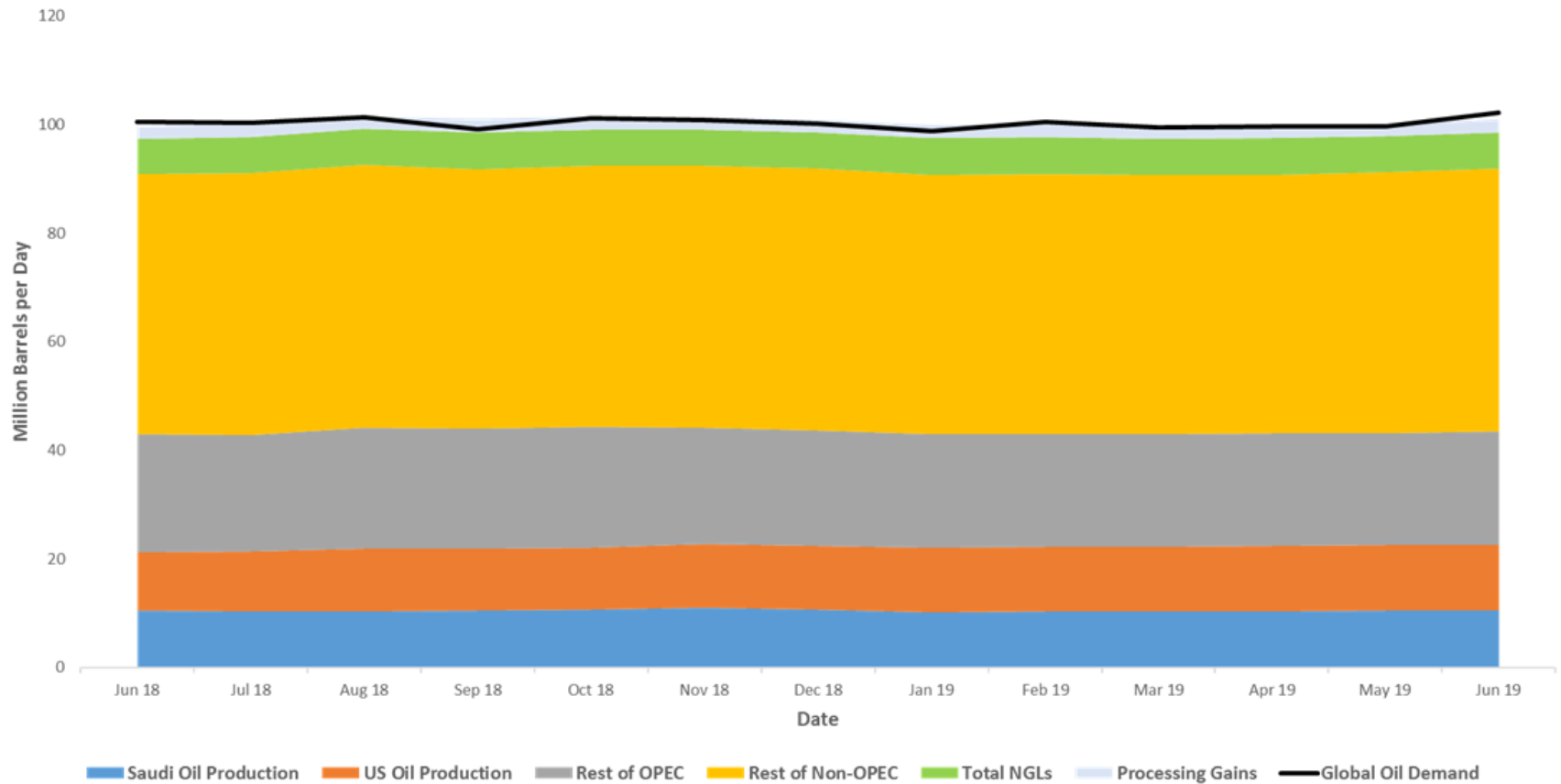
# Recent Events Suggest OPEC Still Has Market Power

Key OPEC Crude Oil Production Trends & Trump Tweets  
(1000 b/d)



# Putting U.S. Production in Perspective

## Global Crude Oil Supply and Demand



# Saudi-Russia oil alliance is problematical

Russian and Saudi leaders at the G-20 in Argentina

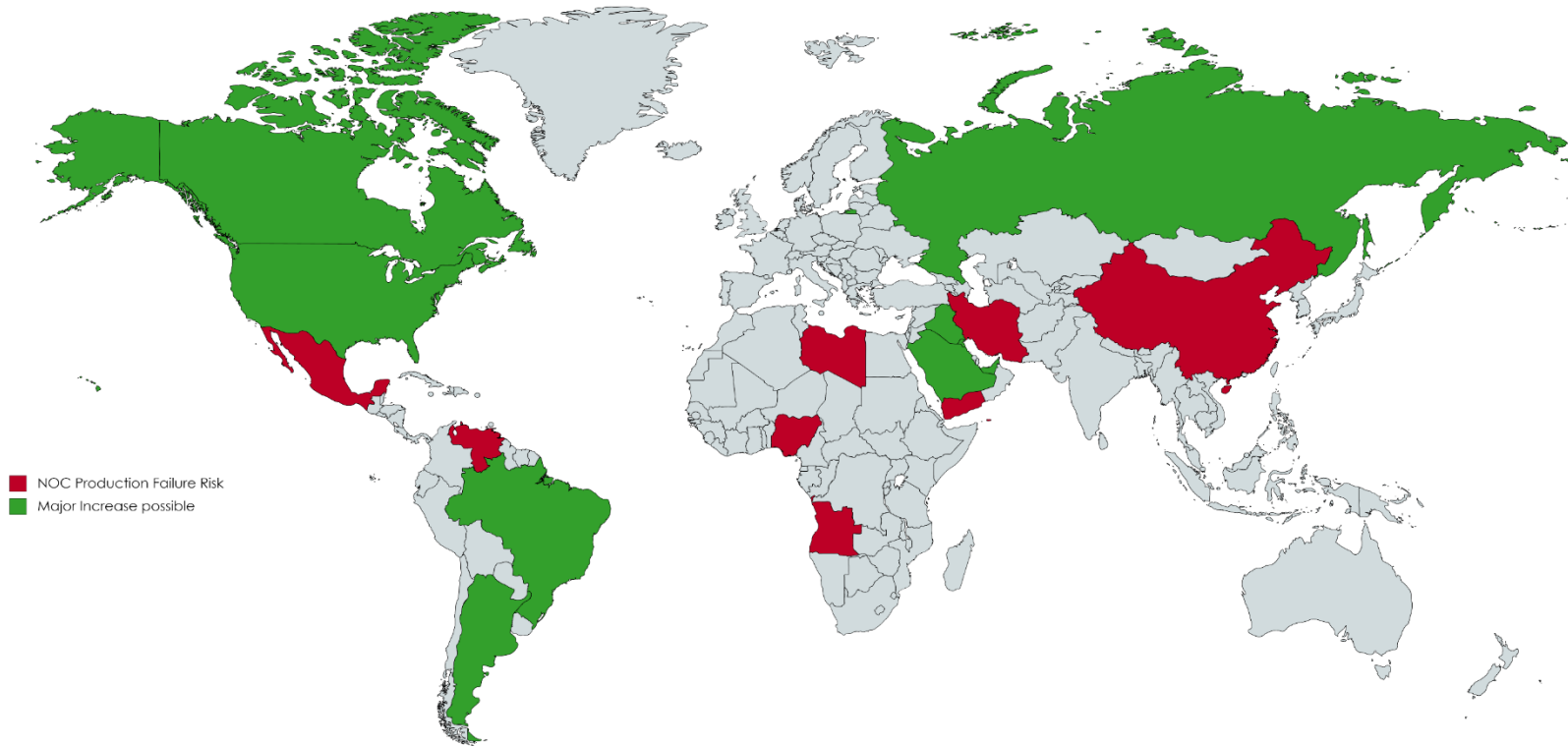


Navigating the Saudi-U.S. and Saudi-Russian bilateral relationship has proven tricky.

As kingdom's economic problems worsen, alignment with Russia could strengthen.

# Rising Oil Production Potential VS NOC Supply Risk

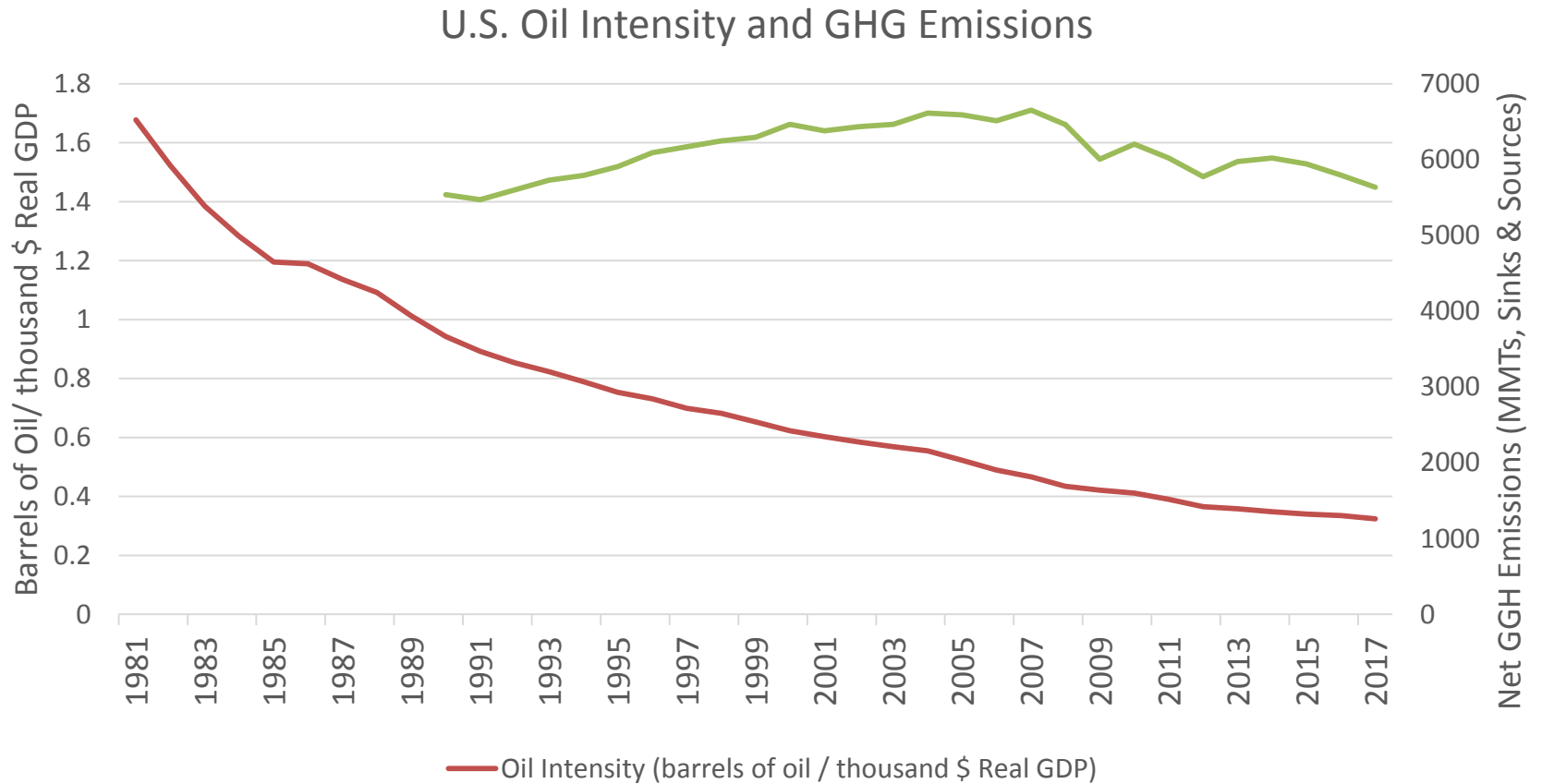
## Corruption Scandals, Failing States, and States Raiding NOC Finances



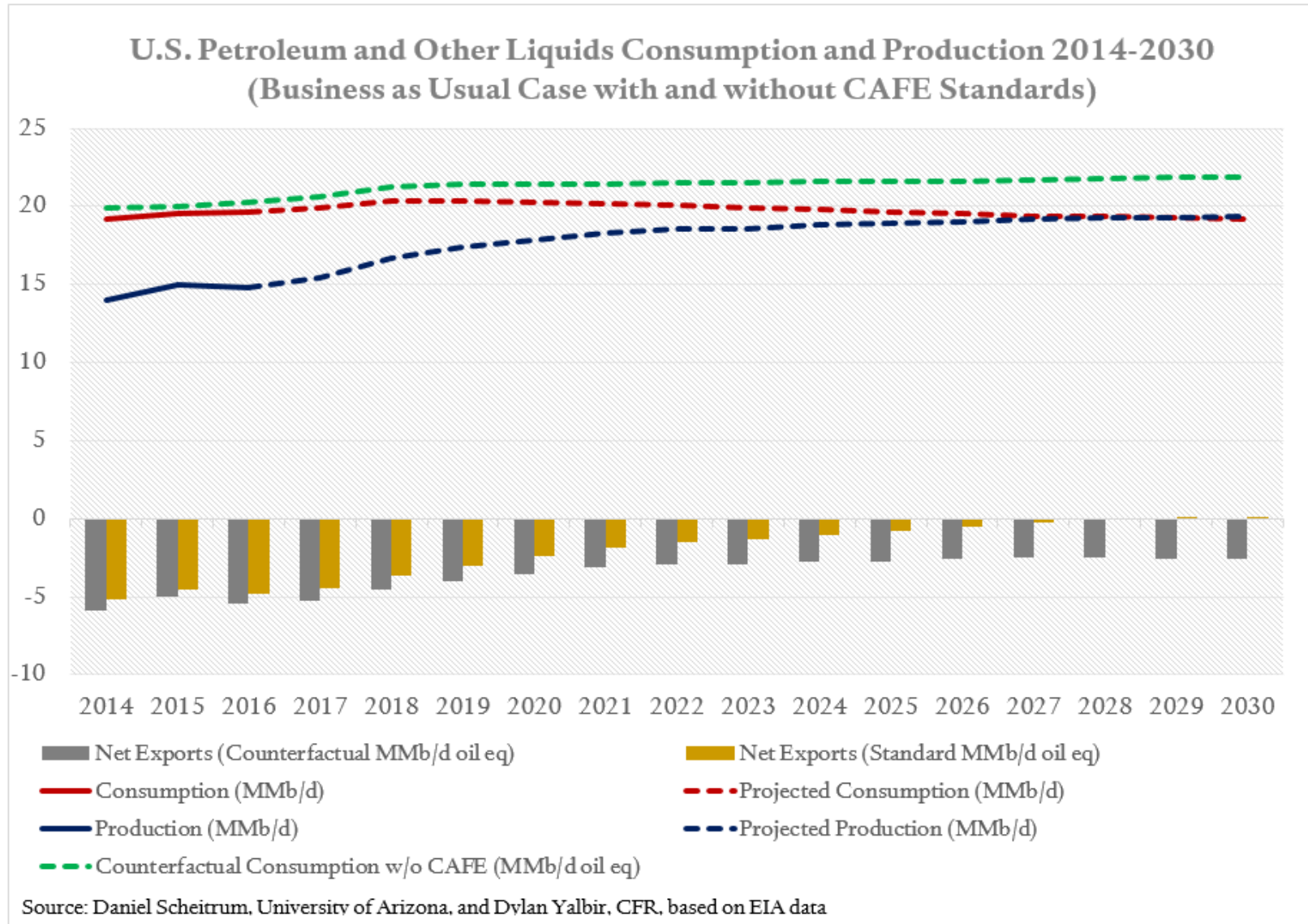
Created with mapchart.net ©

**Shorter cycle times will leave NOCs with less capital flexibility.**  
**NOCs likely to have more difficulty staving off declines in mature fields.**  
**Majors are favoring short cycle projects such as shale in the Americas, brownfield extensions and development of satellite reserves. Interest in long cycle projects like Venezuelan heavy oil and Arctic development is sinking. Longer term, any higher oil prices could breed structural decline in oil use, creating intractable problem for OPEC.**

**Sectoral distribution of oil use has become more limited. Now concentrated in transport which socks consumers more than it damages entire economy.**

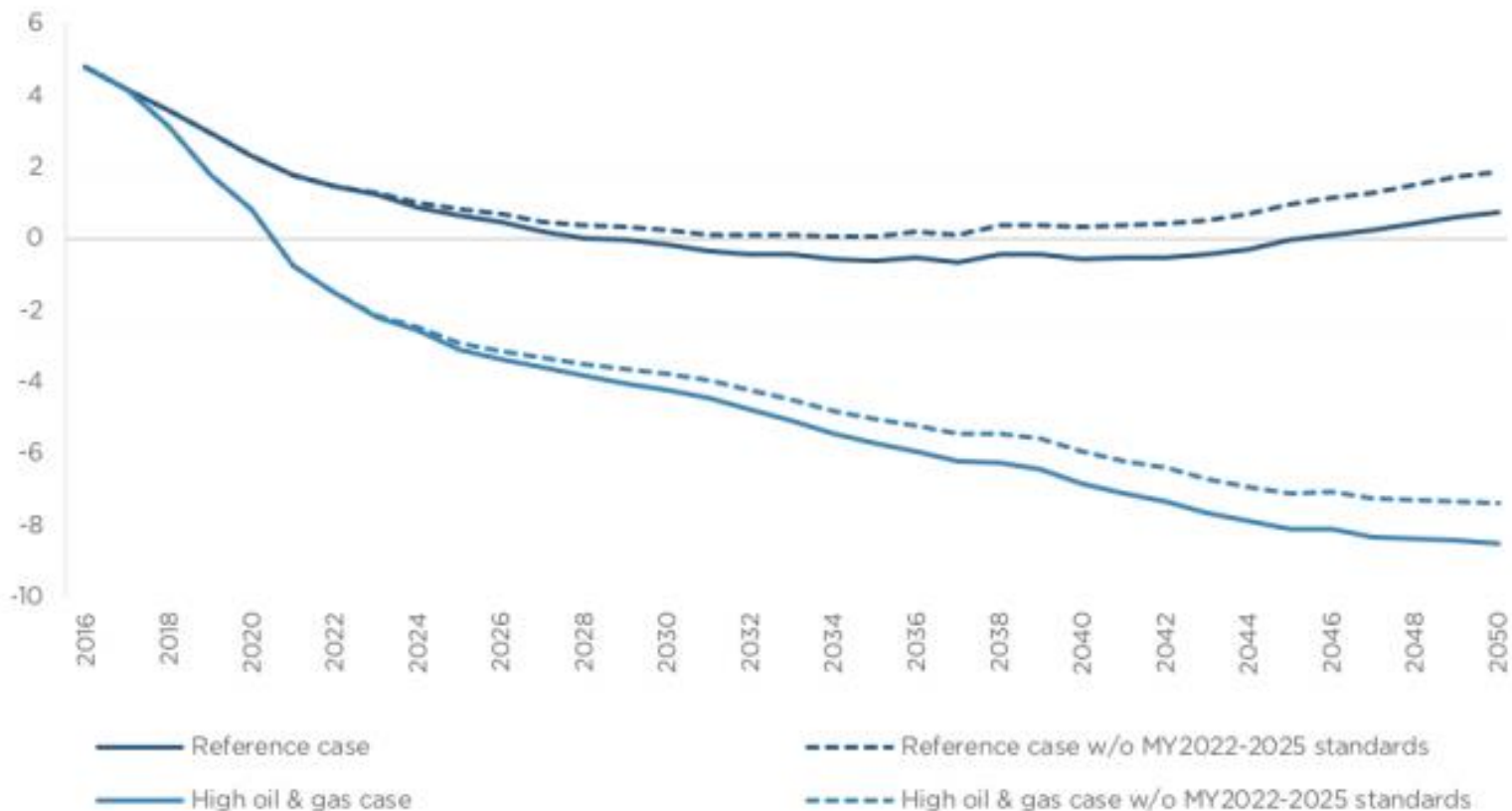


# When it comes to OPEC, U.S. fuel efficiency standards still matter



# When it comes to OPEC, U.S. fuel efficiency standards still matter

**Figure 2:** US net imports of crude oil and petroleum products in the EIA's AEO 2018, projections with and without MY 2022-2025 standards (millions of barrels per day)



Source: EIA, EPA

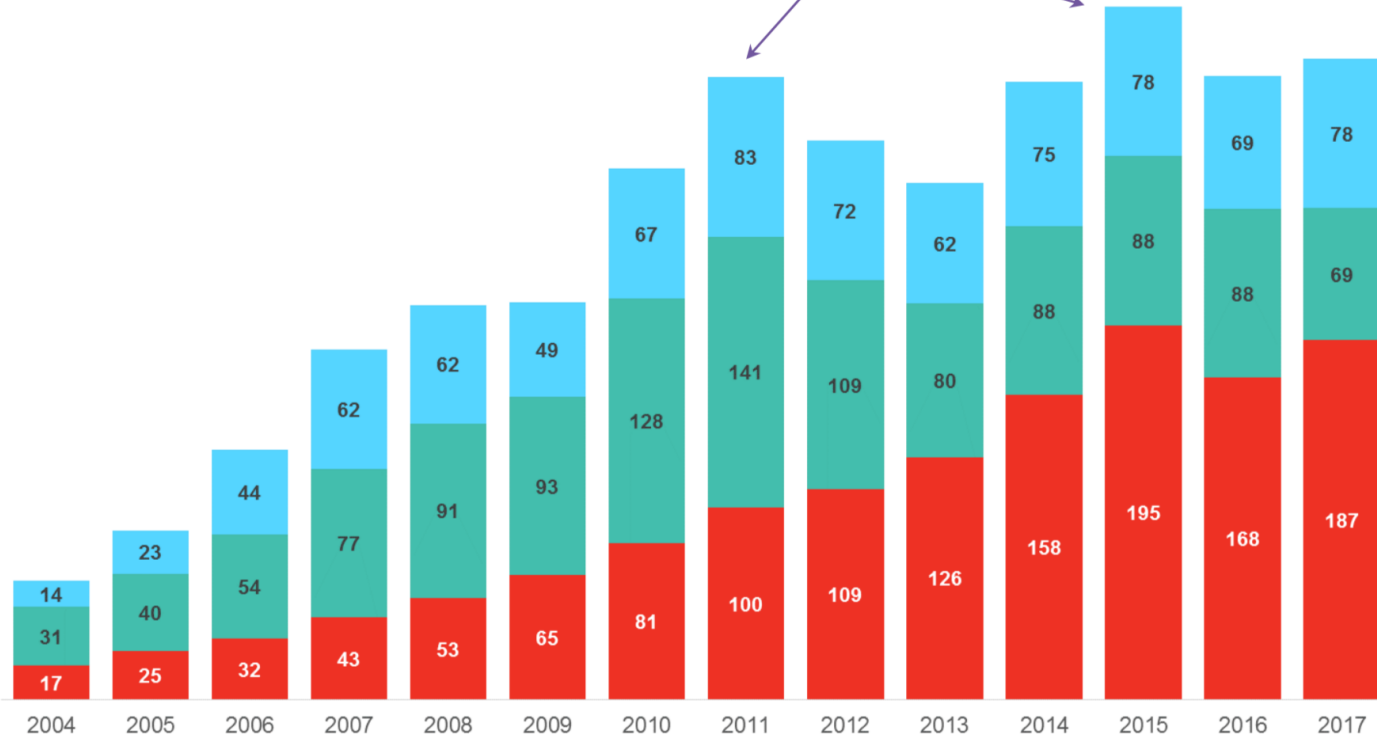


# Global New Investment in Clean Energy by Region

2004 – 2017

\$bn

Balance shifts from Europe as largest-investing region to Asia as number one region



Version WF18.01  
All values nominal

■ APAC ■ EMEA ■ AMER

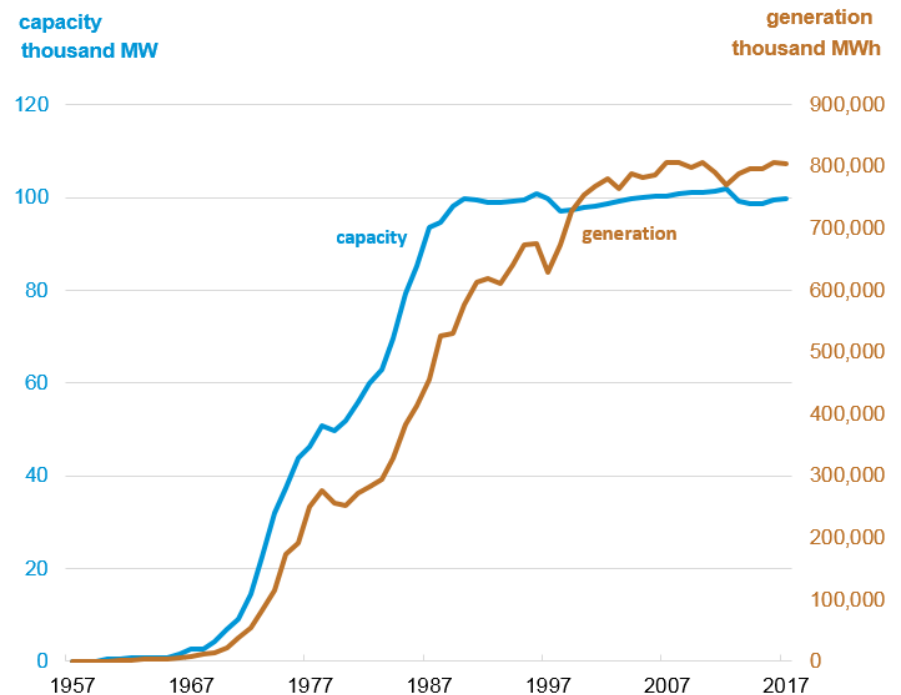
Source:  
Bloomberg New Energy Finance

# Average Age of U.S. Nuclear Generators is 37 Years Old

## New Technology:

- Small Module Reactors (SMR):
  - “Automatic” Safety Features
  - Scalable Sizing
  - Low Cost
  - Highly Flexible for Renewables
- Generation IV Reactors:
  - 3 Models Under Development
  - Improved Safety
  - Ability to Consume Nuclear Waste
  - High Efficiency and Flexibility

U.S. nuclear electricity generation capacity and generation, 1957-2017

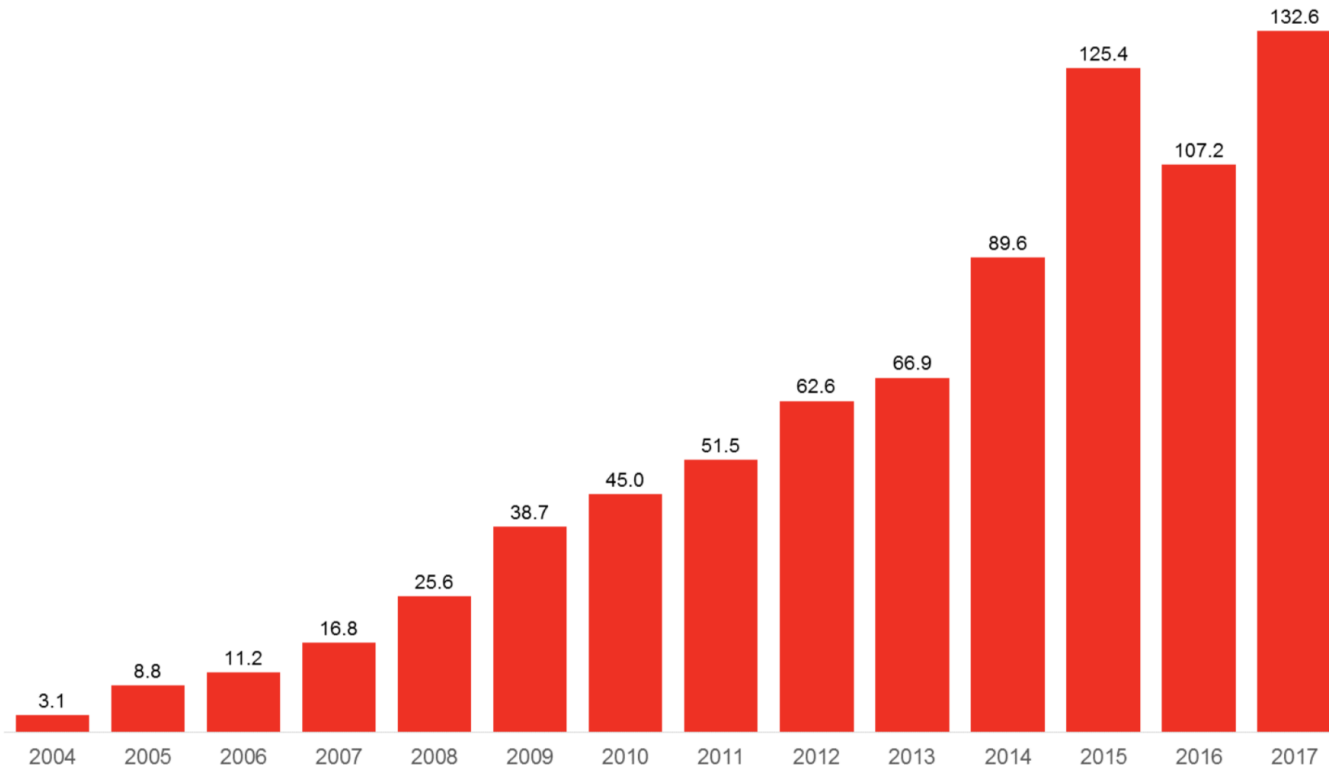


Note: Capacity is net summer; MW is megawatts; MWh is megawatthours.  
Source: U.S. Energy Information Administration, *Monthly Energy Review*,  
Table 8.1, March 2018

# New Investment in Clean Energy China

2004 – 2017

\$bn

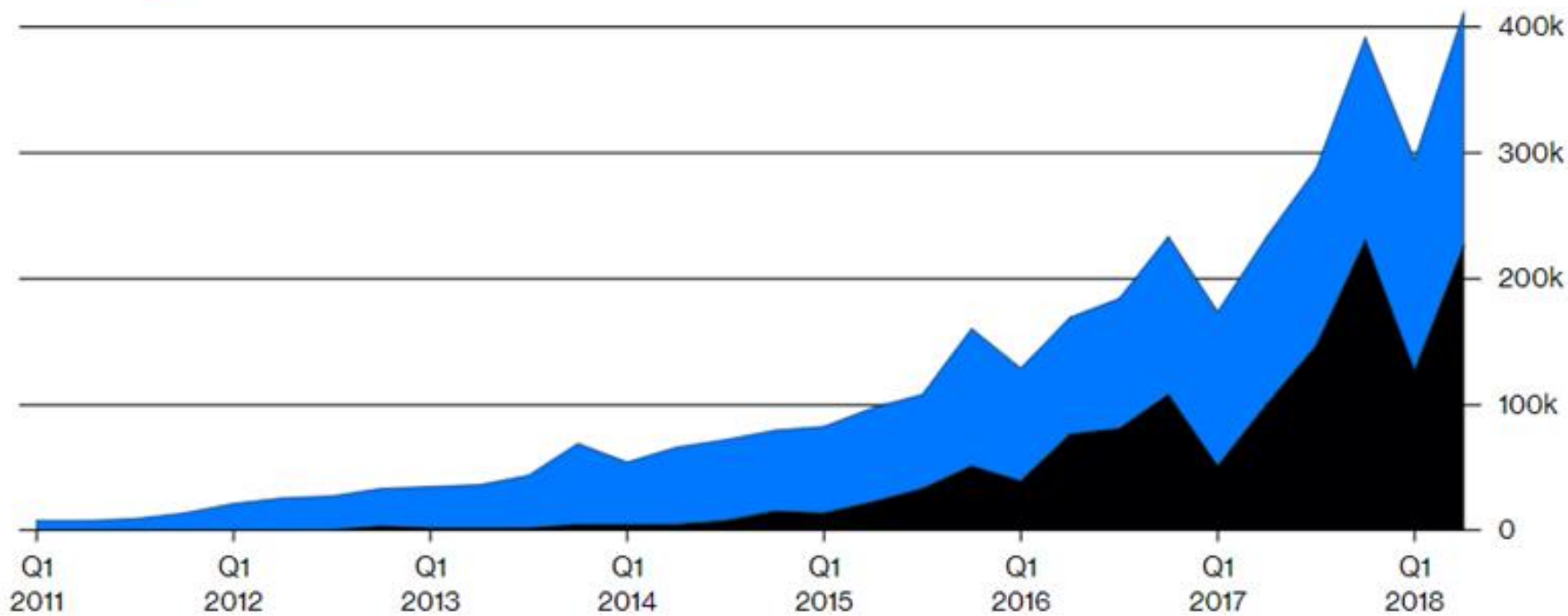


Version WF18.01  
All values nominal

Source:  
Bloomberg New Energy Finance

## Electric Vehicle Sales

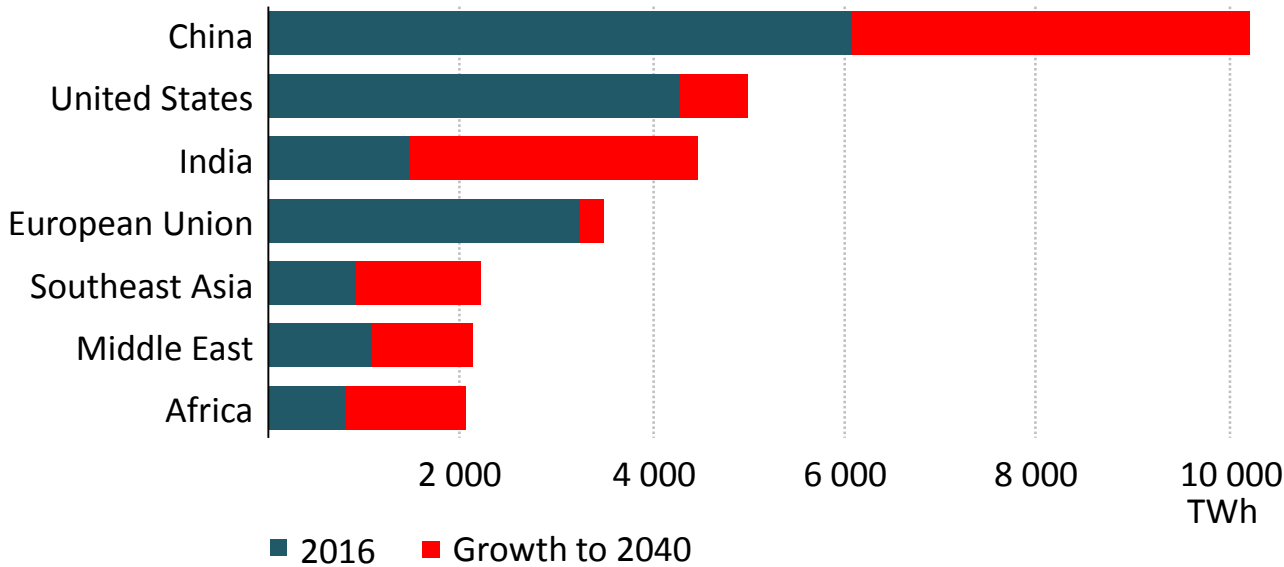
■ China ■ Rest of the world



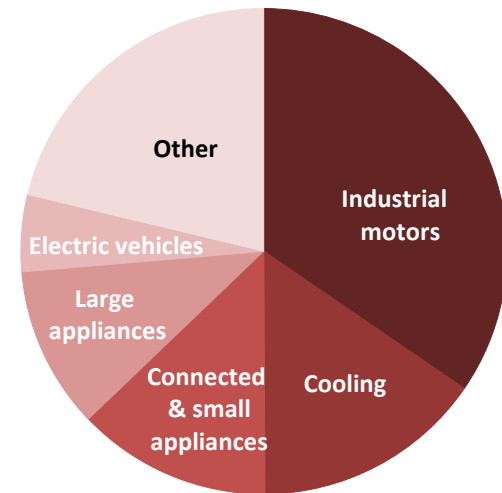
Data: Bloomberg Intelligence

# IEA says the future is electrifying, but what if...

Electricity generation by selected region



Sources of global electricity demand growth



*India adds the equivalent of today's European Union to its electricity generation by 2040, while China adds the equivalent of today's United States*

# In the United States, Natural Gas and Renewables are Replacing Coal.

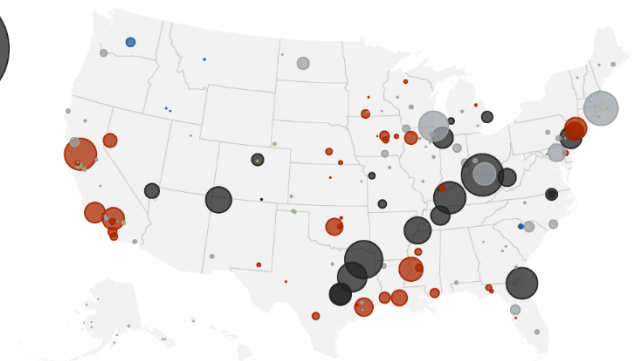
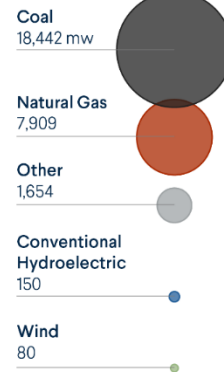
Hawaii and California targeting 100% renewables. In midterms, winning governors pledged 100% renewables from:

- Colorado
- Connecticut
- Nevada
- Maine
- Oregon
- Wisconsin

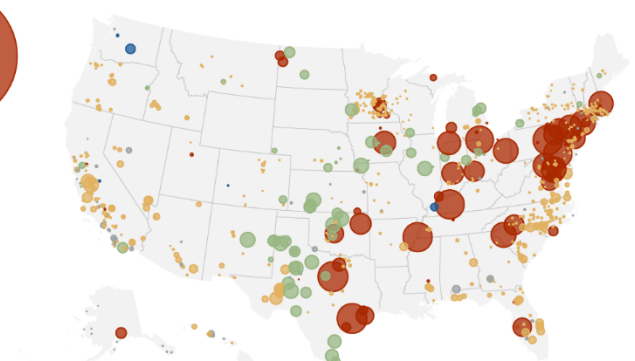
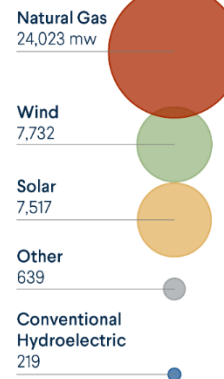
## Power Plant Retirements and Additions, January 2017 - August 2018

Map bubbles represent power plants, sized according to the plant capacity in megawatts.

### RETIREMENTS



### ADDITIONS

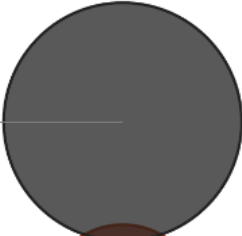


Source: Energy Information Agency.

# U.S. Power Plant Retirements, January 2007 – August 2018

## RETIREMENTS

**Coal**  
18,442 mw



**Natural Gas**  
7,909



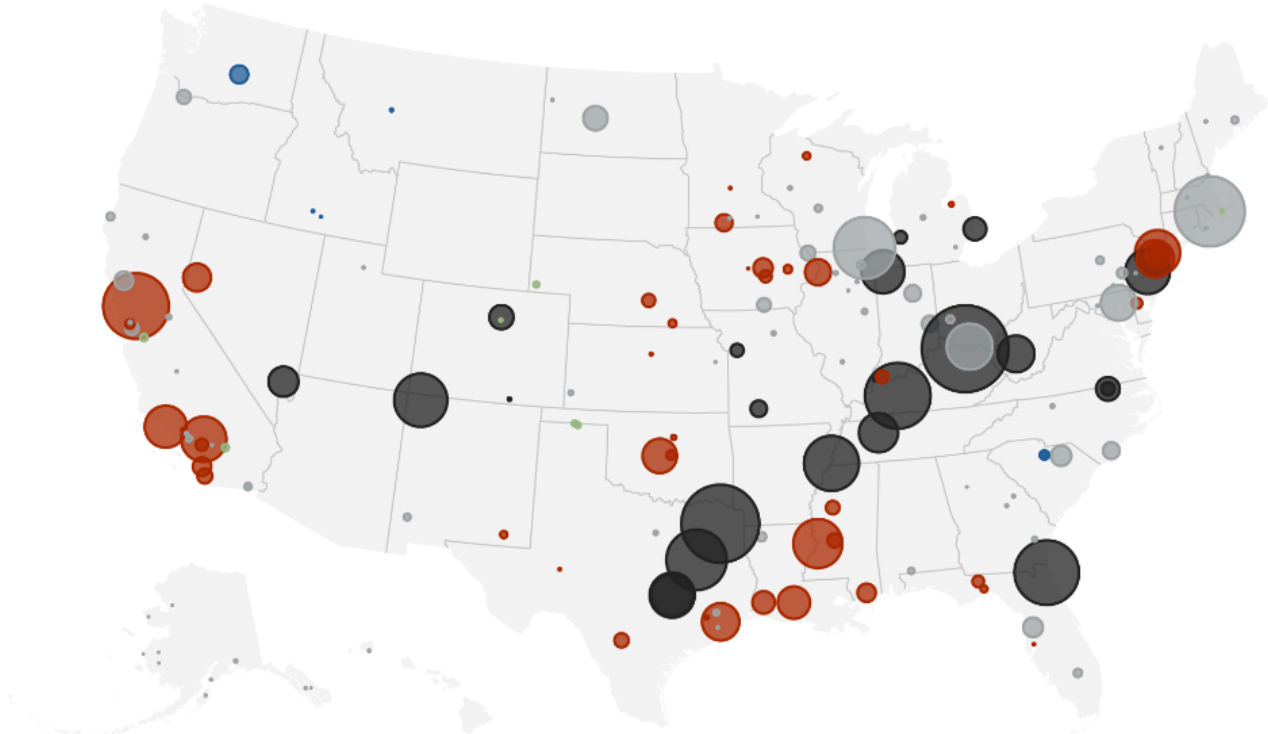
**Other**  
1,654



**Conventional Hydroelectric**  
150

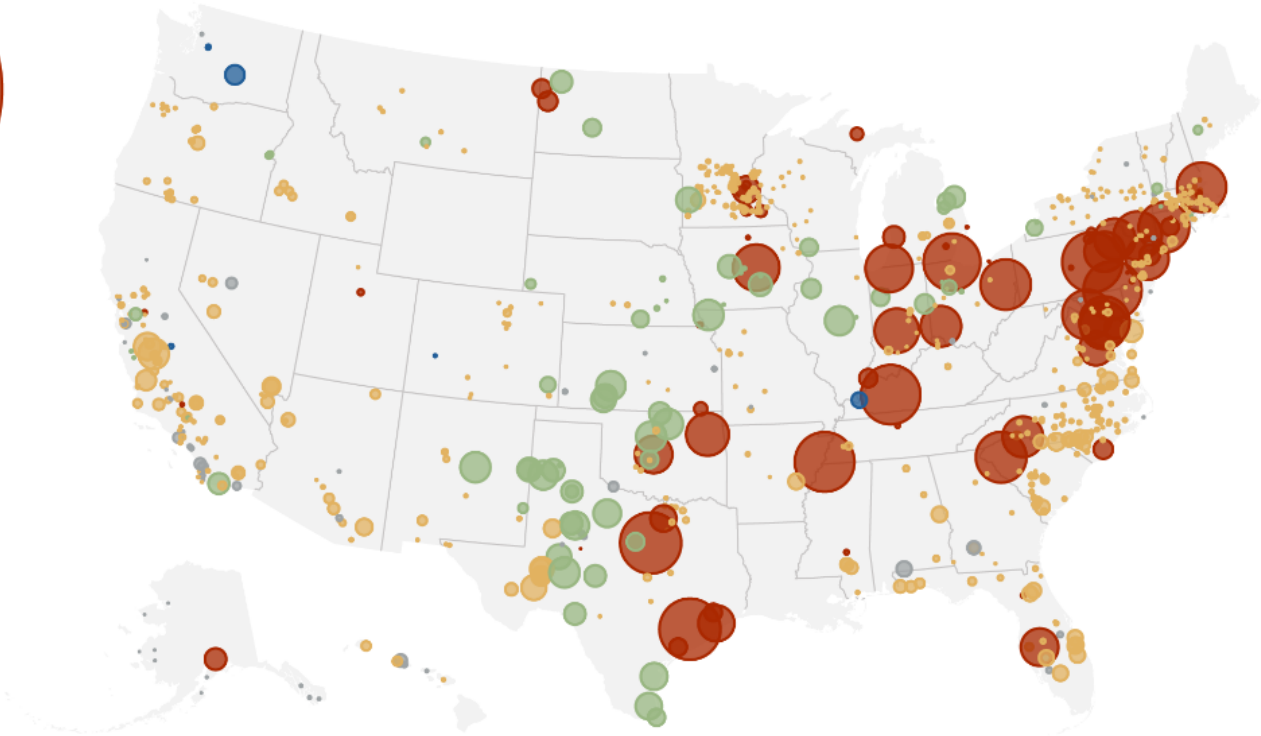
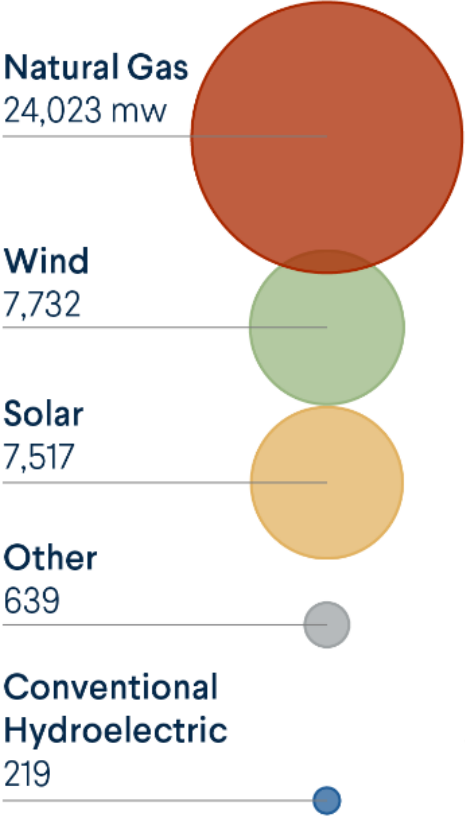


**Wind**  
80



# U.S. Power Plant Additions, January 2007 – August 2018

## ADDITIONS







## Highest Ranking Solar Panel Manufacturers

Jinkosolar	China
Trina Solar	China
Canadian Solar	Canadian
JA Solar	China
HanwhaQ	South Korea (Solarfun,China)

Replacing  
First Solar (US)  
Renesola (Japan)  
Sharp (Japan)  
Sunpower (US)

China dominates **top 10** solar ranking partly because biggest sales market but also due to emerging industrial policies related to China 2025.

It's not just U.S. shale. China will be a major energy exporter via its technologies. India could copy...





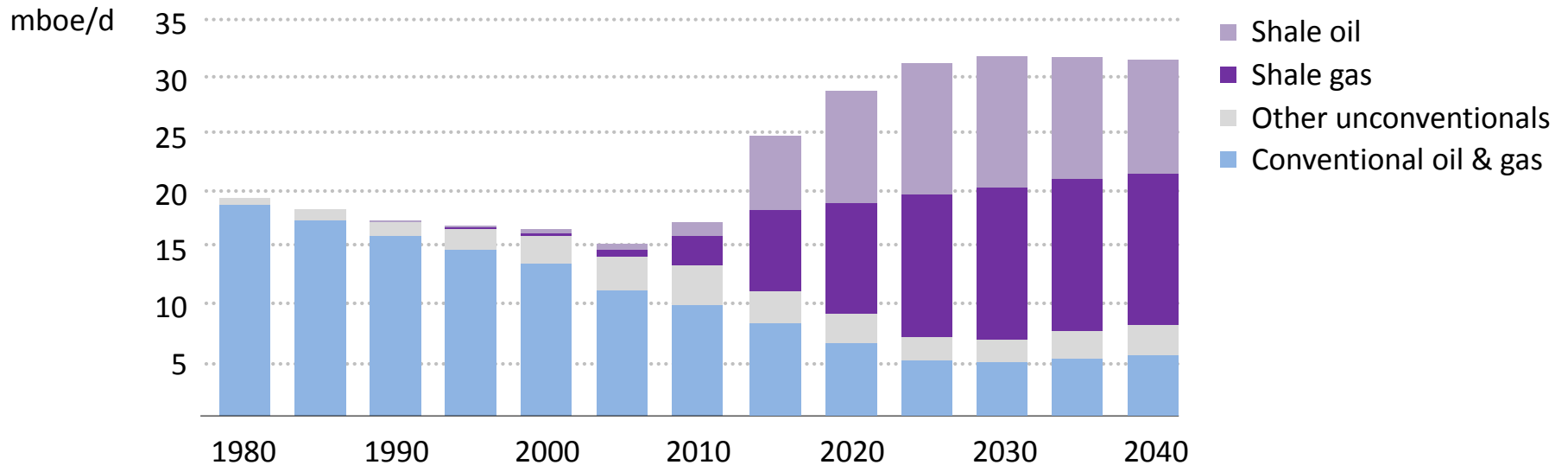
# Hydrogen Fuel Cells

Could natural gas distribution companies deliver directly to stationary fuel cells bypassing electricity distribution?



Germany, Japan still making large bets on hydrogen fuel.

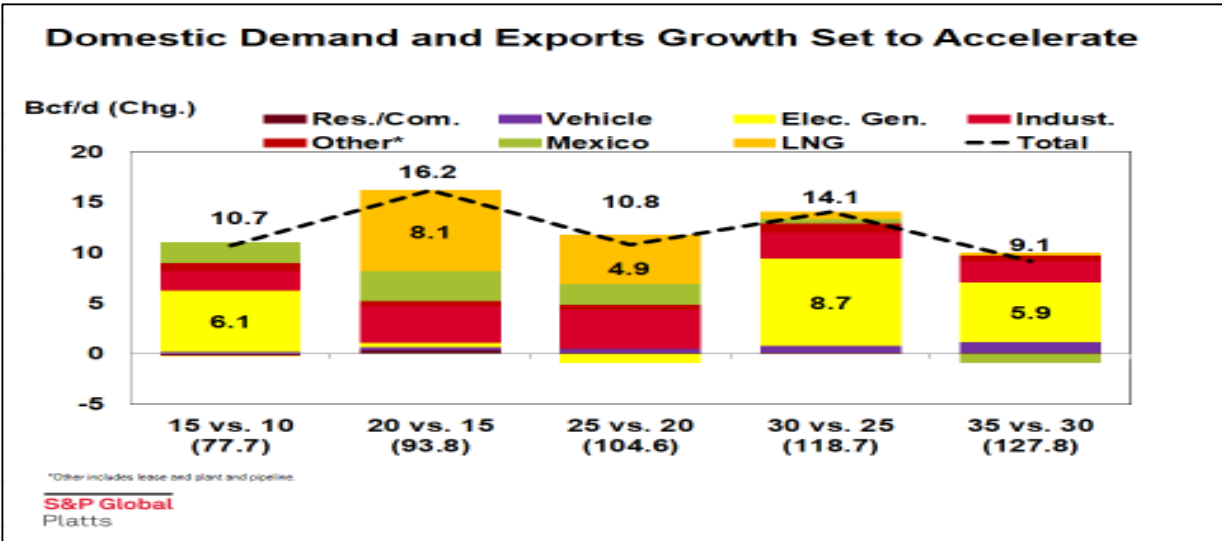
# By 2040, U.S. will account for roughly 20 percent of global natural gas production.



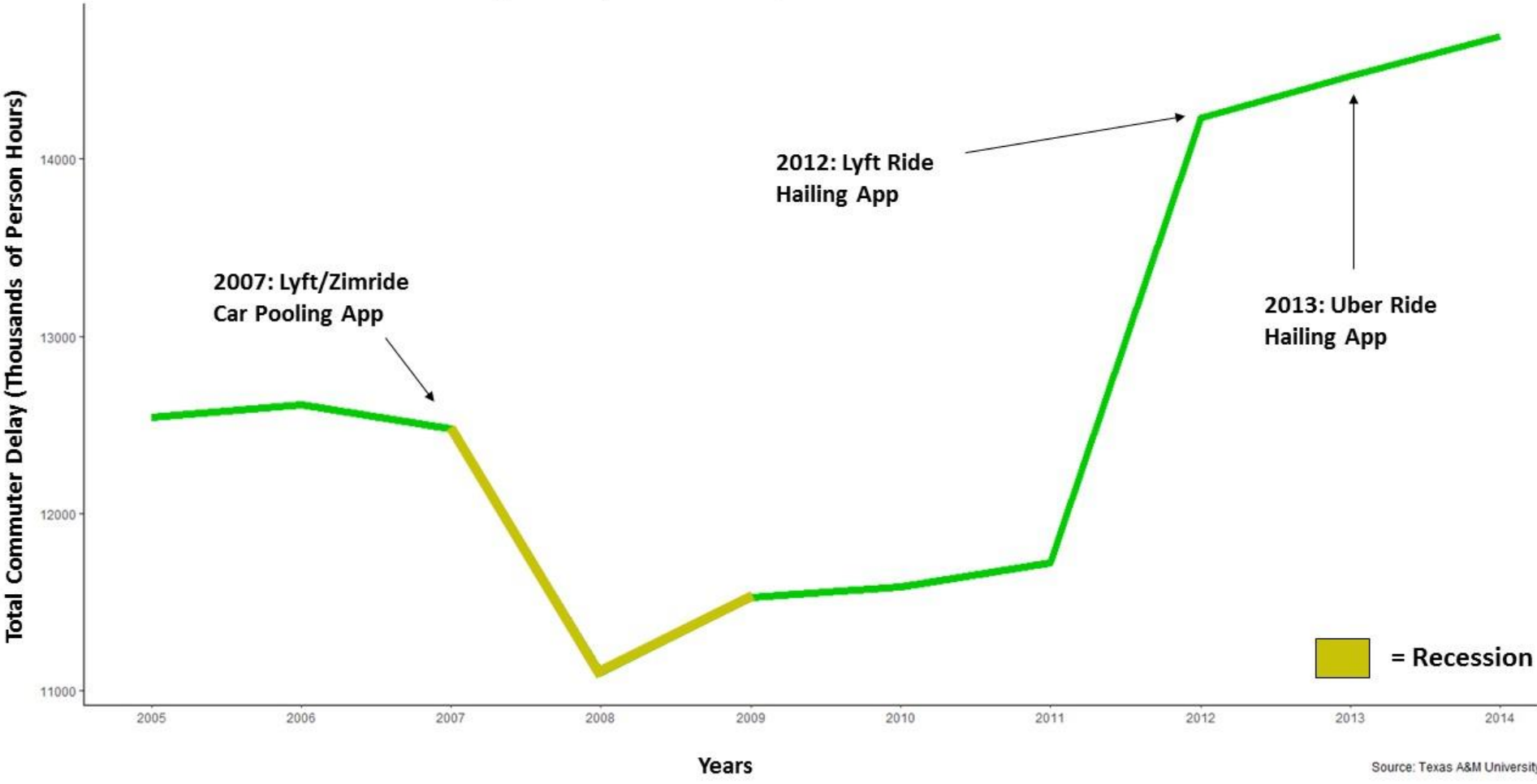
*Rising global natural gas demand will be driven by industrial and power demand in Asia and Africa*

# Russia will respond to rising U.S. LNG exports with price cuts

- U.S. LNG exports expected to continue to rise significantly in 2018 to 2025 timeframe.
- Trade war interfering with previous high interest in U.S. gas on gas deals. If LNG exports don't materialize as substantially as projected, expect lower U.S. prices late 2019 into 2020.
- Still, economics could help. Golden Pass and spot deals could substantially undercut even Russian gas prices.



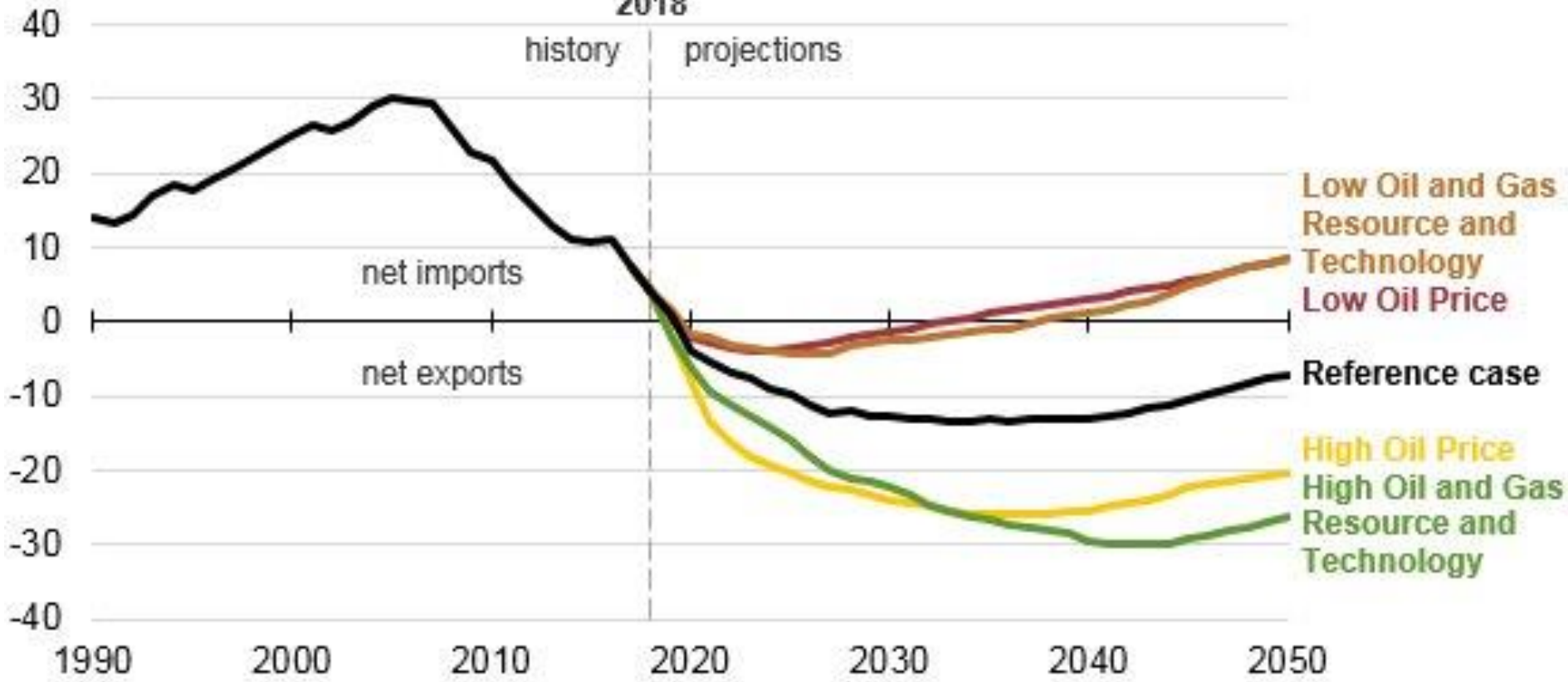
# Urban Commuter Traffic Congestion (2005 – 2014)



Source: Texas A&M University

# U.S. net energy trade (1990-2050)

quadrillion British thermal units



## Transportation: Energy Use by Mode: Freight Trucks

MMb/d oil eq

Case: Reference case

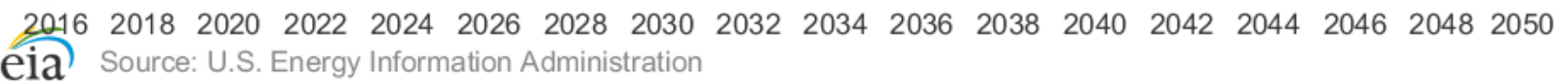
4

3

2

1

0



Source: U.S. Energy Information Administration