

# *Economic Signals That Matter – Path Forward In Abundant Energy*



*Prepared By Our Team...For Our Customers*

*Dr. Jim Duncan*

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*In  
Loving  
Memory*

# Profound Questions from Children Illustrates the Futility of Exactness

- Does my goldfish know who I am?
- Why is there science?
- Why do onions make us cry?
- Can spiders speak?
- Why do we blink when we sneeze?
- Why does time slow down when we're afraid, speed up as we age, and gets all warped while we're on vacation?
- How does our brain store so much information despite being that small?
- What part of my brain holds my spirit?
- How can we be sure that life isn't just a dream?
- Does the universe have an edge?
- Is new technology always good?
- Do animals like sheep and cows have accents?
- Why do we have books?
- How big is your drive?
- What are you willing to give? ...or give up?



# Runway Visual Range



# Extinction List – Jobs You Can't Get Anymore

1. Bowling
2. Human
3. Ice Cutt
4. Pre-rad
5. Rat Cato
6. Lamplig
7. Log Driv
8. Switchb
9. Resurre
10. Lector V



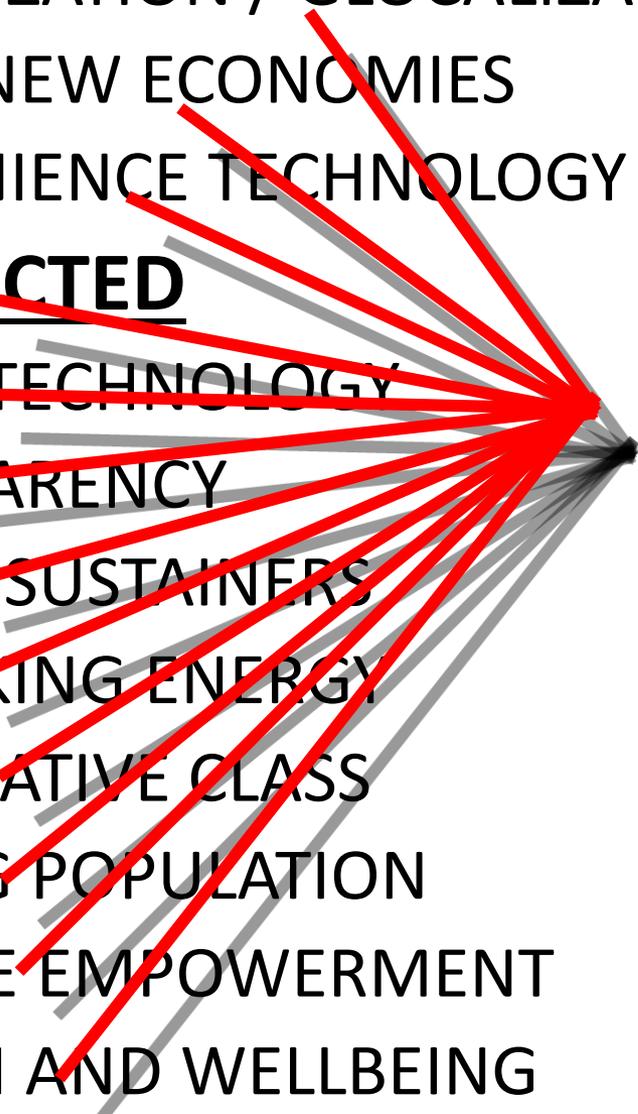
# What's Next?

## The Coming of "Peak Car"?





# Key Trends Shaping Tomorrow

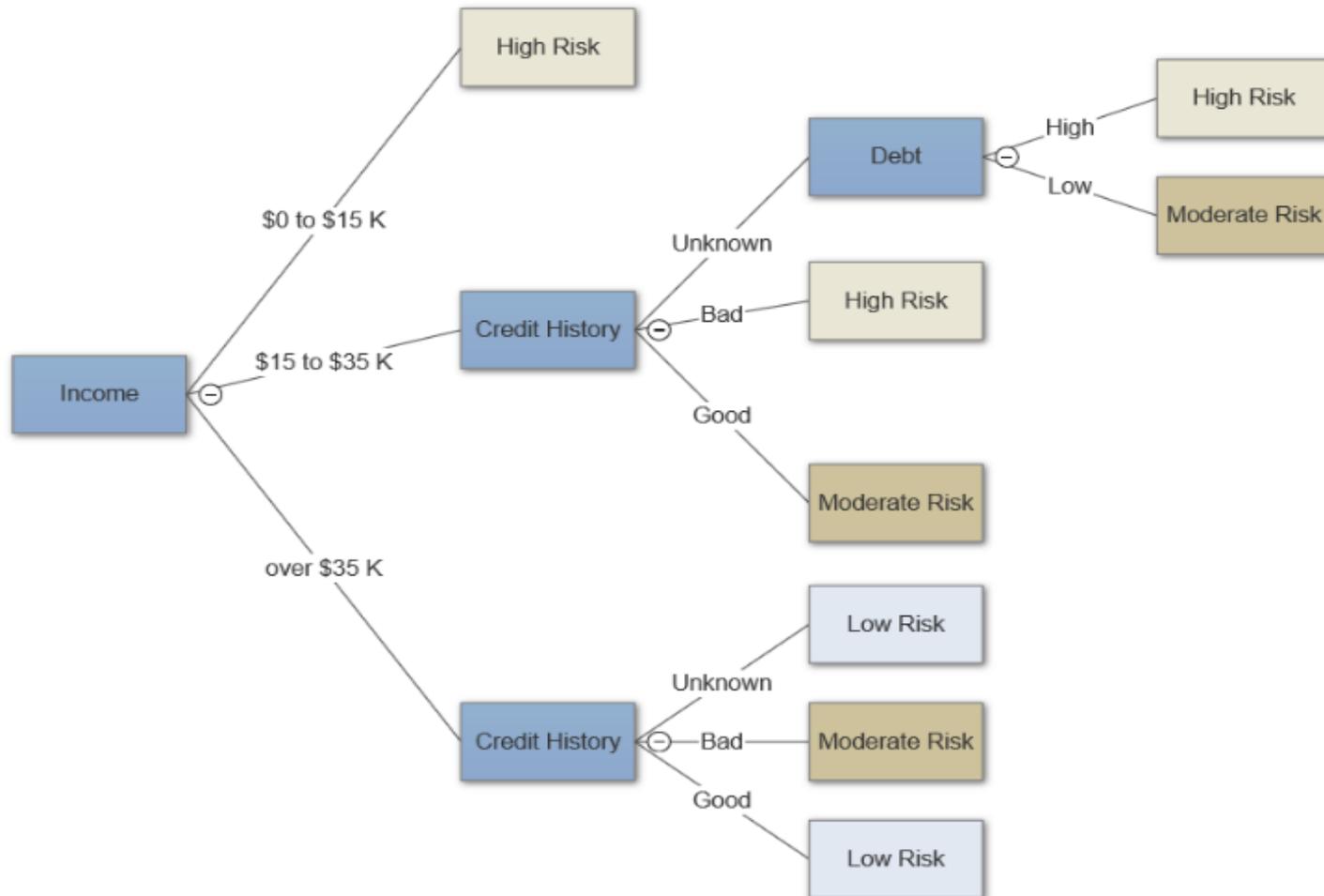
1. GLOBALIZATION / GLOCALIZATION
  2. ASIA & NEW ECONOMIES
  3. CONVENIENCE TECHNOLOGY
  4. **CONNECTED**
  5. SMART TECHNOLOGY
  6. TRANSPARENCY
  7. GLOBAL SUSTAINERS
  8. RETHINKING ENERGY
  9. THE CREATIVE CLASS
  10. AGEING POPULATION
  11. FEMALE EMPOWERMENT
  12. HEALTH AND WELLBEING
- 

Health concerns have changed the face of Western culture. Certain health issues have already reached epidemic levels. A healthy body and mind will become a new form of future capital in the century ahead. The West will “discover” the universal values of the Eastern mindset, and seek the calm, the healing, and recovery it offers.

# HEADWINDS



# Now Back to the Question...Where Do We Begin?



# We Look for Correlations and Patterns

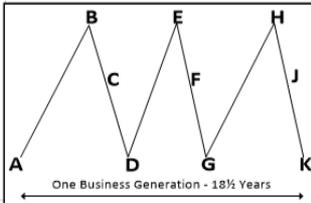
A separate column is here given for each New Business Generation of 18½ years.

The periodicity of Crises and Depressions is very generally recognized.

History repeats itself and a comparison with similar years of previous Business Generations will show the reasons for these predictions.

Inasmuch as the human race advances upon the plan of a spiral, around and around continuously treading near upon the ground it has trodden before, and each new Business Generation learns by bitter experience making the same mistakes at the same period in its history, over and over, again. The story of American Panics and Stock Value Fluctuations should have particular interest for us, now, that a New Business Generation has begun.

A Panic is not a Matter of the Purse, but of the Mind.



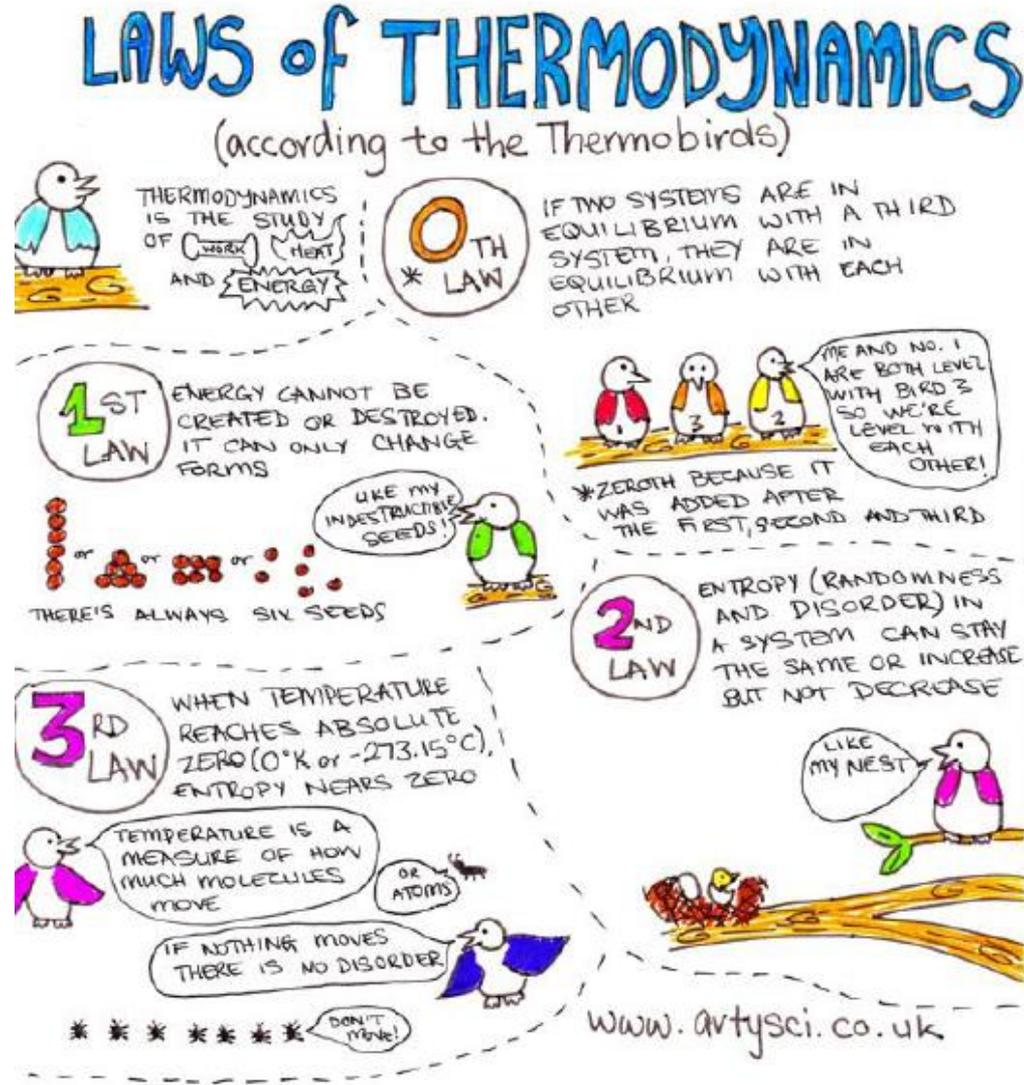
## LEGEND

A	Extreme low stock prices - strikes - Depression - Despair. Beginning of New Business generation of 18½ years. About four years of rising stock prices. About four years of improving business
B	High Stock Prices
C	Panic!!
D	Interim Low Stock Prices
E	Interim High Stock Prices
F	Panic!!
G	Interim Low Stock Prices
H	Very high stock prices - Most prosperous Year - Waste - Over Speculation - Extravagance - No more poverty, ever! Most paper money in circulation - Everybody rich - Stocks high & rising.
J	Major Panic - Crash - About four years falling stock prices. Also, business stagnation. Bread lines & Soup kitchens. Despair and Unemployment...
K	Extreme low stock prices - Depression - Despair. (Same as A) Strikes-Unemployment. Many prominent deaths.

1784	1803	1821	1840	1858	1877	A	1895	1914	1932	A	1951	1969	1988	2008											
1785	A	1804	A	1822	A	1841	1859	A	1878	1896	A	1915	A	1933	1952	A	1970	A	1989	A	2009	A			
1786	1805	1823	1842	A	1860	1879	1897	1916	1934	1953	1971	1990	2010	A											
1787	1806	1824	1843	1861	1880	1898	1917	1935	1954	1972	1991	2011													
1788	1807	B	1825	B	1844	B	1862	1881	B	1899	1918	1936	1955	1973	1992	2012	B								
1789	B	1808	1826	1845	1863	1882	1900	B	1919	B	1937	B	1956	B	1974	B	1993	2013	C						
1790	1809	1827	1846	1864	B	1883	1901	1920	1938	1957	1975	1994	B	2014											
1791	C	1810	1828	1847	C	1865	C	1884	C	1902	C	1921	CD	1939	C	1958	C	1976	C	1995	C	2015	C		
1792	D	1811	CD	1829	D	1848	D	1866	D	1885	D	1903	D	1922	CD	1940	D	1959	D	1977	D	1996	D	2016	D
1793	1812	1830	1849	1867	D	1886	1904	1923	E	1941	1960	1978	1997	2017											
1794	1813	E	1831	1850	F	1868	1887	F	1905	1924	1942	1961	E	1979	1998	E	2018	E							
1795	E	1814	F	1832	F	1851	F	1869	E	1888	F	1906	E	1925	F	1943	E	1962	F	1980	E	1999	F	2019	F
1796	F	1815	1833	E	F	1852	F	1870	F	1889	F	1907	F	1926	F	1944	F	1963	F	1981	F	2000	F	2020	F
1797	G	1816	G	1834	G	1853	1871	G	1890	1908	1927	G	1945	G	1964	G	1982	G	2001	G	2021	G			
1798	1817	H	1835	1854	GH	1872	H	1891	G	1909	H	1928	1946	1965	H	1983	2002	H	2022						
1799	H	1818	1836	H	1855	1873	J	1892	H	1910	1929	H	J	1947	H	1966	1984	H	2003	2023					
1800	J	1819	J	1837	J	1856	1874	1893	J	1911	J?	1930	1948	J	1967	J	1985	J	2004	J	2024				
1801	1820	1838	1857	J	1875	1894	1912	1931	1949	1968	1986	2005	2025												
1802	1821	1839	1858	1876	1895	1913	1932	K	1950	1969	1987	2006	2026												
1803	1822	K	1840	1859	K	1877	K	1896	K	1914	1933	1951	1970	K	1988	2007	K	2027							
1804	K	1823	1841	1860	1878	1897	1915	K	1934	1952	K	1971	1989	K	2008	2028									
			1842	K																					

# Predictable Forecasts Based in Logic

- Common analogs among at least 30% of probabilistic outcomes occur within reasonable norms.
- Price moves can be correlated with extrinsic forces involving even greater bias...buried in impressive scientific flotsam.
  - Models are not forecasts.
  - Momentum buy/sell drives directional bias.
- Correlations are usually weak for long-term dynamics.
- Which paradigm shifts will impact economic equilibrium NEXT?
- At the end of mathematical gymnastics we're more often left with THE CALL.



Heisenberg's Uncertainty Principle

# Global Economic Outlook – Good Chance of Continued Growth

## Tailwinds



### Energy Demand Growth

- Rising 30% out to 2030
- 8.8bn population/Urbanization
- Renewables 40% of demand growth
- Nat Gas use rises 45% to 2040



### Commodity Prices

- Been rising since Q1 2017
- Supply deficit worked down
- Demand improvement
- Need for new production investment



### Improving Microeconomics

- Low unemployment
- Less bank volatility
- High levels of consumer confidence
- Industrial/Consumer Product Manuf.



### Favorable Macroeconomics

- Still historically low interest rates
- Weaker dollar
- Low likelihood of recession

## Headwinds



### Inflation & Credit Risk

- Low unemployment -> tight labor markets
- Higher wage rate inflation
- Prospect of interest rate hikes
- Higher borrowing costs
- Rise in global debt – Debt-to-GDP Ratio



### China Growth Slowdown

- Biggest consumer & consumer of commodities.



### Trade Tensions & Uncertainty

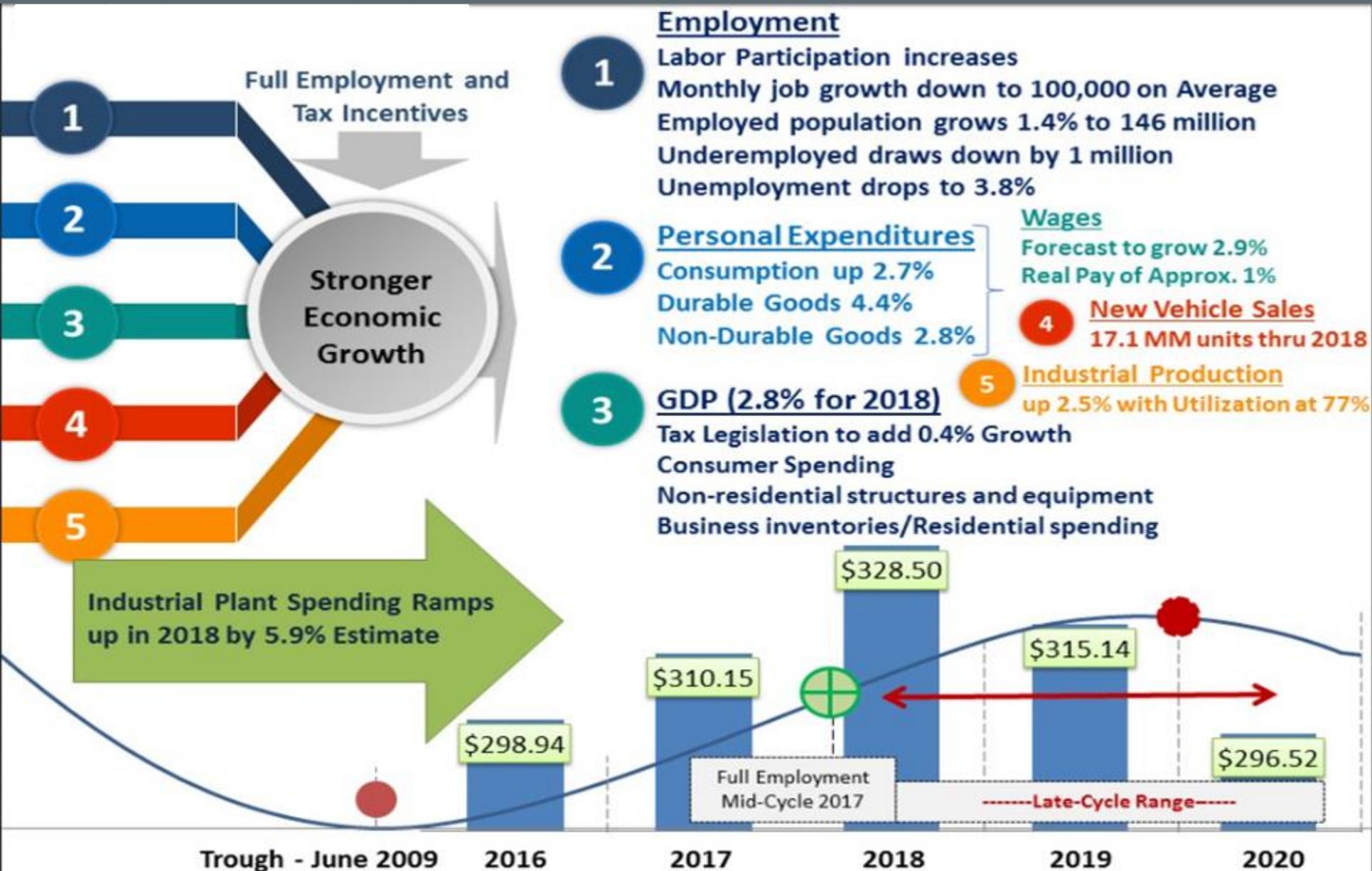
- NAFTA, TPP
- BREXIT /.... Italian elections, Czech, Greece
- Protectionism and Trade Tariffs
- Retrenchment towards “make at home”



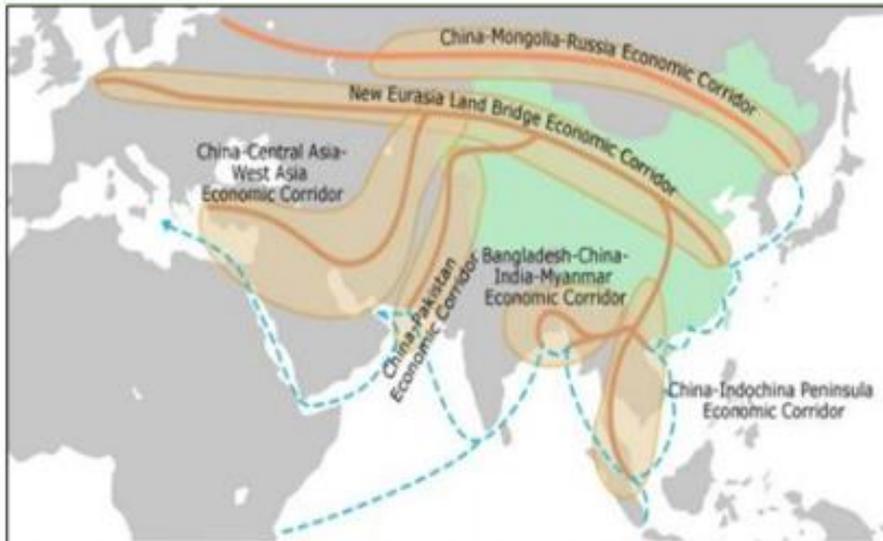
### Geopolitical Tensions

- Middle East destabilization / policy reform.
- North Korea.

# U.S. Macro Economic Outlook

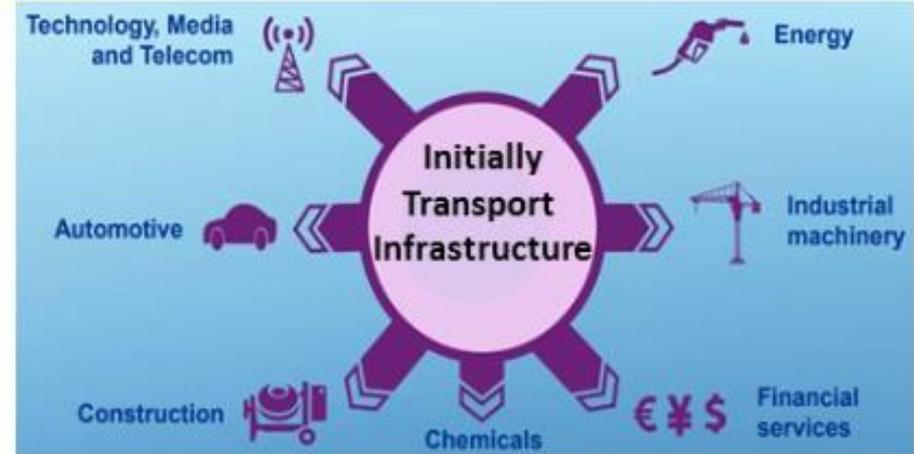


# China...Mega-Trade & Development Initiative or Geopolitical Strategy?



**65 countries, 70% global population, 55% of world's GNP & 75% of proven energy reserves**

- U\$ 1 Trillion
- Building land & sea trade “corridors”
- 30-40 year plan
- U\$ 2.5 trillion in Trade by 2025
- \$250 bn of projects already signed off or underway



- Framework of interregional cooperation.
- **Beneficiaries are three-fold:**
  - Enhanced trade of good & services & commodities
  - Demand for Metals & Minerals, Equipment Manufacturing, Engineering & Construction, Technology
  - Propagate energy infrastructure development.

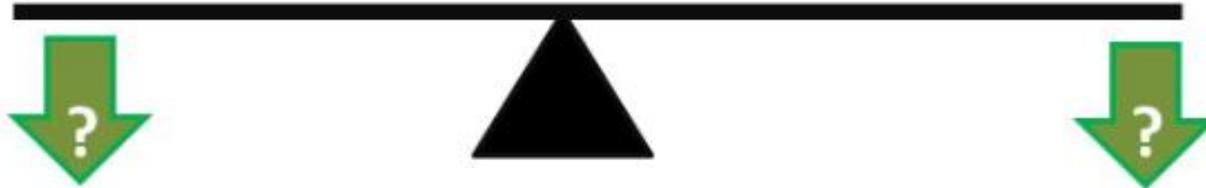
# Impact of Tax Repatriation

How Much Will Be Thrown At Capital Investments?

Is there more upside in moving foreign earnings back to the US or leaving it in Asia to capture some potential upside from regional growth projections?

**OBOR**

**Repatriation**



Is it all about one-way flow of Chinese products & oversupply?

Will US & European companies get a seat at the table?

Are all (the right) countries supportive?

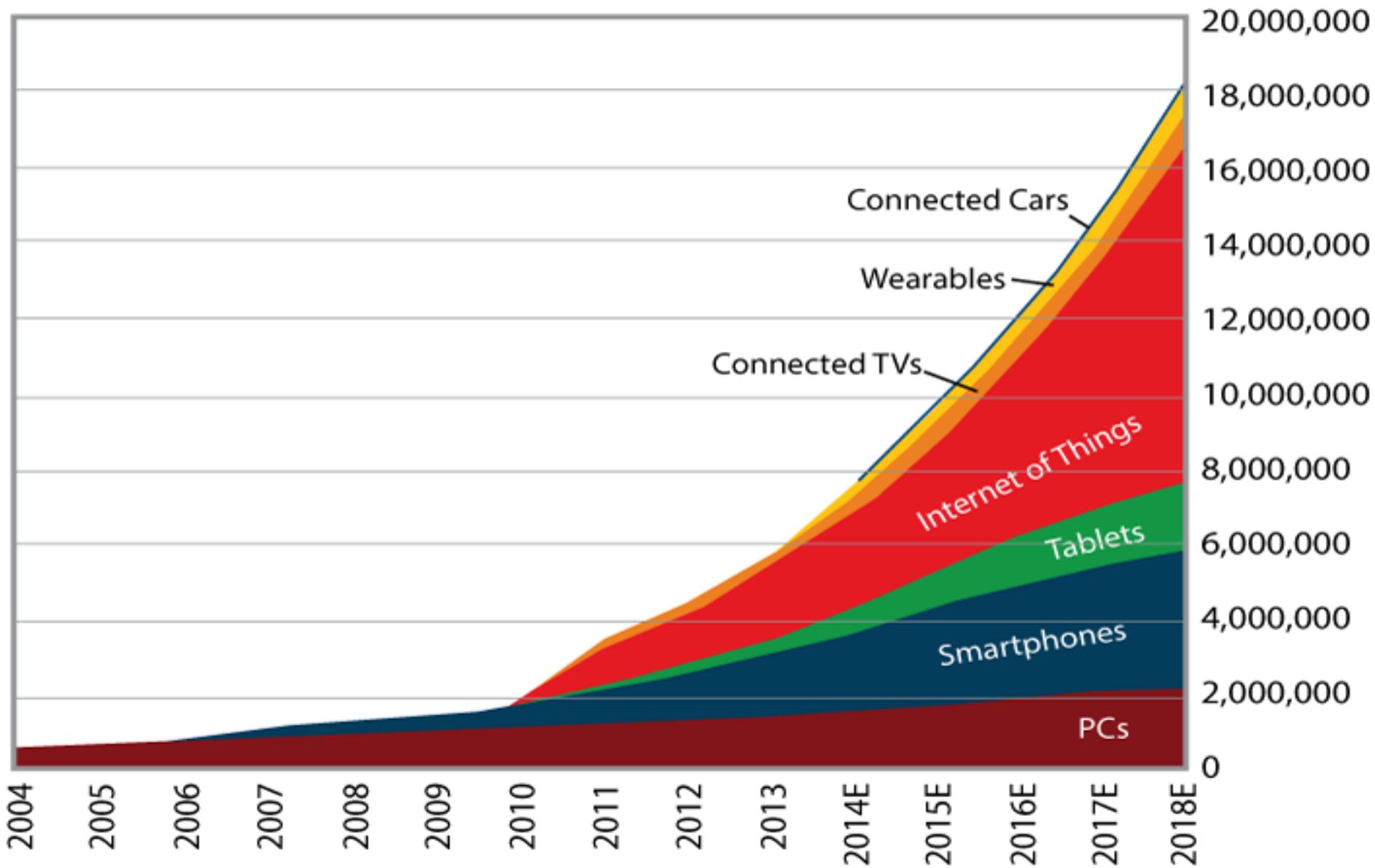
Could it create the next big credit risk?

How much will tax cuts incentivize repatriating foreign earnings long term?

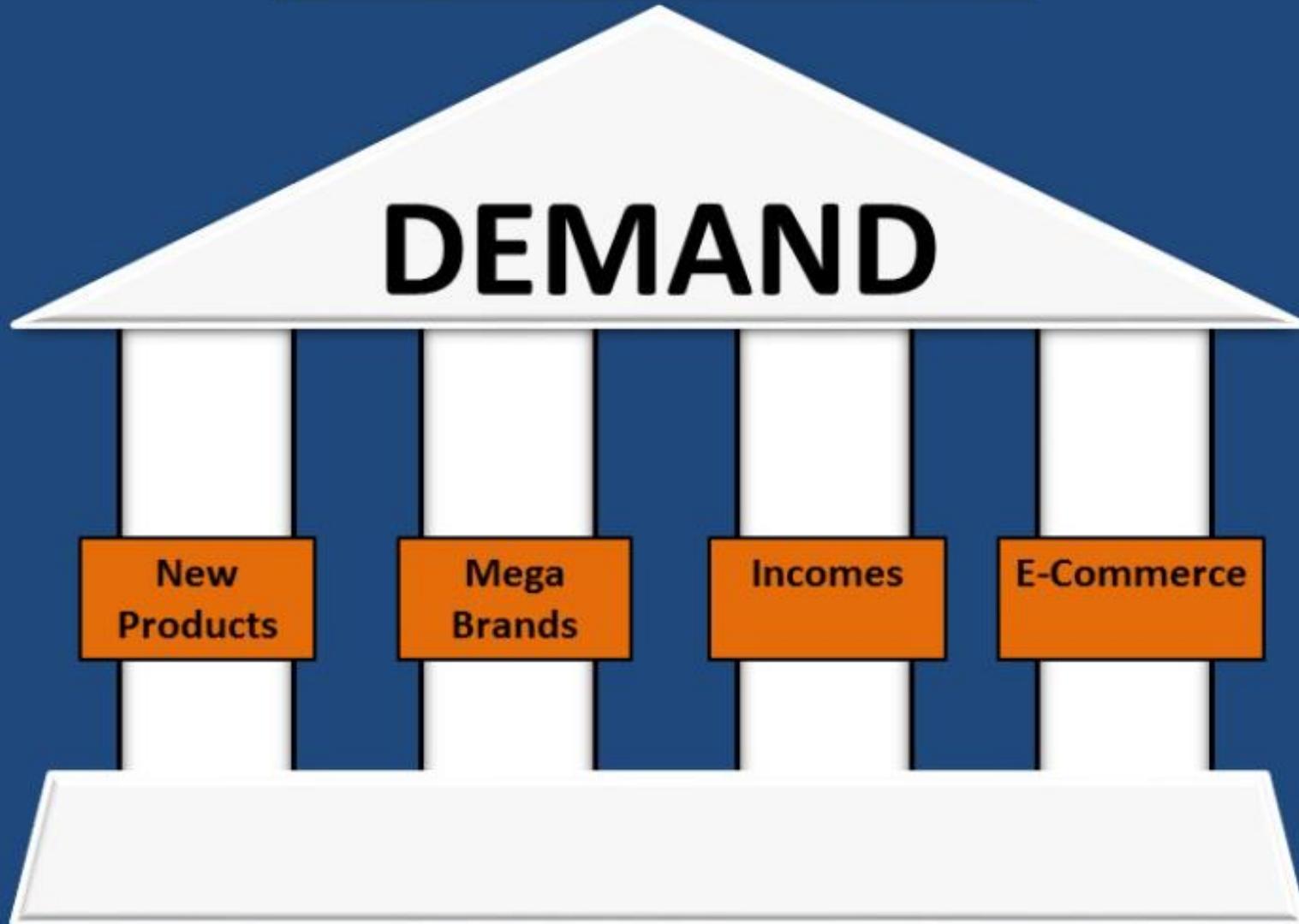
How much of the earnings uptick will translate into more capital spending?

Would it incentivize US companies to move more production back to the US?

# The Internet of Everything - IoT



## Key Pillars of Industry Growth



# U.S. Industrial Plant Spending Forecast – By Region

**2Q18 Update: 2017 Preliminary: \$311.45 Billion | 2018 Forecast (\$333.01 Billion)**

## West Region

**2018 Forecast**

\$52.74 Billion

17.0% Increase

5-YR CAGR 3.72%



## Midwest Region

**2018 Forecast**

\$79.03 Billion

8.1% Increase

5-YR CAGR 3.71%



## Northeast Region

**2018 Forecast**

\$35.58 Billion

1.8% Increase

5-YR CAGR 5.46%



## South Region

**2018 Forecast**

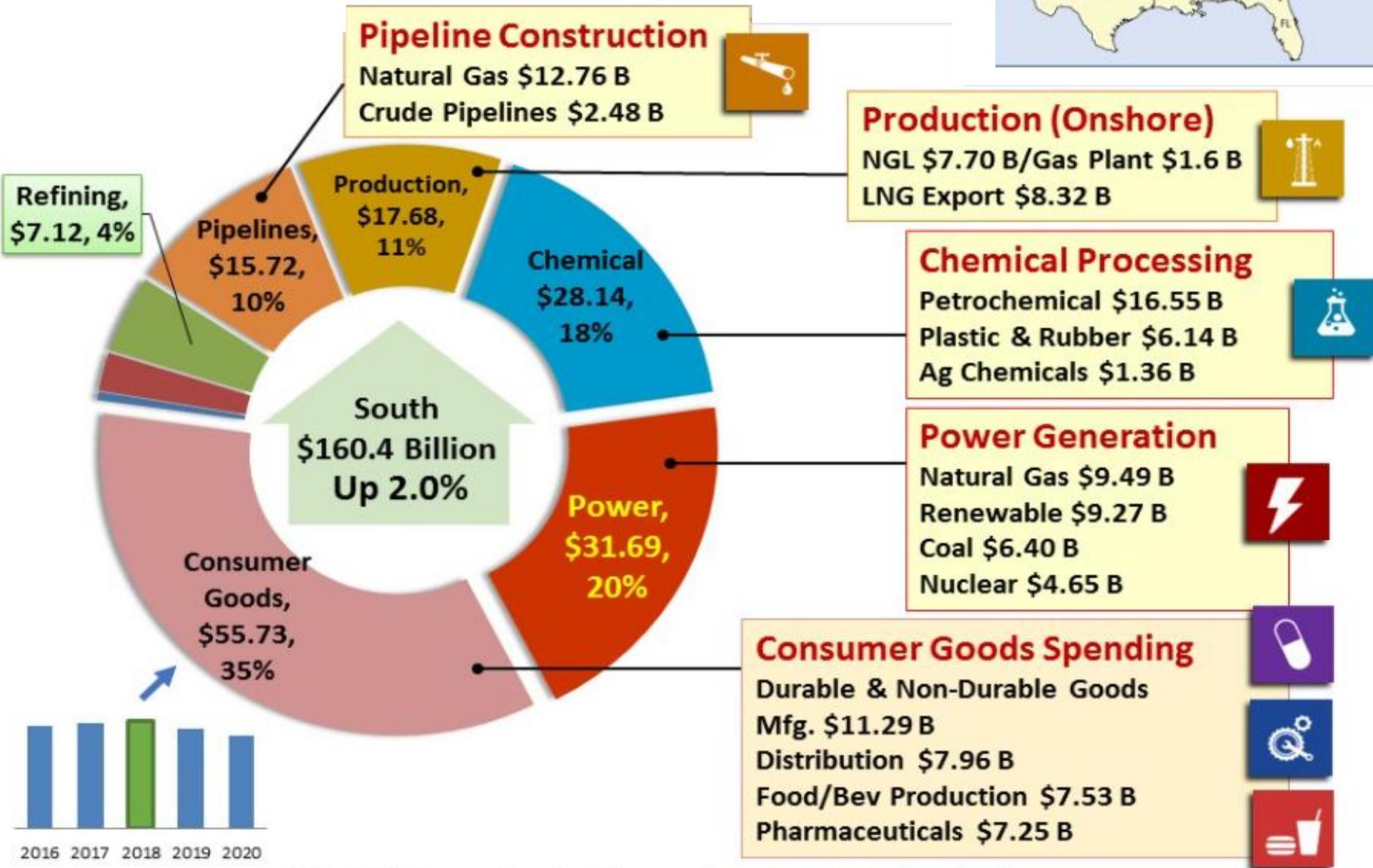
\$164.90 Billion

4.8% Increase

5-YR CAGR 5.28%



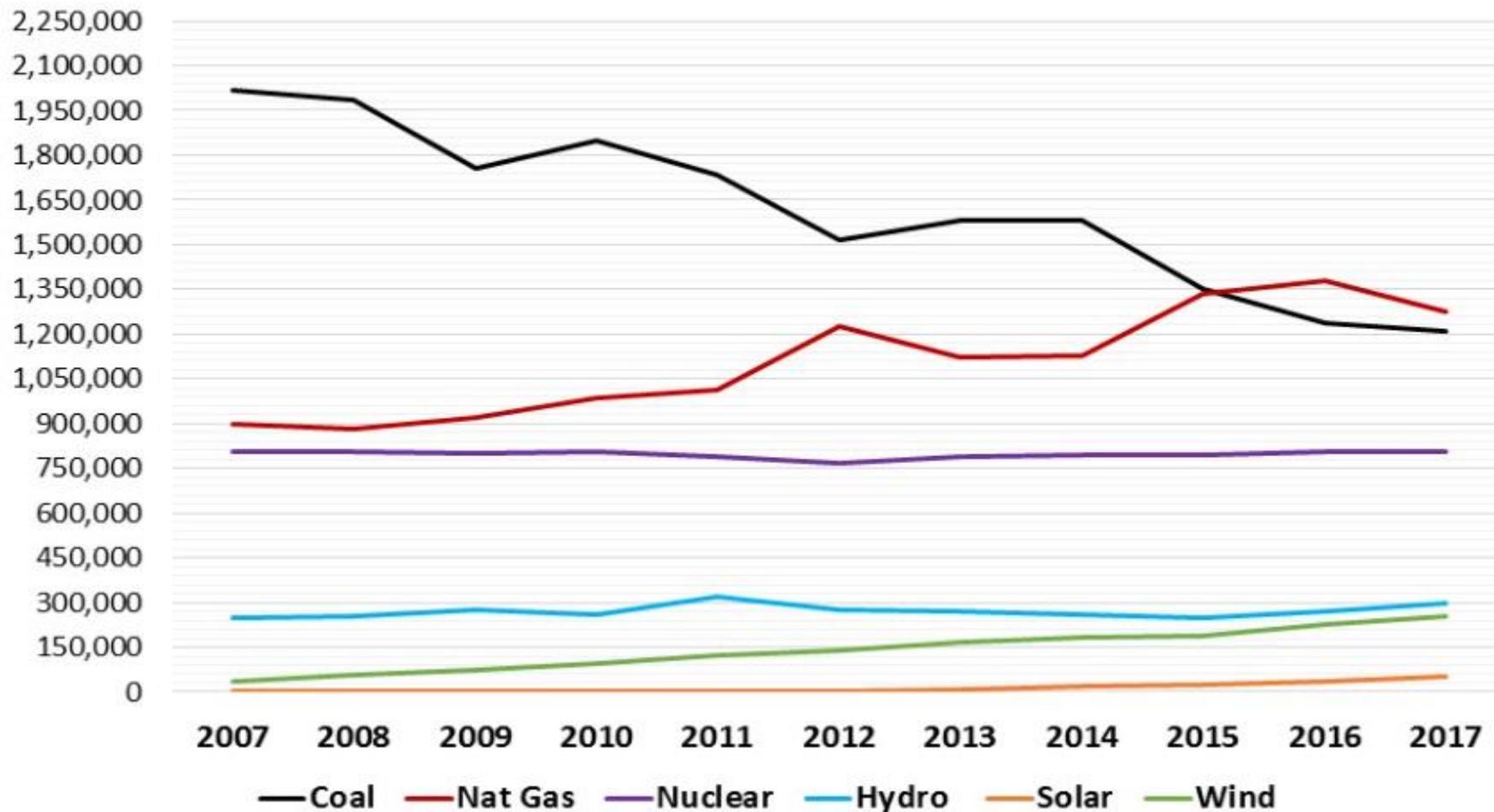
# South Plant Capital & Maintenance Spending



# U.S. Power Industry

## Electricity Net Generation by Energy Source (Million kWh)

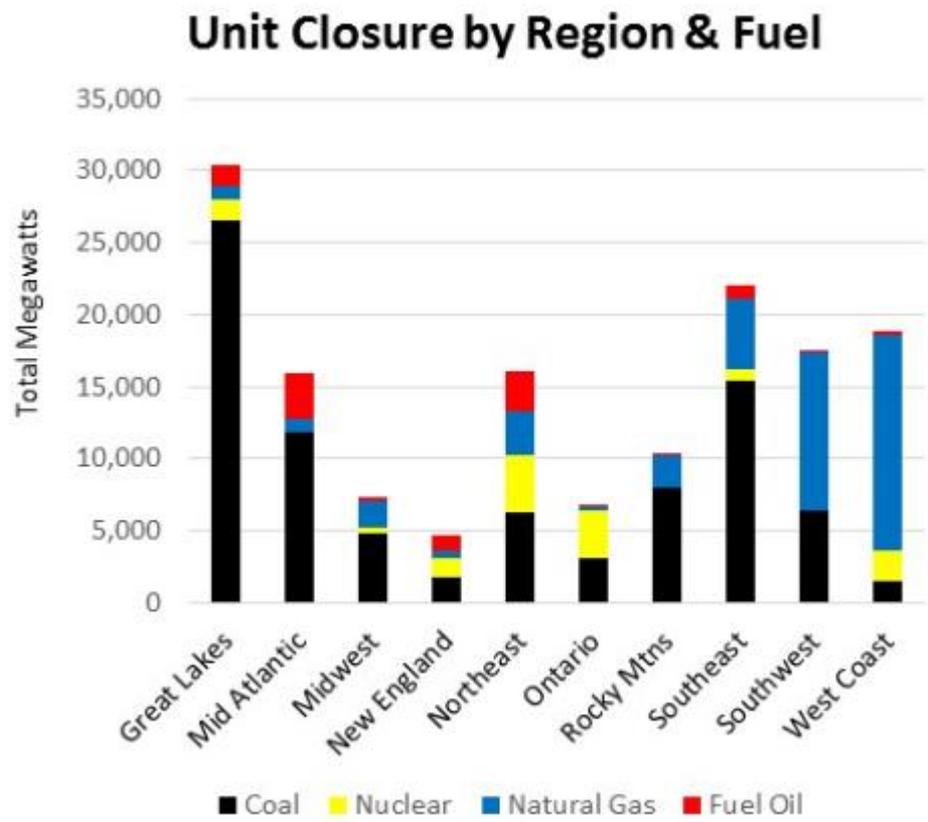
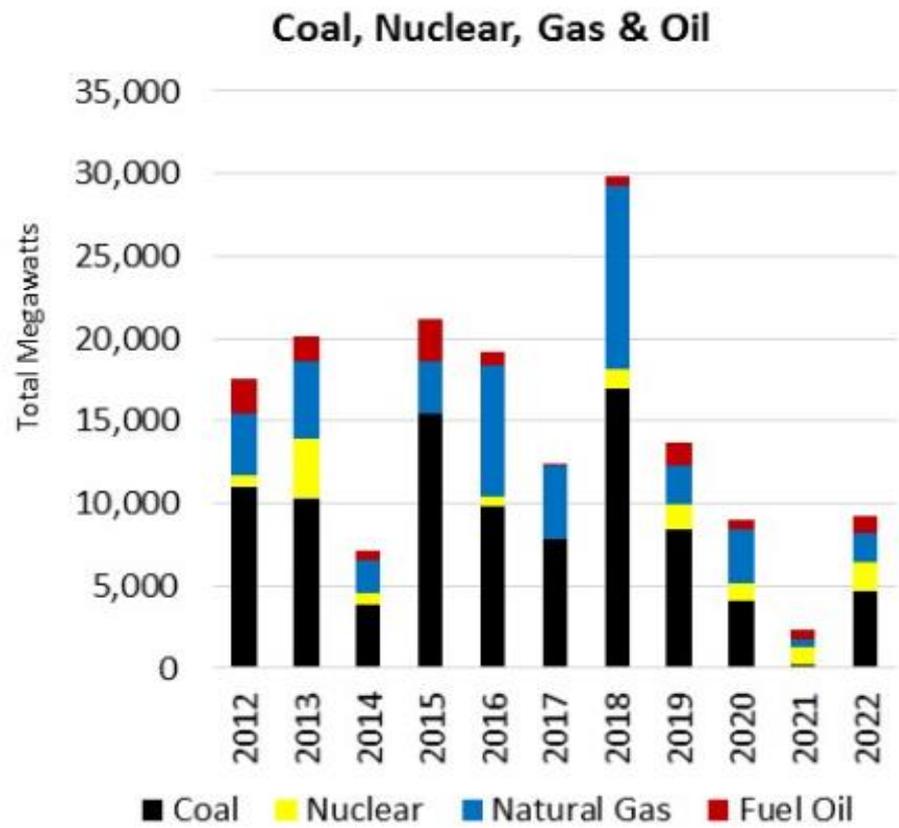
Million Kwh



Source :EIA

# North American (U.S. & Canada) Power Industry

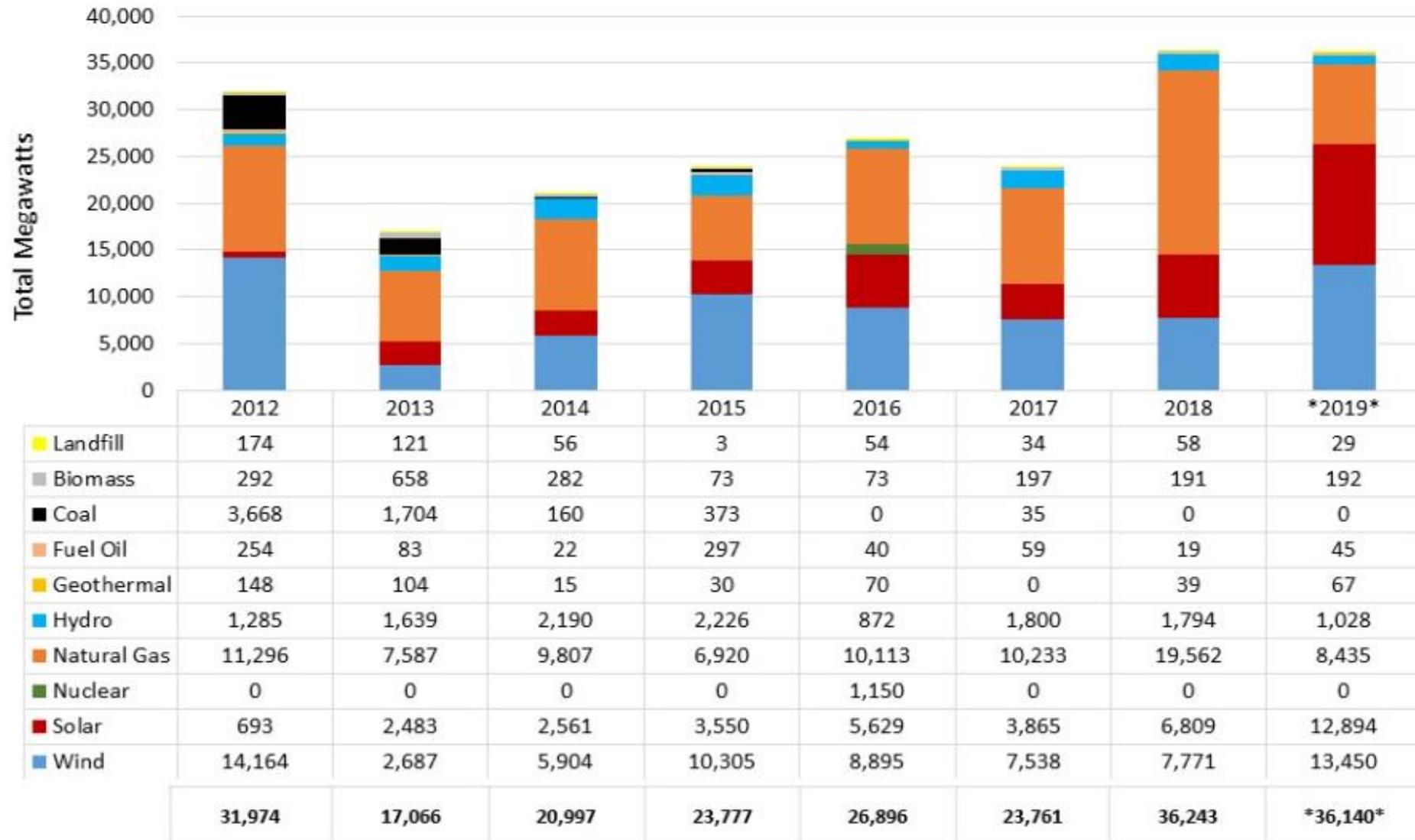
## Unit Closures from 2012-2022



107 Gigawatts Retired Since 2012  
 50 Gigawatts 2018 (May)-2022

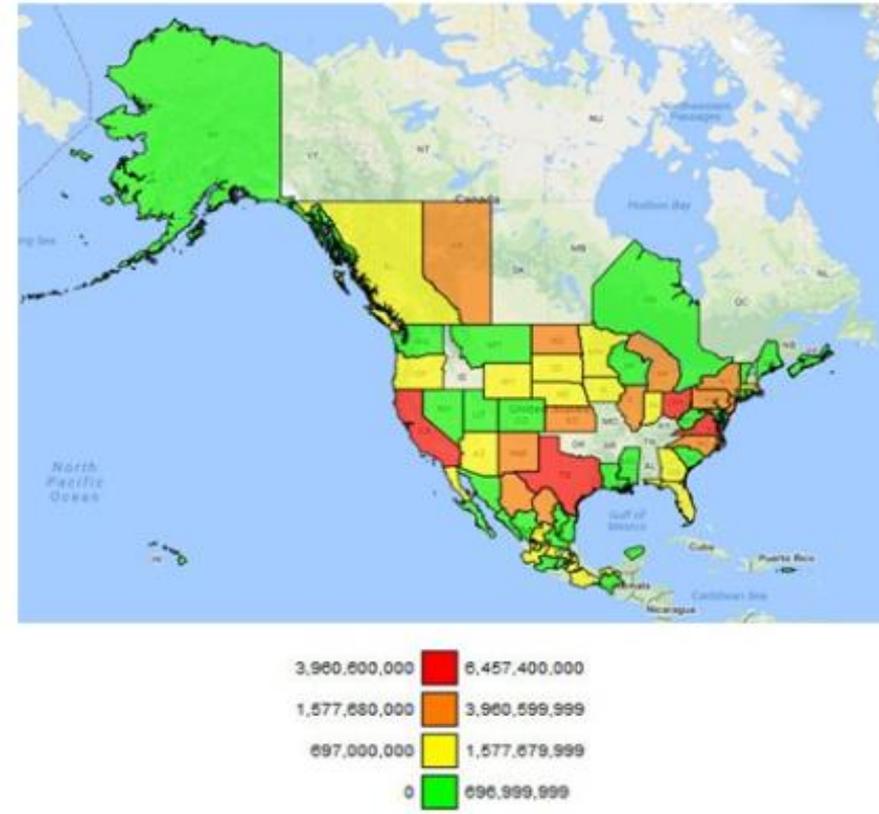
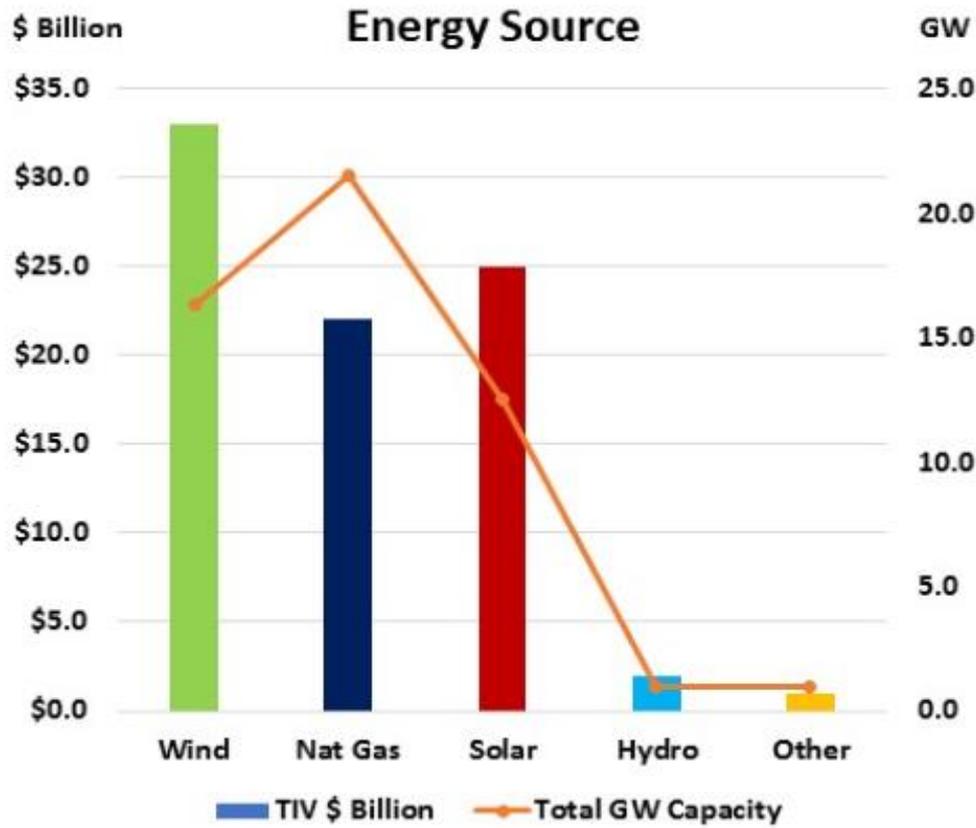
# North American Power Industry (U.S. & Canada)

## Unit Startups by Energy Source (2012 – 2019 Total MW)



# North American Power Industry

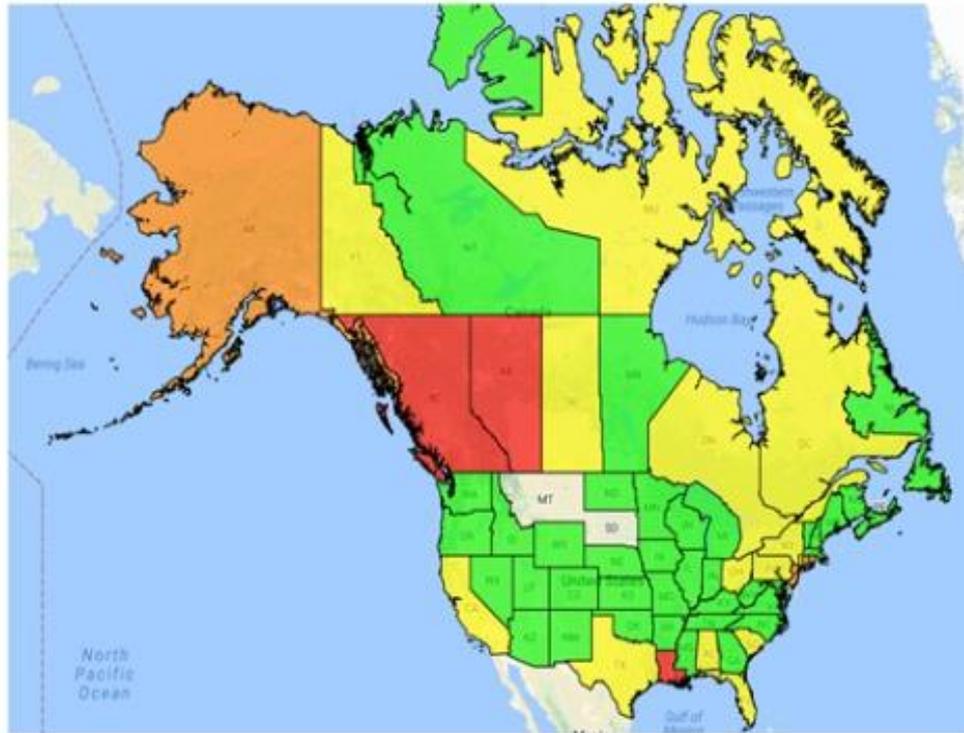
## Grassroot Project Kickoffs 2018 (May)-2020



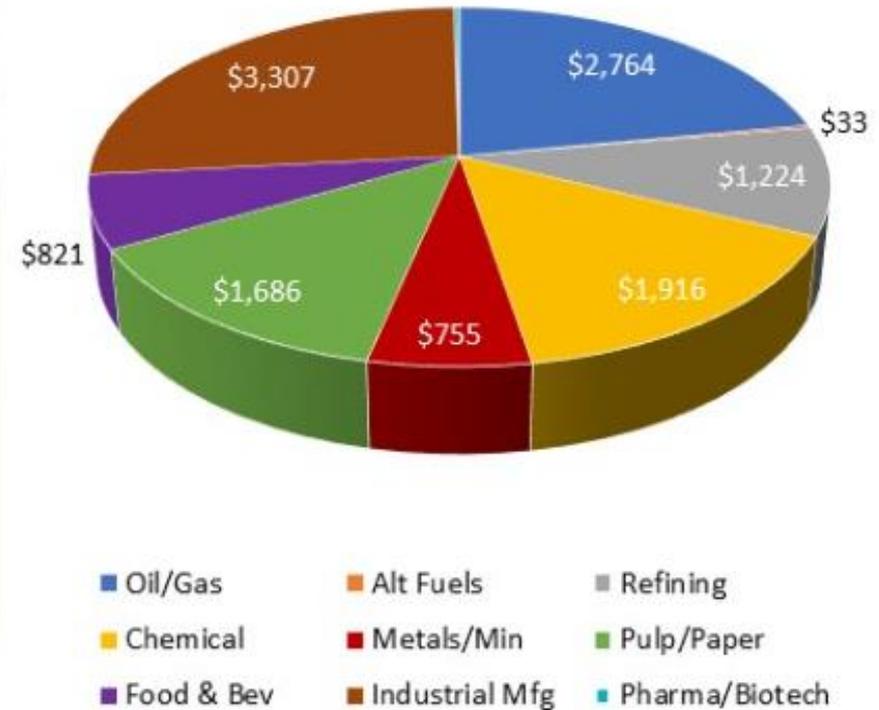
422 Projects worth \$83 Billion  
 37% Probability Factor of \$226 Billion Project Pipeline

# US & Canada Power Industry

## Industrial Energy Producers (IEP) Projects Kicking Off 2018-2022



**Project Spending by Industry**  
**Total Pipeline in \$Millions**



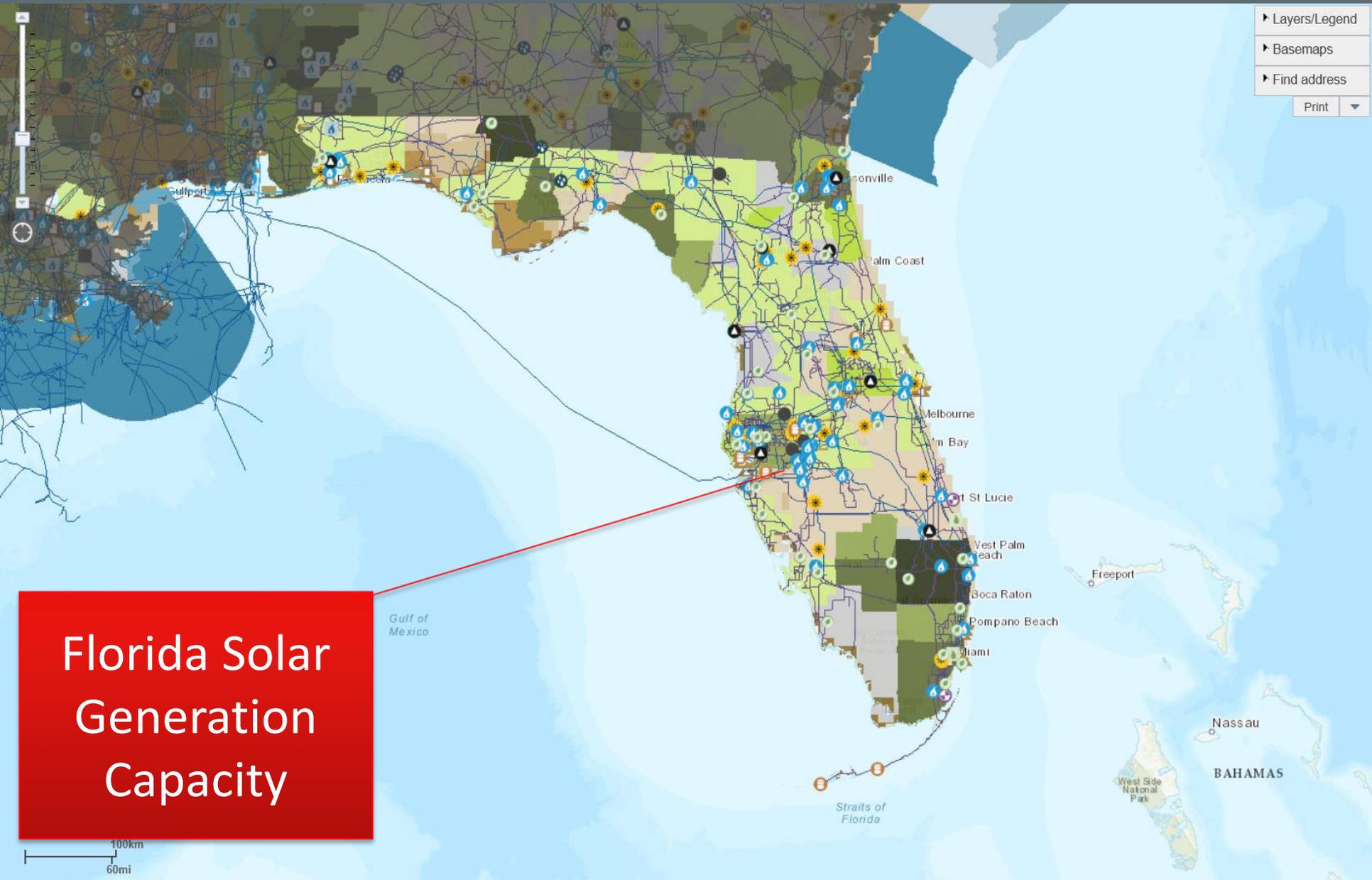
**805 High-Probability Projects Valued at \$12.5 Billion**  
**66% Confidence Factor** of a \$19 Billion Pipeline

# North American Power Industry

## Conclusions

- Growth in power demand remains “flat-lined”
- New-build generation continues to be led by natural gas-fired power plants and renewable energy sources
- Renewable Tax Credits are still in play
- Modernization and Upgrades for traditional power sources
- Environmental compliance upgrades continue
- Challenging business climate for traditional power plants
- Energy storage continues to gain traction

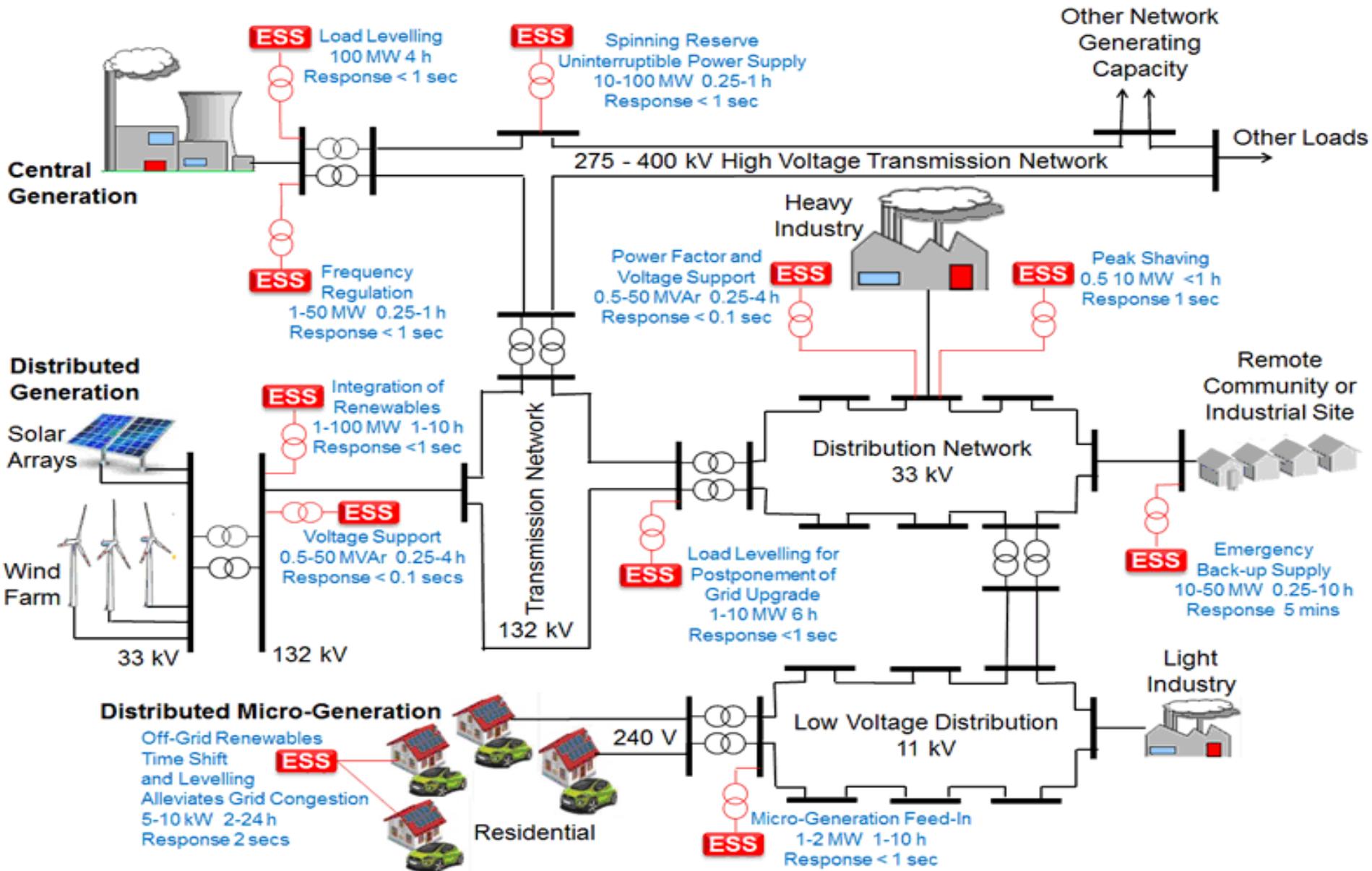
# Florida



**Florida Solar  
Generation  
Capacity**

# Energy Storage

## Grid Energy Storage Systems (ESS) and Applications



# Global Power Generation Projects 24-Month Outlook

## Active Capital & Maintenance Projects

Source: IIR Power Project Database

### Current Active Projects Planning & Engineering Stage Only & Maintenance Start/Kick-off Date – ALL DATES

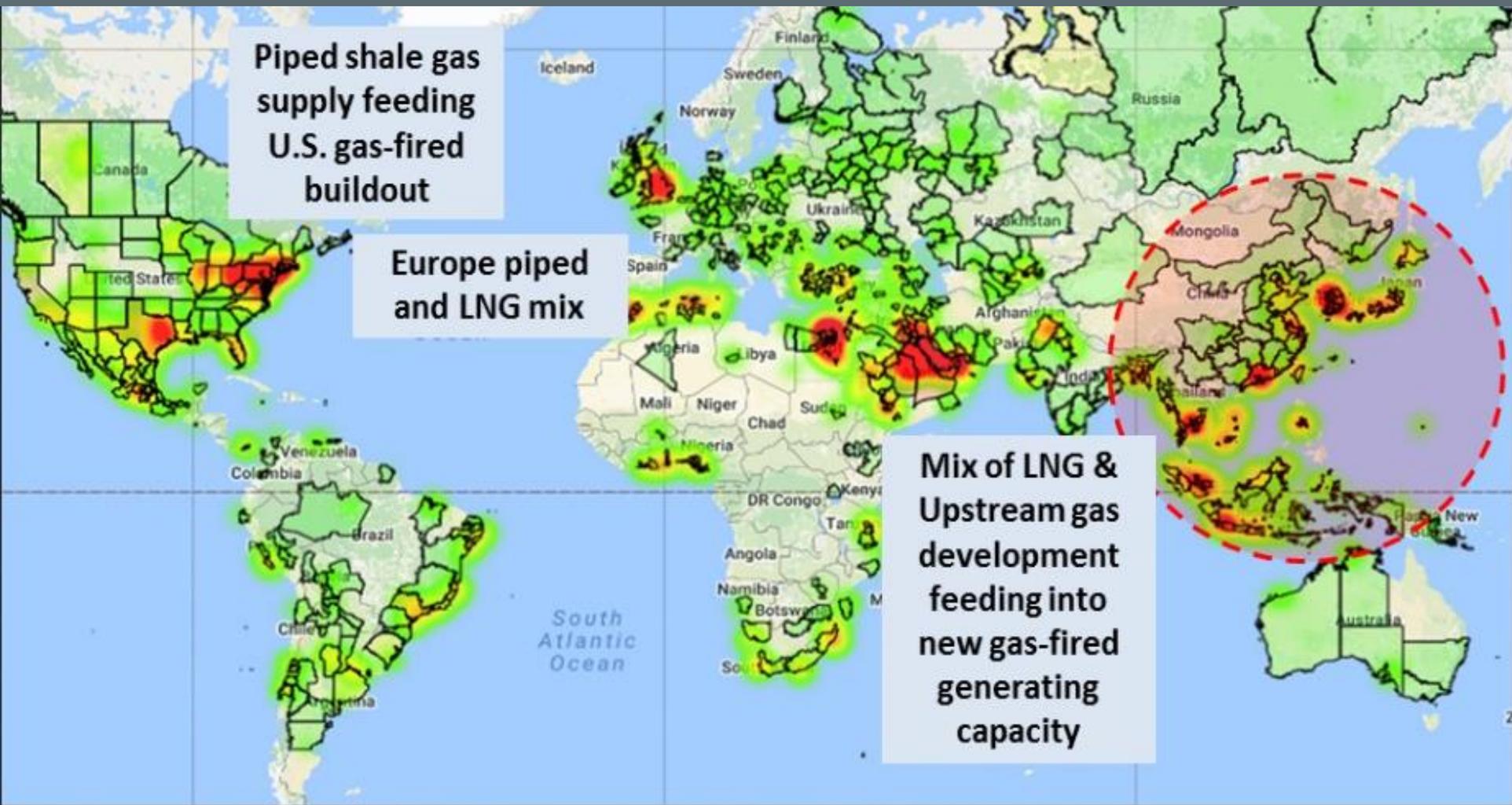


**4241 Projects - \$1.18 trillion Under Construction**

**Global Planned Projects**  
**36,515 Active Projects - \$5.28 Trillion TIV**  
 Planning & Engineering Stage  
 Construction Starts - ALL DATES

# LNG Global Capacity Buildout

## LNG Demand Drivers – Natural Gas Power Generation Grassroot/New Units



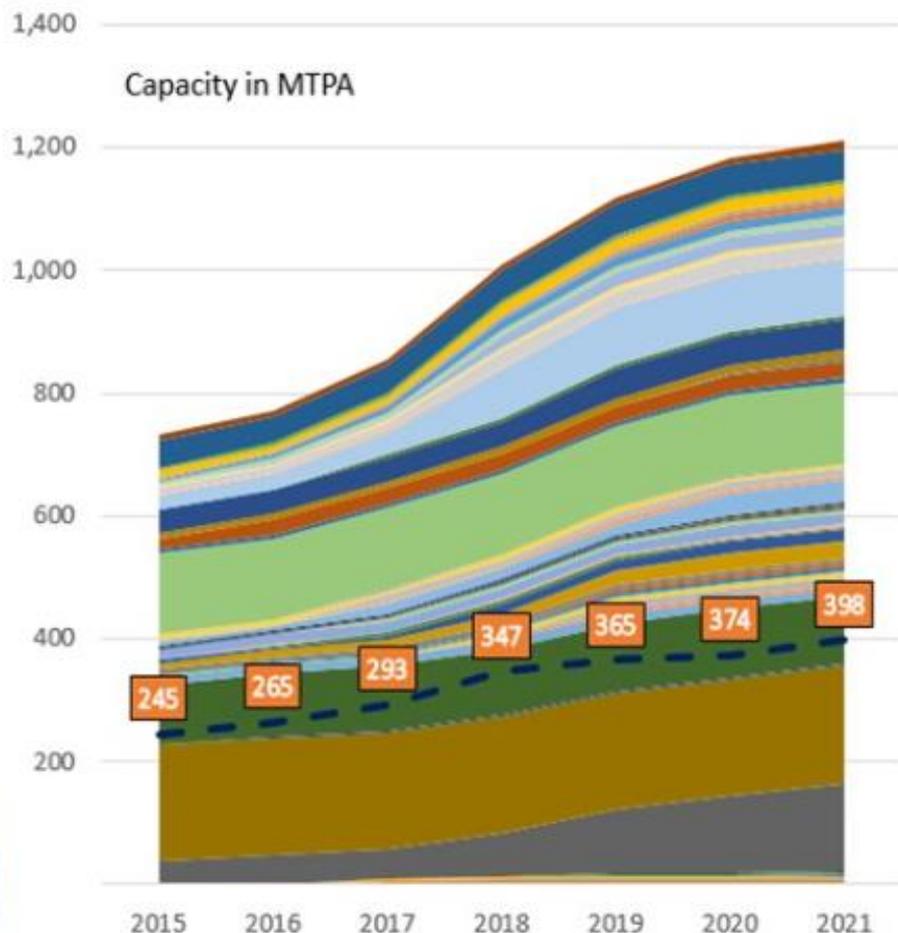
**1,398 Active Natural Gas Power Generation  
Grassroot & Unit Additions Projects**

**\$564 bn  
New Capacity Investments**

# LNG Regasification Buildout

## 32 New First-Time LNG Buy-Side Countries

### LNG Regasification Terminals by Country Operational with Cumulative Planned Capacity



### 185 Active Projects - \$80 Billion adding 494 MTPA of Regasification Capability

- |   |  |  |
|---|--|--|
| <b>Africa</b><br><ul style="list-style-type: none"> <li>Benin ✓</li> <li>Cote d'Ivoire ✓</li> <li>Djibouti ✓</li> <li>Ghana ✓</li> <li>Morocco ✓</li> <li>Namibia ✓</li> <li>Senegal ✓</li> <li>South Africa ✓</li> </ul> | <b>East Asia</b><br><ul style="list-style-type: none"> <li>China</li> <li>Japan</li> <li>Macau ✓</li> <li>South Korea</li> <li>Taiwan</li> </ul>   | <b>Latin America</b><br><ul style="list-style-type: none"> <li>Argentina</li> <li>Brazil</li> <li>Chile</li> <li>Colombia ✓</li> <li>Cuba ✓</li> <li>Dominican Republic</li> <li>El Salvador ✓</li> <li>Jamaica ✓</li> <li>Panama ✓</li> <li>Peru ✓</li> <li>Puerto Rico</li> <li>Uruguay ✓</li> </ul> |
| <b>Eastern Europe</b><br><ul style="list-style-type: none"> <li>Albania ✓</li> <li>Croatia ✓</li> <li>Estonia ✓</li> <li>Latvia ✓</li> <li>Lithuania</li> <li>Poland ✓</li> <li>Romania ✓</li> </ul>                      | <b>Southeast Asia</b><br><ul style="list-style-type: none"> <li>Indonesia</li> <li>Malaysia</li> <li>Myanmar</li> <li>Philippines ✓</li> <li>Singapore</li> <li>Thailand</li> <li>Vietnam ✓</li> </ul> | <b>Middle East</b><br><ul style="list-style-type: none"> <li>Bahrain ✓</li> <li>Israel</li> <li>Jordan ✓</li> <li>Kuwait ✓</li> <li>Lebanon ✓</li> <li>UAE ✓</li> </ul>  |
| <b>North America</b><br><ul style="list-style-type: none"> <li>US</li> <li>Canada</li> <li>Mexico</li> </ul>  | <b>Southern Europe</b><br><ul style="list-style-type: none"> <li>Greece</li> <li>Italy</li> <li>Malta ✓</li> <li>Portugal</li> <li>Spain</li> <li>Turkey</li> </ul>                                    | <b>South Asia</b><br><ul style="list-style-type: none"> <li>Bangladesh ✓</li> <li>India</li> <li>Pakistan ✓</li> </ul>   |
| <b>Northern Europe</b><br><ul style="list-style-type: none"> <li>Belgium</li> <li>France</li> <li>Netherlands</li> <li>UK</li> </ul>  |  |  |

# LNG Global Capacity Buildout

## LNG Regasification – Top Global Hotspot Project Markets



**406 Active LNG**

**\$111 bn**

**Regasification Projects Total Investments**

**185 Active LNG**

**\$80 bn**

**494 MTPA**

**New Import Projects New Import Spend New Regas**

# LNG Liquefaction Capacity Build-Out Is The Spending Over?

## LNG Liquefaction Capacity Buildout Is the Spending Over?

Developer	Project	Train	Location	Kick-off	Start-up	MTPA
Sempra Energy	Cameron	T1-3	Louisiana	2014	2019	15
Cheniere Energy	Corpus Christi	T1-2	Texas	2015	2018-9	9
Freeport LNG	Freeport	T1-3	Texas	2014-15	2019-20	15
Cheniere Energy	Sabine Pass	T5	Louisiana	2015	2020	4.5
Kinder Morgan - Southern LNG	Elba Island	T1-10	Georgia	2017	2018-19	2.5

### U.S. - LNG Capacity FERC Approved awaiting FID or notice to proceed

Developer	Project	Train	Location	Kick-off	Start-up	MTPA
Cheniere Energy	Corpus Christi	T3	Texas	2019	2023	4.5
Cheniere Energy	Sabine Pass	T6	Louisiana	2019	2023	4.5
Energy Transfer-Trunkline/Shell LNG Limited	Lake Charles	T1	Louisiana	2019	2023	5.5
Qatar Petroleum-Exxon Mobil	Golden Pass	T1	Texas	2019	2023	5.2
Golar LNG - Enbridge	Delfin	FLNG	Gulf of Mexico	2019	2021	2

### U.S. - Formal FERC Application Filed

Companies	Project	Train	Location	Kick-off	Start-up	MTPA
Kinder Morgan	Gulf	T1	Mississippi	2019	2023	6
Venture Global	Calcasieu Pass	T1-5	Louisiana	2019	2021	5
Texas LNG	Texas	T1	Texas	2019	2023	2
NextDecade LLC	Rio Grande	T1-2	Texas	2019	2023	9
Freeport LNG	Freeport	T4	Texas	2019	2023	5.1
Exelon	Annova	T1-2	Texas	2019	2023	2
Sempra - Woodside	Port Arthur	T1	Texas	2019	2023	5
Tellurian	Driftwood	T1-4	Texas	2019	2023	5.2
Pembina	Jordan Cove	T1-2	Oregon	2020	2024	7.8
Eagle LNG	JAX 1	T1	Florida	2019	2021	0.3

### Canada - Awaiting FID or Notice to Proceed

Companies	Project	Train	Location	Kick-off	Start-up	MTPA
Shell/PetroChina/Korea Gas	LNG Canada	T1-2	British Columbia	2019	2023	12
Woodfibre LNG	Woodfibre	T1	British Columbia	2018	2021	2.1

### Proposed without a Formal FERC Application Filed

<b>61 Projects</b>	<b>121 Trains</b>	<b>\$211B</b>
--------------------	-------------------	---------------

**\$41.5 Billion**  
46 MTPA  
8.0 Bcf/d



**\$16.3 Billion**  
25.7 MTPA  
6.2 Bcf/d



**\$36.5 Billion**  
41.3 MTPA  
7.1 Bcf/d



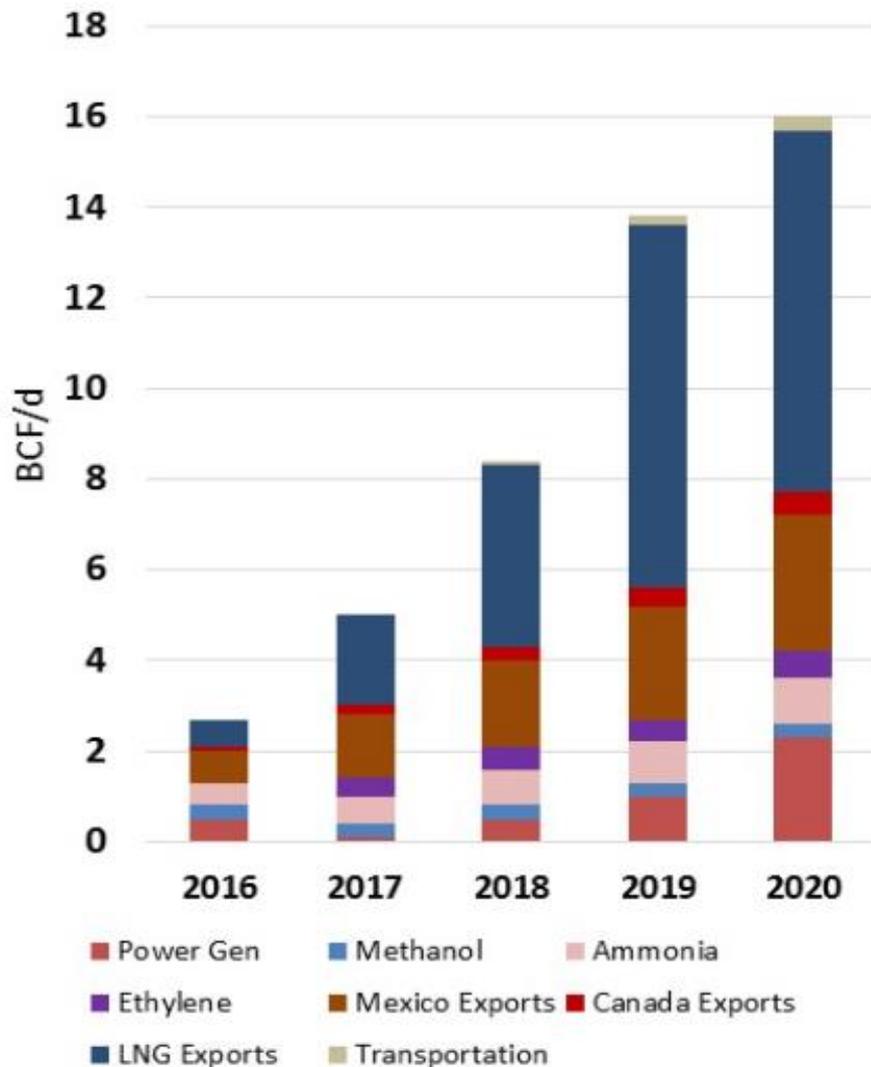
**\$26 Billion**  
14.1 MTPA  
1.9 Bcf/d



**171 Trains**  
**427 MTPA**  
**\$335 Billion**

# Natural Gas Demand

## U.S. Natural Gas Cumulative Demand Growth (2016-2020)



### Gas Demand

Below \$4MMBtu Gas projected 30+ Years Out

Natural Gas Supply Growth 25% 2015-2020

### Demand Drivers

LNG exports 8 Bcf/d Under Construction

Coal displacement – Coal-to-Gas Switching

Gas power generation – New Construction

Gas-on-gas competition – Pushing out imports

Pipeline exports to Mexico

New industrial demand (Ammonia and Methanol)

**\$198 billion in advanced stage industrial projects scheduled for startup in between now and late 2019**

### NGL Demand

U.S. Supply Growth 40+% 2016-2020

U.S. is now the largest exporter of Propane in the World

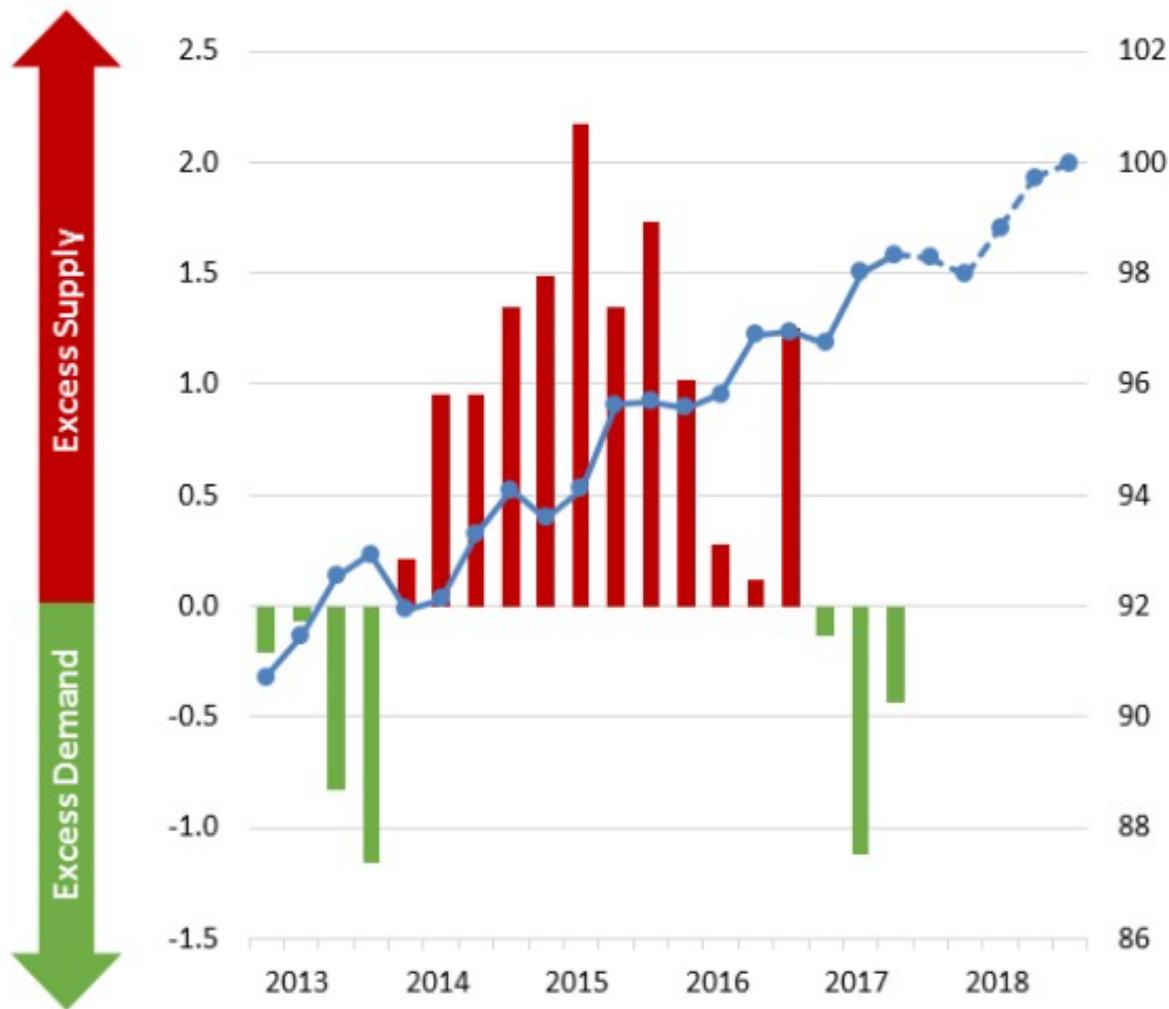
U.S. Ethane Crackers to add 495,000 BBL/d demand by 4Q18

Lower 48 Onshore U.S. Gas Production Full-Year average

	2010	2016	2018	2020
BCF/d	61	70.1	80	89

# Global Crude Demand Outlook

## The Imbalance is Shifting



Axis shows difference (mn/bpd) between global crude production and global demand

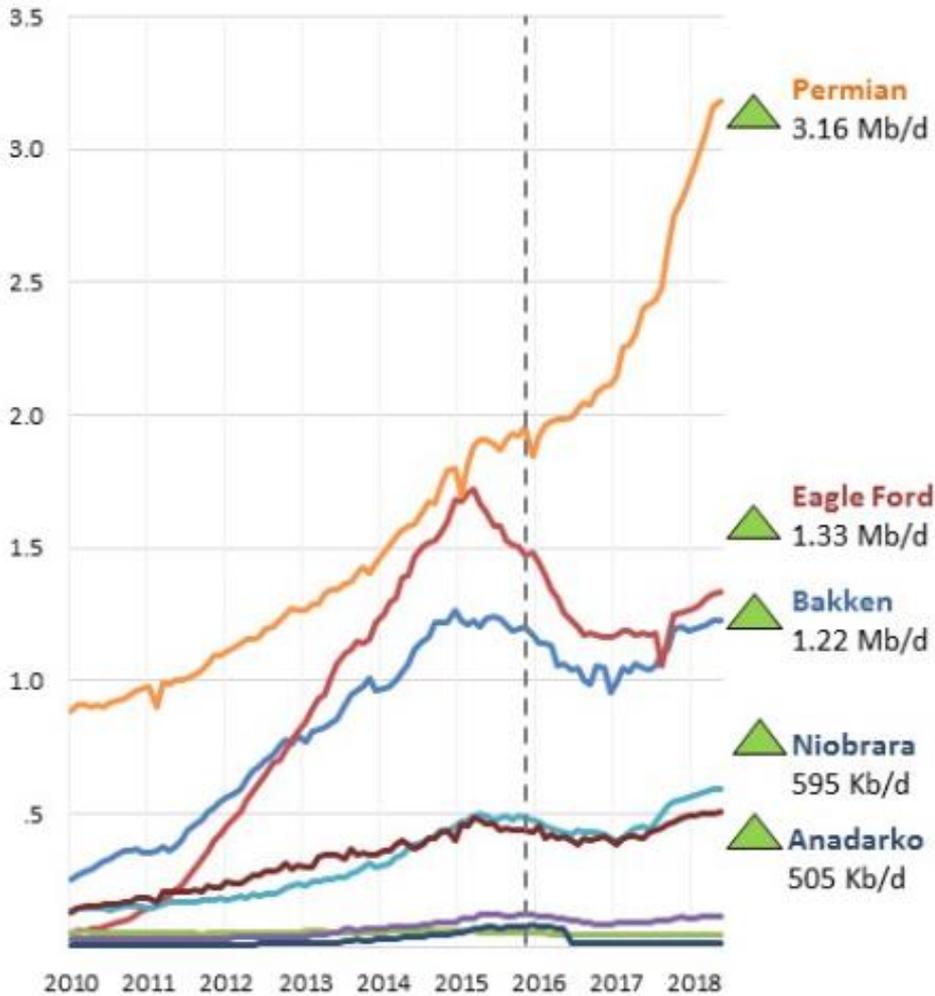
### Market Highlights

- Global demand growth 1.5 mb/d in 2018; same as 2017
- OPEC and non-OPEC participants agreed to extend supply cuts through 2018
- OPEC crude supply fell to 31.83 mb/d in March
- OECD commercial stocks fell to 2.841 mb in February, 30mb above five-year average
- Global oil supply decreased in March to 97.8 mb/d,
- Refinery runs expected to increase in 2Q18 after planned turnaround activity .

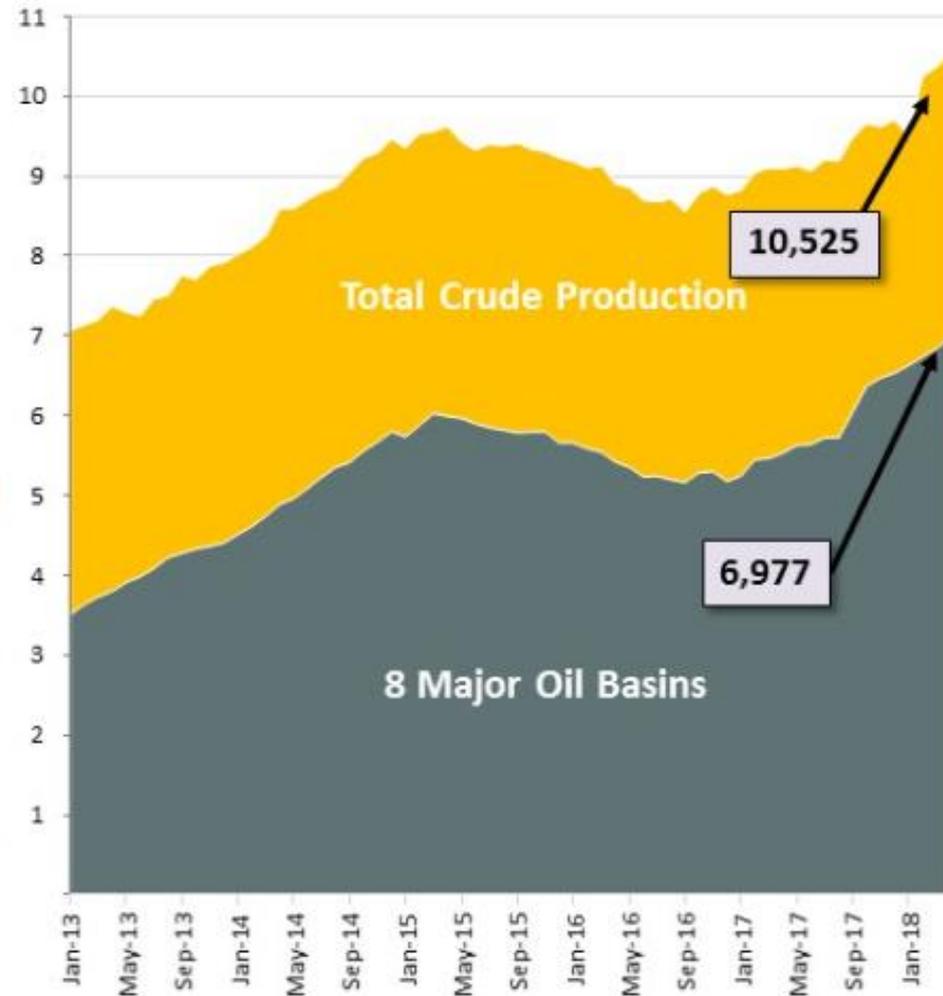
# Crude Oil Production – US

## Major Oil Basins Still a Major Contributor

**Total Oil Production for 8 Major Oil Basins  
(Million Barrels/Day)**



**U.S. Domestic Oil Production  
(Million Barrels/Day)**



# Global Oil & Gas Project Outlook

## Active Capital & Maintenance Projects

### Total O&G Projects Under Construction \$ Billions



**2,750 Projects - \$433bn**  
Under Construction

### Current Active Projects

Planning & Engineering Stage only  
Start/Kick-off Date – ALL DATES

Source: IIR Project Database

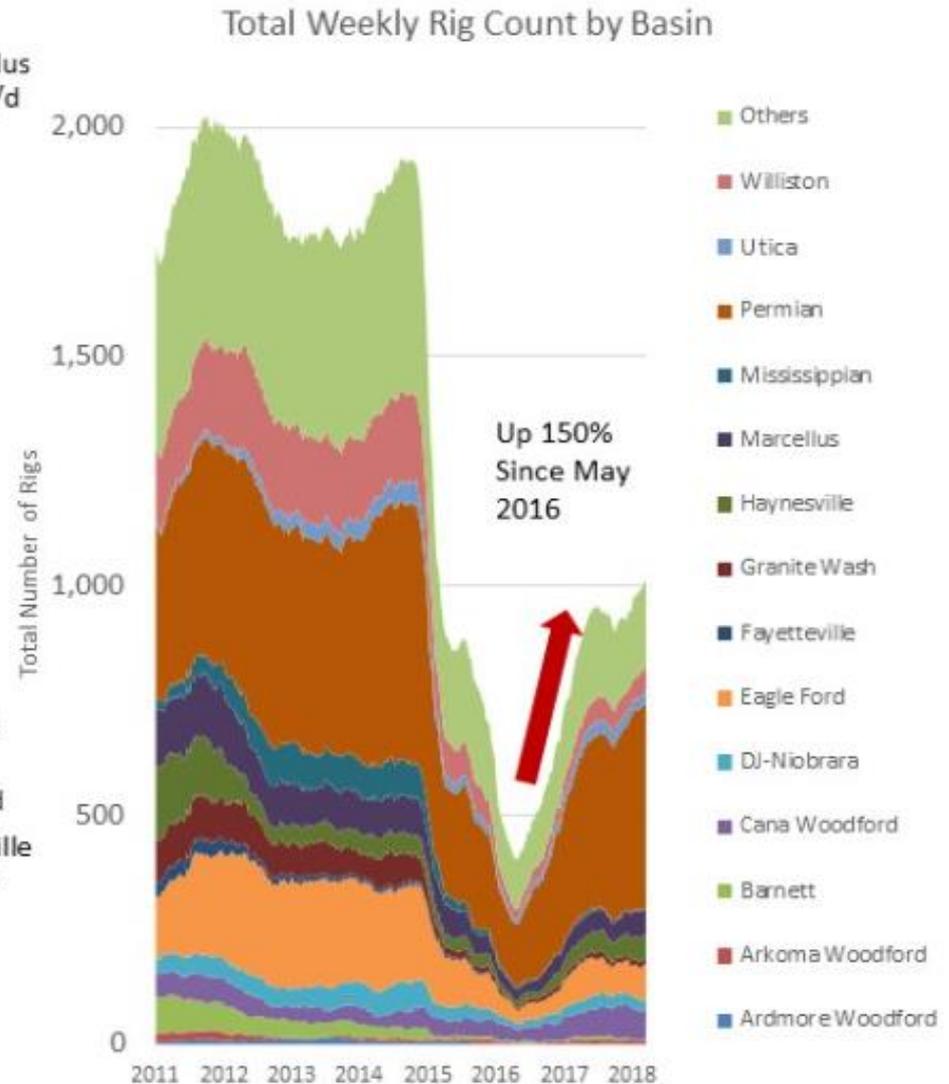
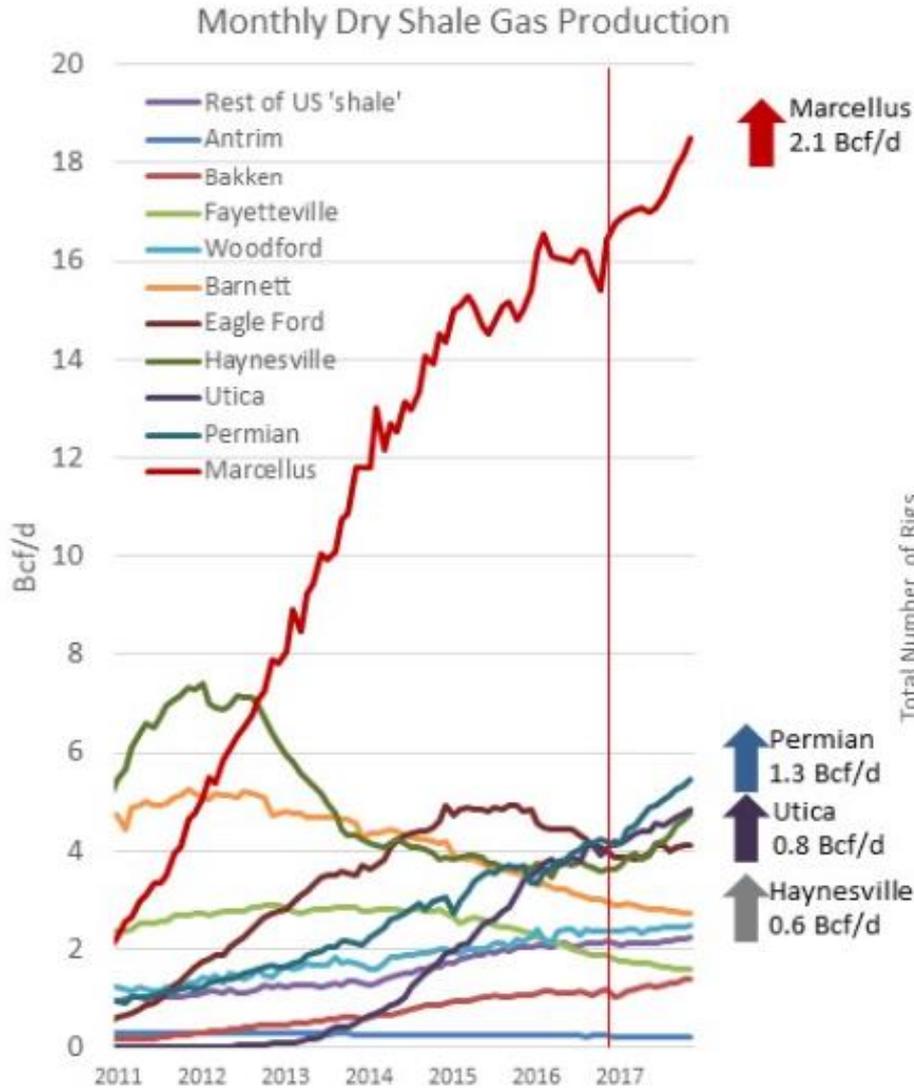


### Global Planned Projects

**10,818 Active Projects - \$1.76 Trillion TIV**

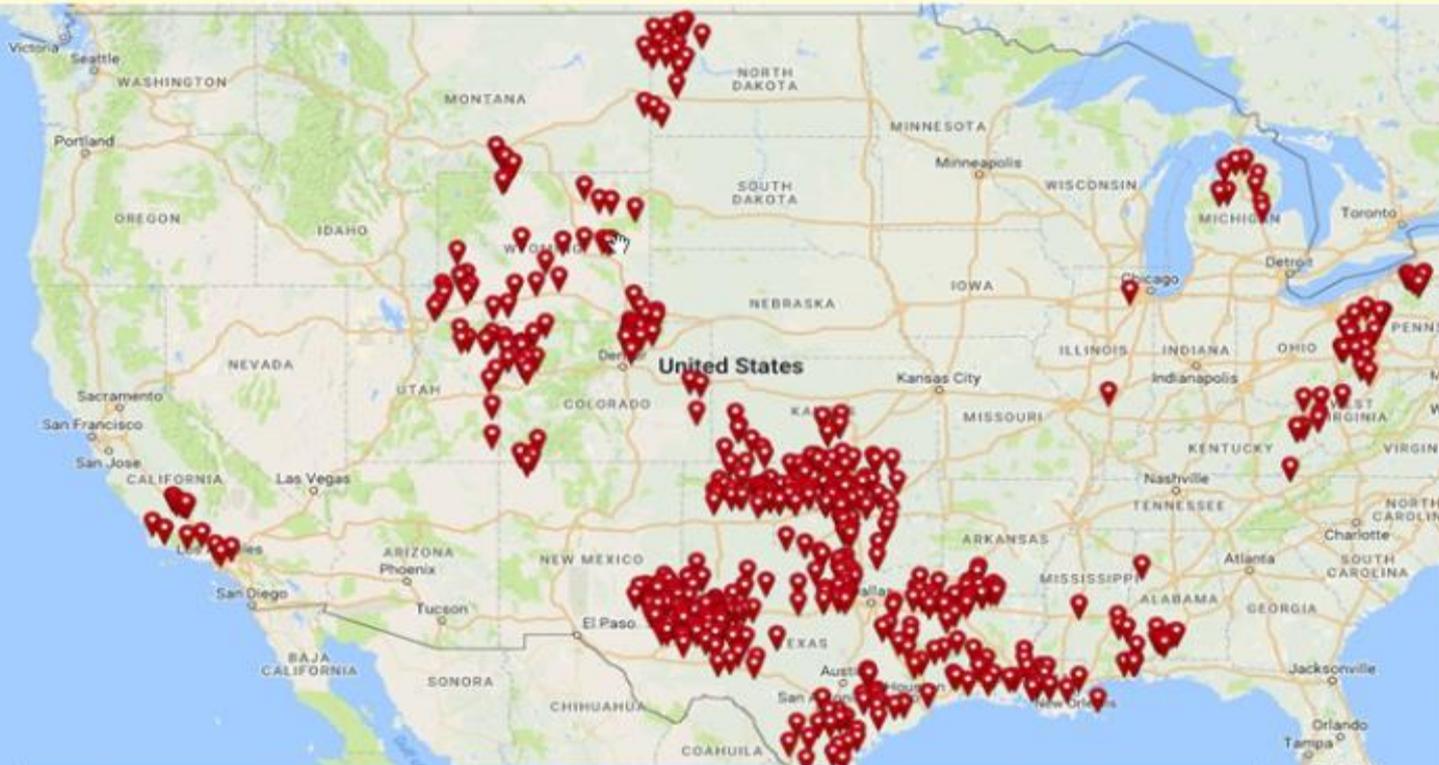
Planning & Engineering Stage  
Construction Starts - ALL DATES

# Onshore Natural Gas Production – US Remains Strong Despite Lower Rig Count



# Natural Gas Processing – U.S.

## NGL Recovery Train Startups (2006 – 2019)

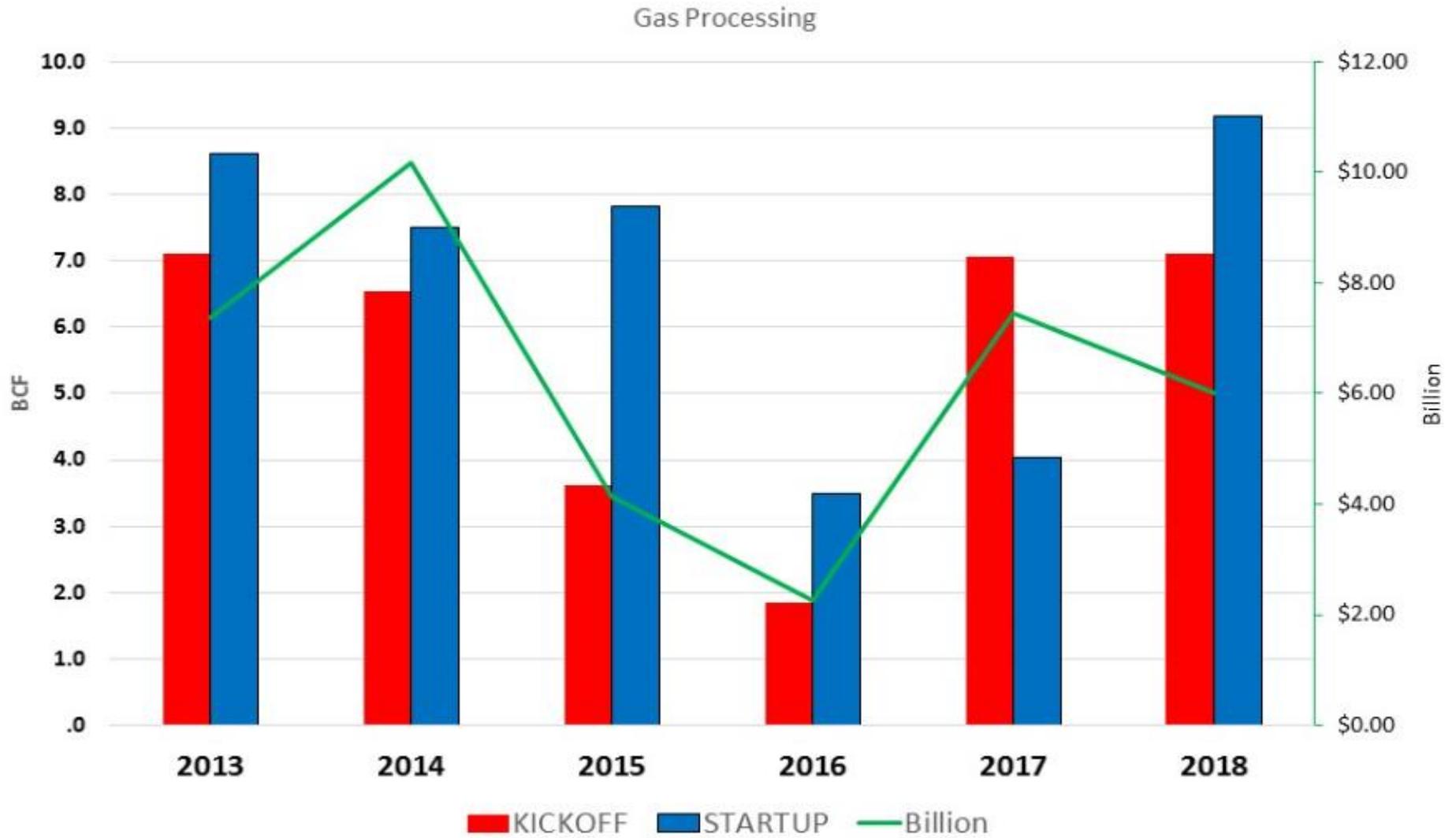


Commercial Startup Year		
Startup	Bcf/d	Trains
<b>2019*</b>	<b>7.8</b>	<b>46</b>
<b>2018*</b>	<b>9.8</b>	<b>59</b>
2017	4.9	32
2016	3.5	26
2015	7.9	49
2014	7.5	50
2013	8.7	61
2012	4.2	36
2011	2.6	23
2010	1.7	17
2009	3.5	27
2008	2.5	26
2007	3.8	22
2006	1.5	18
<b>Total</b>	<b>69.9</b>	<b>492</b>
<b>Before 2006</b>	<b>46.3</b>	<b>431</b>
<b>Operational</b>	<b>99.6</b>	<b>827</b>

Construction Kickoff by Region as of April 2018

State	Shale Play	2017	2018	Total Bcf/d
Texas/New Mexico	Permian	4.8	3.8	8.6
Oklahoma	Woodford (STACK & SCOOP)	1.3	1.6	2.9
West Virginia/Ohio	Marcellus/Utica	0.7	1.4	2.1
Colorado	Niobrara DJ	0.3	0.7	1
Montana	Bakken	0.1	0.5	0.6
Louisiana	Haynesville/MS Lime	0.3	0.2	0.2
<b>Total Bcf/d</b>		<b>7.5</b>	<b>8.2</b>	<b>15.4</b>

# Natural Gas Processing – US



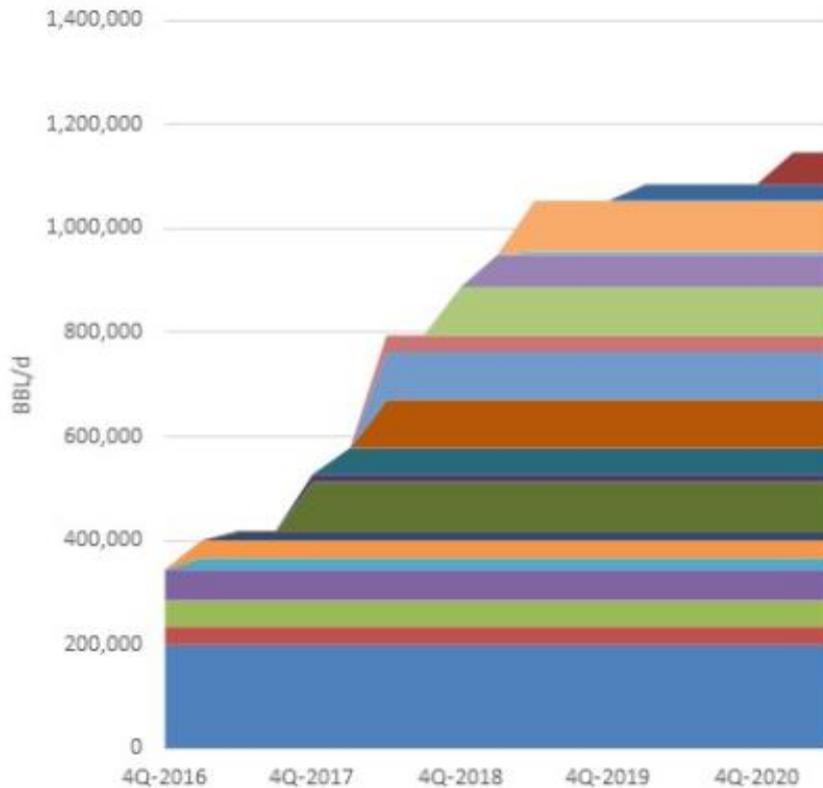
# Ethane Demand

## U.S. Ethane Demand Growth 2016-2020

### Ethane Demand

U.S. Supply Growth 40+% 2016-2020  
(Largest Exporter of Propane in the World)

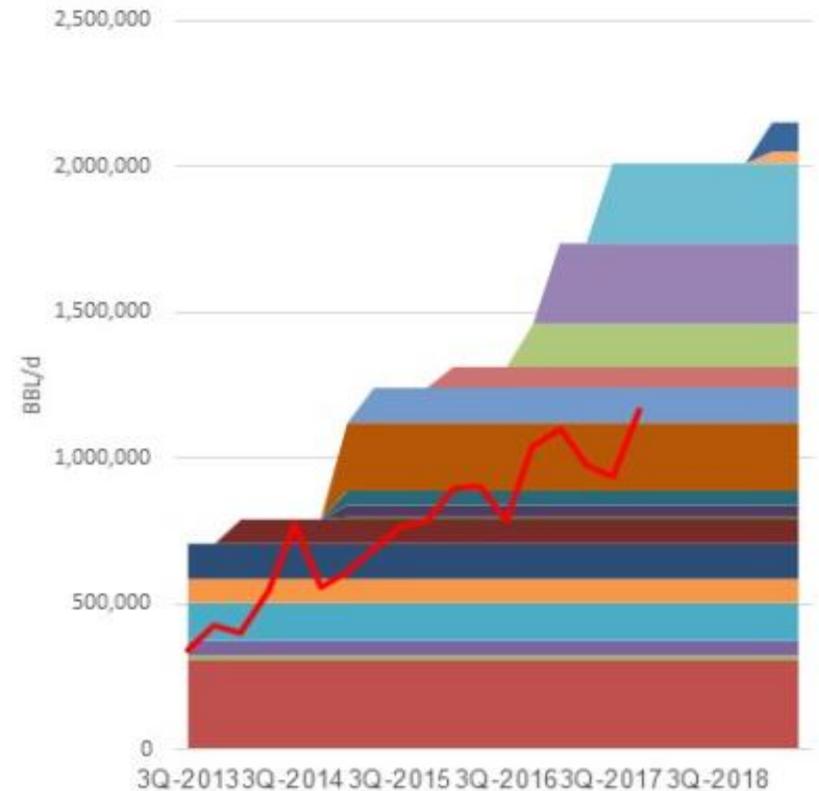
U.S. Ethane Demand 3Q16-1Q21



### LPG Demand

U.S. Supply Growth 40+% 2016-2020  
(Largest Exporter of Propane in the World)

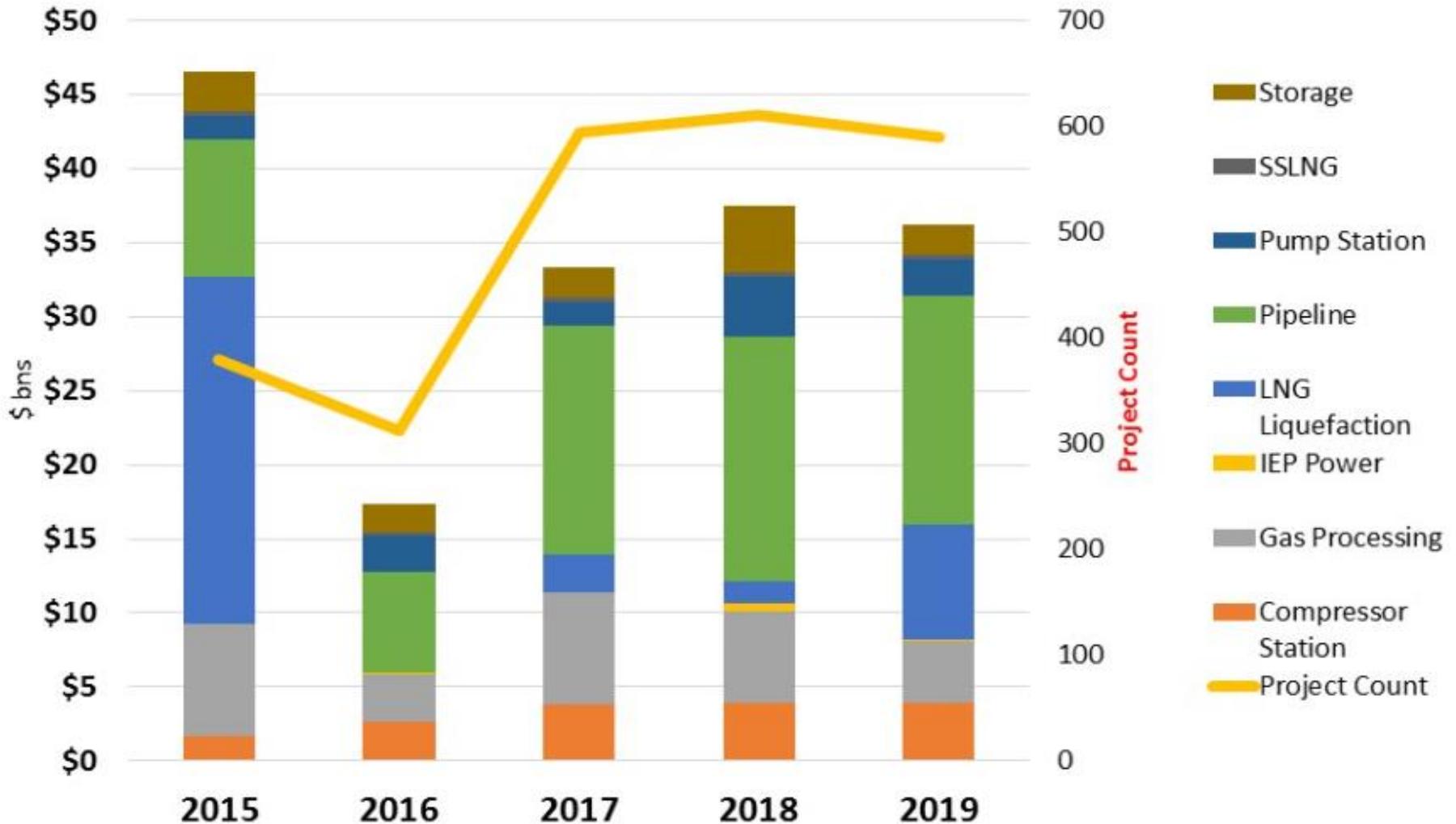
LPG Export Demand



# Oil & Gas – Midstream

## US & Canada Oil & Gas Midstream Build-Out

2018 - \$136 Billion in active development - \$37 Billion forecasted to Move Forward

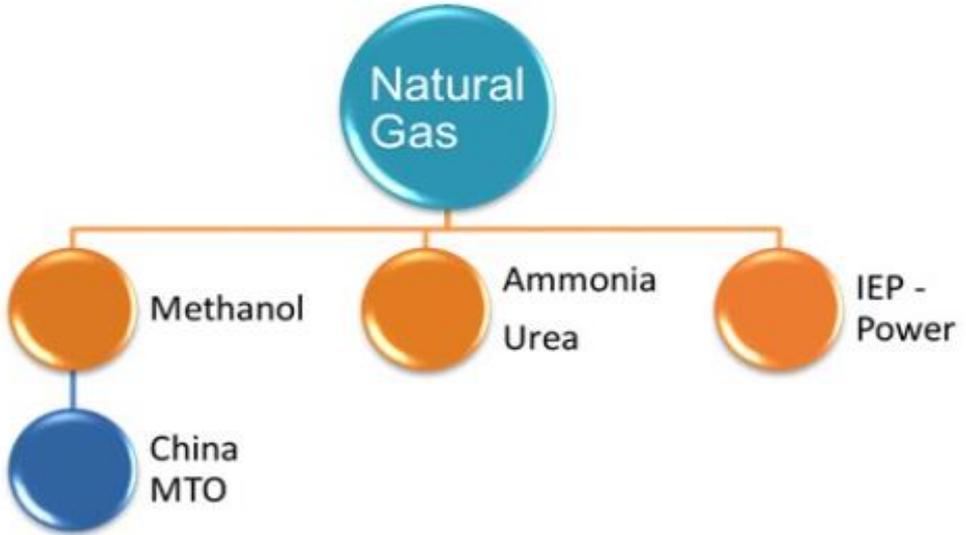
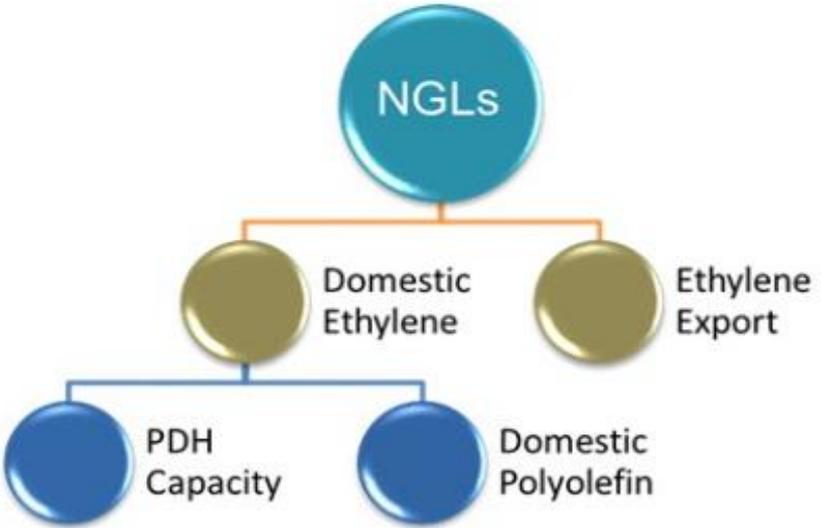


# Chemical Processing Industry

## More than 1,100 chemical types across the supply chain



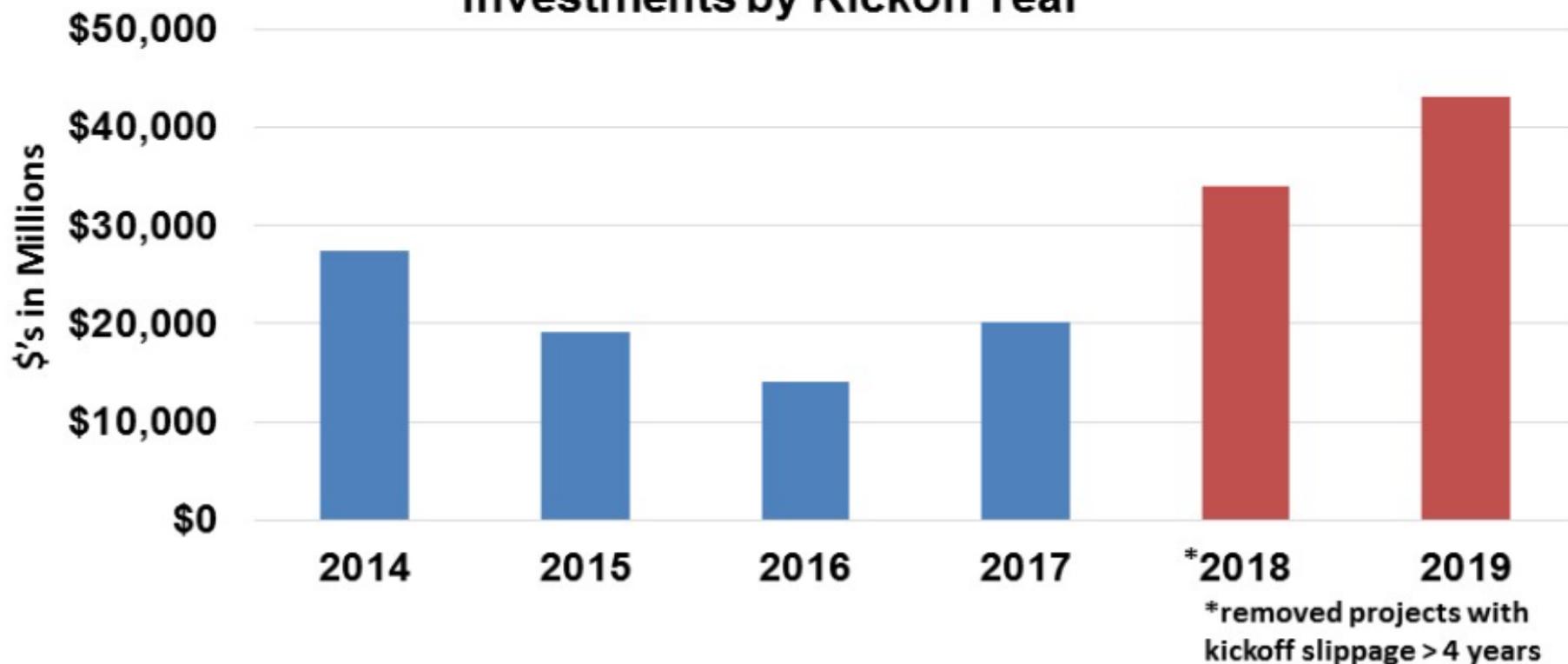
# Oil-to-Gas Ratio



# Oil-to-Gas Ratio



## Investments by Kickoff Year



# Natural Gas Distribution

82 Pipeline Projects In 2018 Valued At Over \$26.1 Billion



Selection of projects likely to Move Forward			
Region	MMSCFD	Miles	TIV (millions)
<b>Southeast</b>			
Atlantic Coast	1,500	560	\$5,000
TGP (ACRP)	200	10.2	\$280
<b>Northeast</b>			
PennEast	1,000	114	\$385
Northern Access 2016	300	101	\$155
<b>Mid-Continent</b>			
MIDSHIP	1,440	200	\$600
Kingfisher	200	200	\$380
Wildcat	400	140	\$275
Case	140	205	\$245
Arkoma Residue Capacity	200	80	\$265
<b>Great Lakes</b>			
Texas Eastern Appalachian Lease Project	950	4.5	\$37
Spire STL	400	65	\$220
<b>LNG</b>			
TGP Lone Star	300	N/A	\$100
Pecos Trail Pipeline	1,850	468	\$750
<b>Mexico</b>			
Sierrita Gas Pipeline	200	N/A	\$45
Valley Crossing Pipeline	2,600	168	\$1,500
<b>Southwest</b>			
Gulf Coast Express	1,900	447	\$1,700
Permian To Katy (P2K)	2,000	450	\$1,000
South Louisiana Expansion Project (SOLA)	600	35	\$65
Westlake Expansion Project	200	5	\$20

Kickoff Year	Active Projects TIV (Billions)	Miles
2016	\$5.6	1,778
2017	\$6.5	2,672
2018	\$15.3	6,726
2019	\$6.5	2,013
<b>Total</b>	<b>\$33.9</b>	<b>13,189</b>

# Mexico – Project Spending 24-Month Outlook

## Oil & Gas

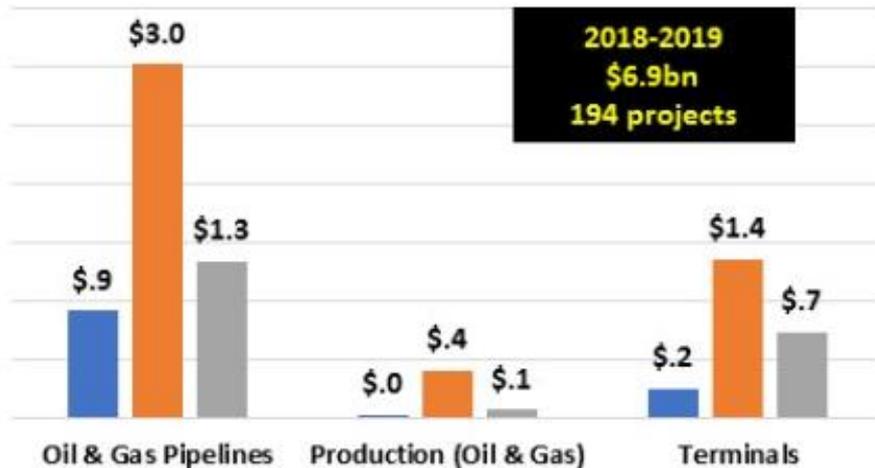


### Mexico O&G Project Outlook

\$bn

Capital & Maintenance

■ 2017 ■ 2018 ■ 2019



\$4bn  
**Gas/NGL-Related**  
33 Projects

**2018-2019**  
**Capital**  
**Projects**

\$3bn  
**Oil-Related**  
88 Projects

## Market & Spending Drivers

### Production:

- Energy reforms lead to the first deepwater licenses seen.
- Natural gas production declines increase reliance on imports. Recent gas production rounds will not mitigate the declines.

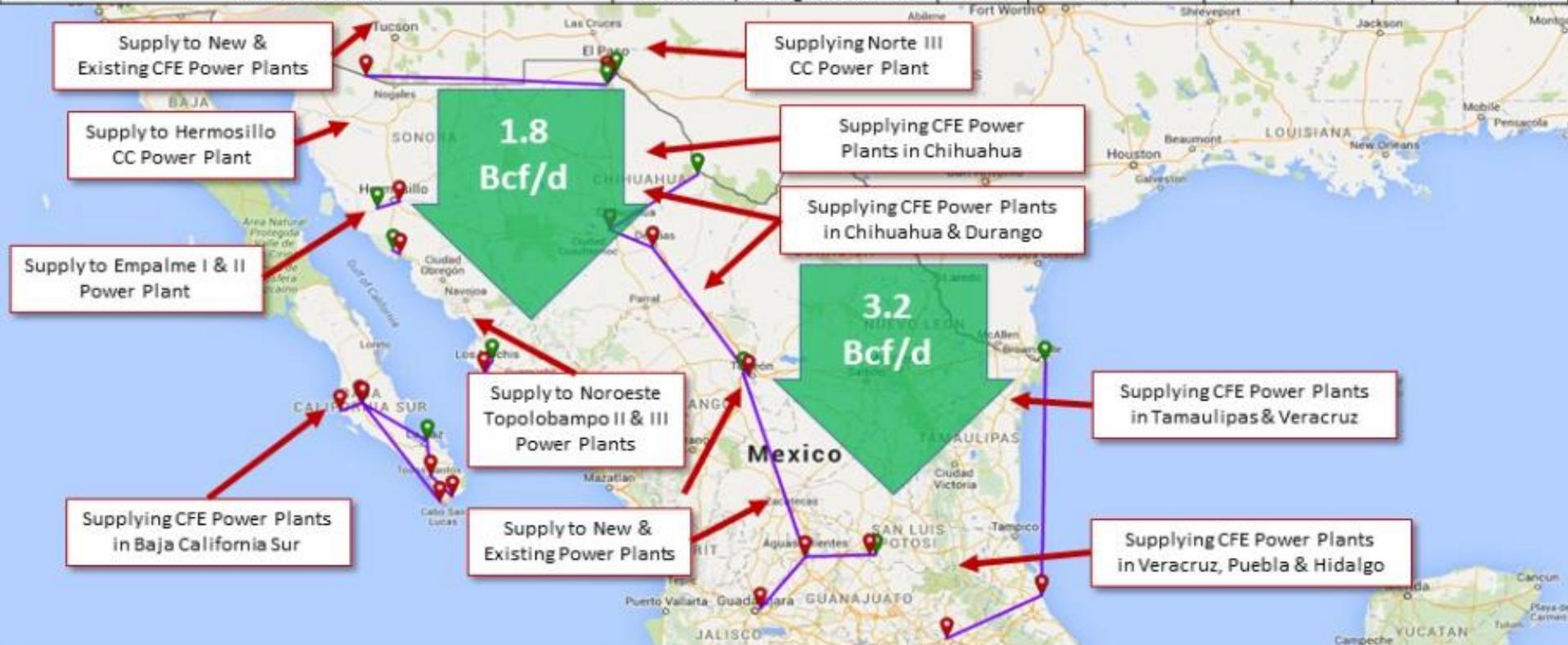
### Infrastructure

- New pipeline capacity required to meet fuel oil-to-gas switch and the massive buildout in new gas-fired power plant capacity.
- Mexico enacted legislation last April allowing companies other than PEMEX to import fuel for the first time since the 1930s to meet rising petroleum products demand.

# Mexico – Project Spending 24-Month Outlook

## New Gas Pipelines Tapping into US Gas

Owner	Project	KO date	Previous Startup	Startup	Length (Km)	\$mns	MMSCFD
Fermaca Pipeline El Encino Sde RL de CV	El Encino-Delicias (Phase 1)	15-Jan	17-Mar	18-May	100	\$128	1,500
Fermaca Pipeline El Encino Sde RL de CV	Delicias-La Laguna (Phase 2)	16-May	17-Apr	18-May	314	\$400	1,500
Fermaca Global	La Laguna-Durango	17-Jun	18-Jan	18-Nov	220	\$131	1,150
Fermaca Global	Durango-Aguascalientes	17-Jun	18-Jan	18-Nov	330	\$140	1,150
Infraestructura Marina del Golfo	South Texas-Tuxpan	17-May	18-Oct	19-Apr	800	\$2,000	2,600
Transportadora de Gas Natural de la Huasteca S de RL de CV	Tuxpan-Tula	16-Oct	17-Dec	19-Apr	350	\$500	886
Nueva Era Pipeline LLC	Colombia-Escobedo	16-Oct	17-Nov	18-Sep	300	\$350	600
Kinder Morgan Gas Natural de Mexico S de RL de CV	Mier-Monterrey (Loop)	17-Jul	17-Sep	20-Jul	93	\$120	200
CFEnergia SA de CV	Samalayuca-to-Sasabe	16-Nov	17-Nov	18-Nov	650	\$471	472
Transportadora de Gas del Noroeste S de RL de C V	El Encino-Topolobampo	14-May	16-Aug	18-Aug	670	\$250	530
Fermaca Global	Villa de Reyes - Aguascalientes	17-Sep	17-Dec	19-Mar	185	\$140	1,000



# U.S. & Canada Chemical Industry

## Great Lakes & Northeast Project Activity

**\$25.5 billion in 526 active projects**



### Grassroot

12 Projects

### Expansion & Additions

79 Projects

### In-Plant Capital

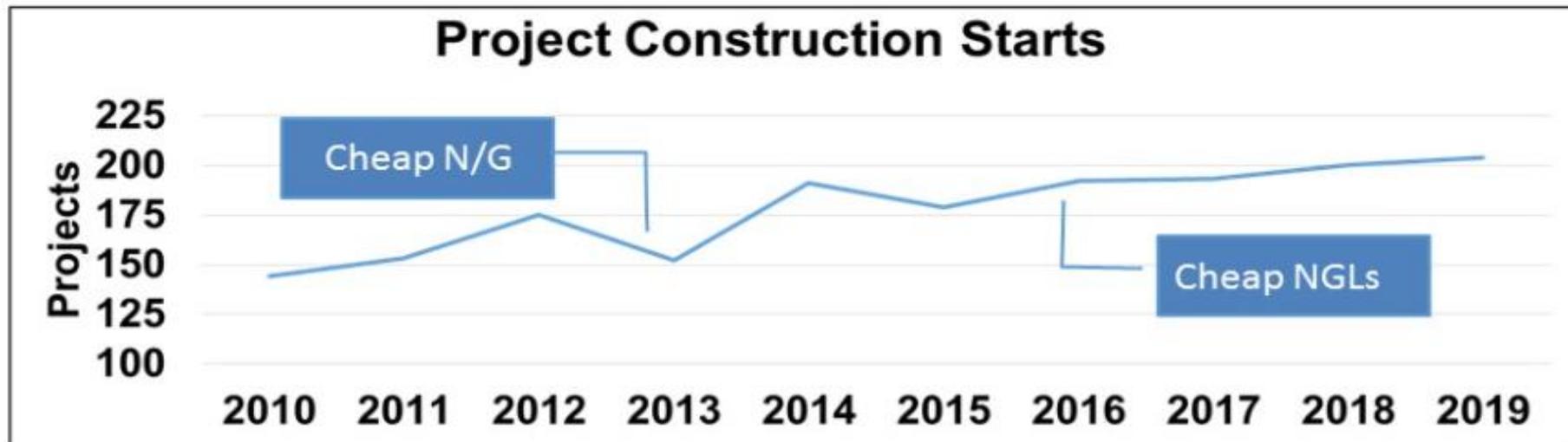
93 Projects

### Maintenance

342 Projects

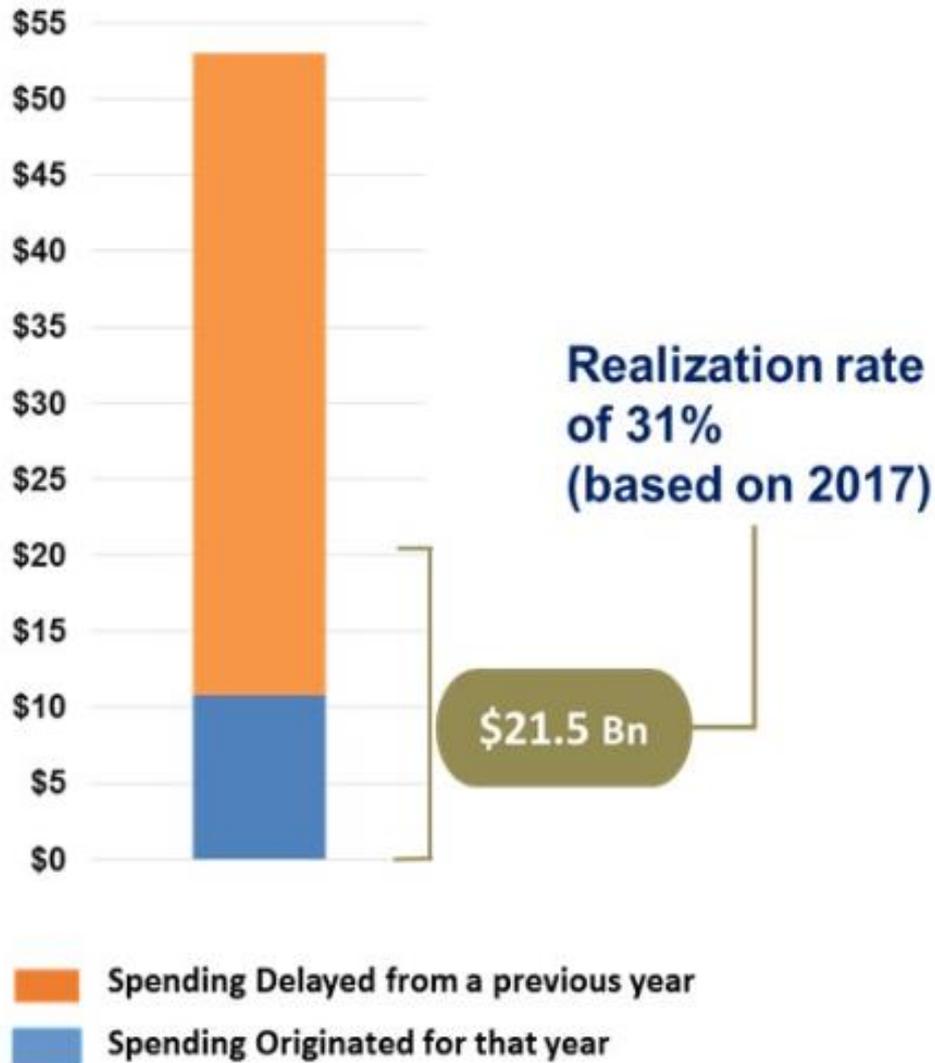
# U.S. & Canada Chemical Industry

## Great Lakes & Northeast - the Natural Gas Influence



- 2014 Big investments in Agricultural sector
- 2015 New capacity for Industrial Gases & Petrochemical sector
- 2016 Expansion of installed ethylene capacity
- 2017 Grassroot construction, In-Plant capital
- 2018 2019 Derivative unit additions, In-Plant capital

# U.S. & Canada Chemical Industry Construction Starts by Probability Factor 2017 vs 2018

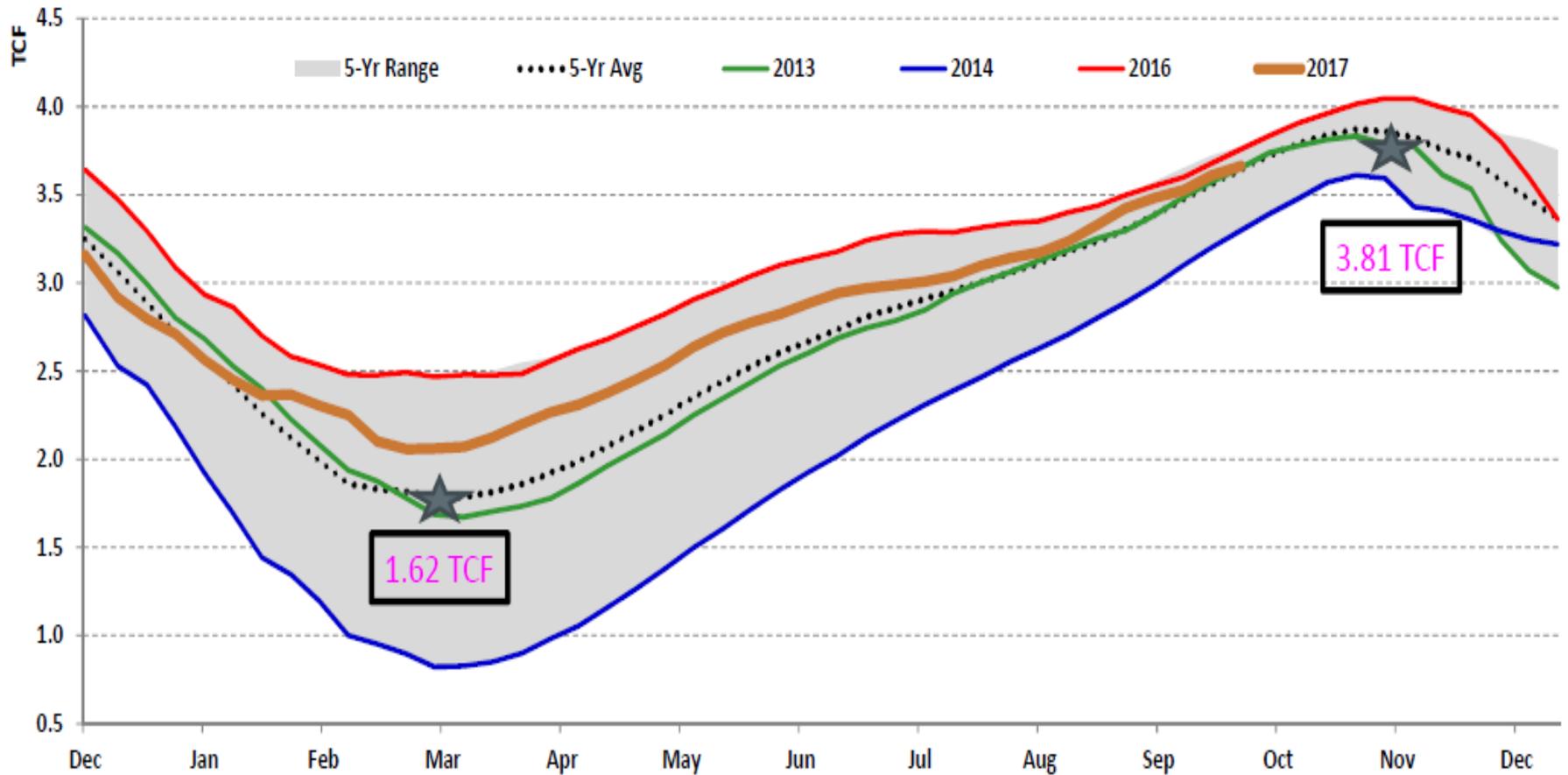


Mega projects lift future spending totals, projects with an individual TIV greater than **\$500 million**



Migration of Mega-Projects to the North and West

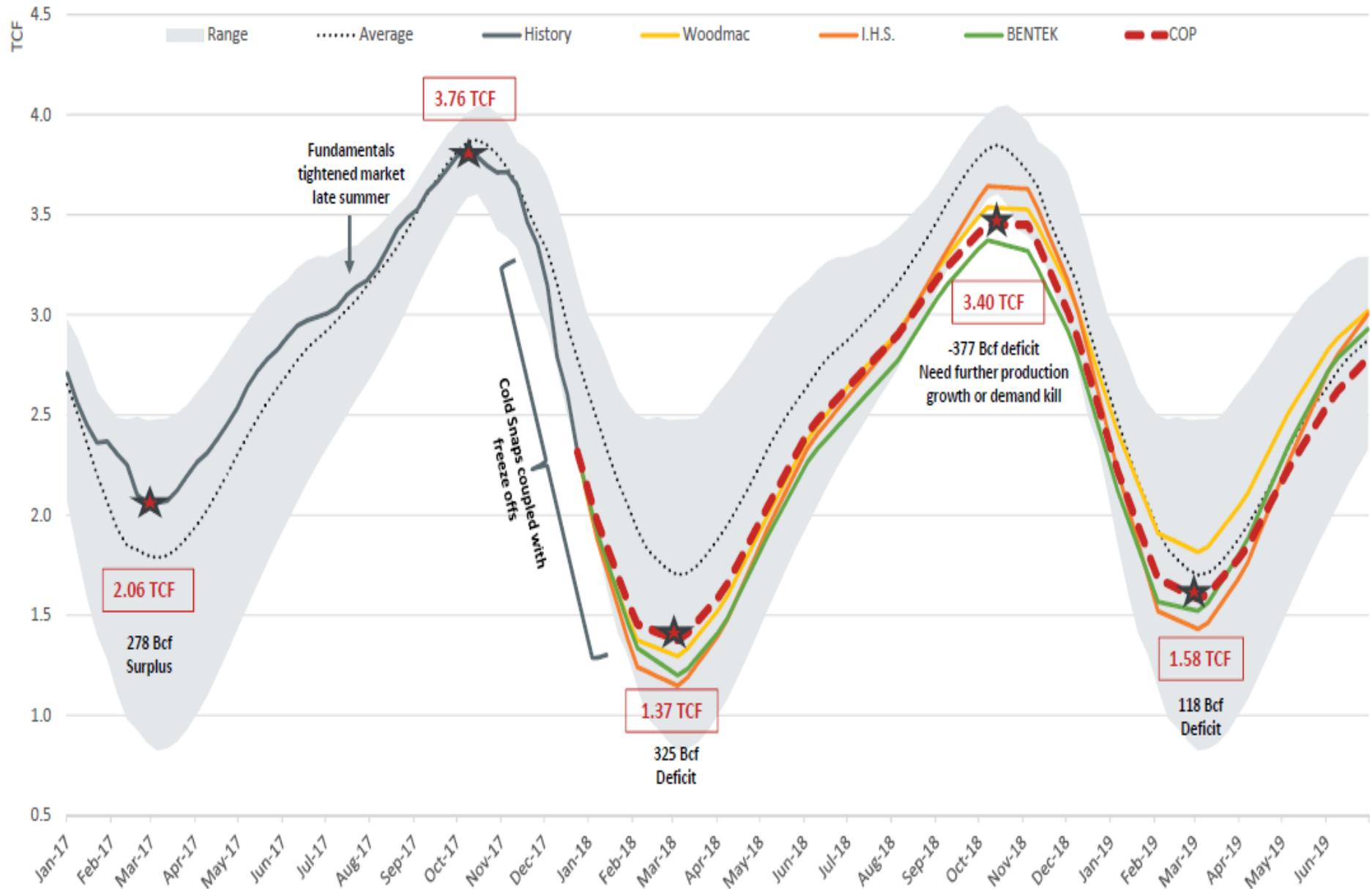
# Storage



## FUNDAMENTALS

	Canadian Imports	Total Supply	Industrial	Power Gen	Res/ Comm	Mexican Exports	LNG Exports	Total Demand	End Storage Inventory	
2016-2017	70.9	5.0	75.9	22.3	21.0	36.7	4.0	1.7	85.7	2,035
2017-2018	76.2	5.1	81.3	22.7	21.3	40.5	4.6	3.7	92.9	1,620
Diff (Bcf/d)	5.3	0.1	5.4	0.4	0.3	3.8	0.7	2.0	7.2	(415)

# Storage



# The Past Year...NG Futures Moved In An Acutely Narrow Trade-Range



# Transco Station 85

Transcontinental Gas Pipeline Co./Transco Station 85 Natural Ga (NGGCTR85 Index)

User



Transcontinental Gas Pipeline Co./Transco Station 85 Natural Ga Daily Close

6 Jun 2018 Ar

Update Analytics - Enterprise : Data by Bloomberg

C: 2.79 -0.04 (-1.41%)

T: 05:02:35



# Pine Prairie Hub

Natural Gas Columbia Mainline/Perryville Louisiana Spot Price (NGTXPERY BNGC Index)

User



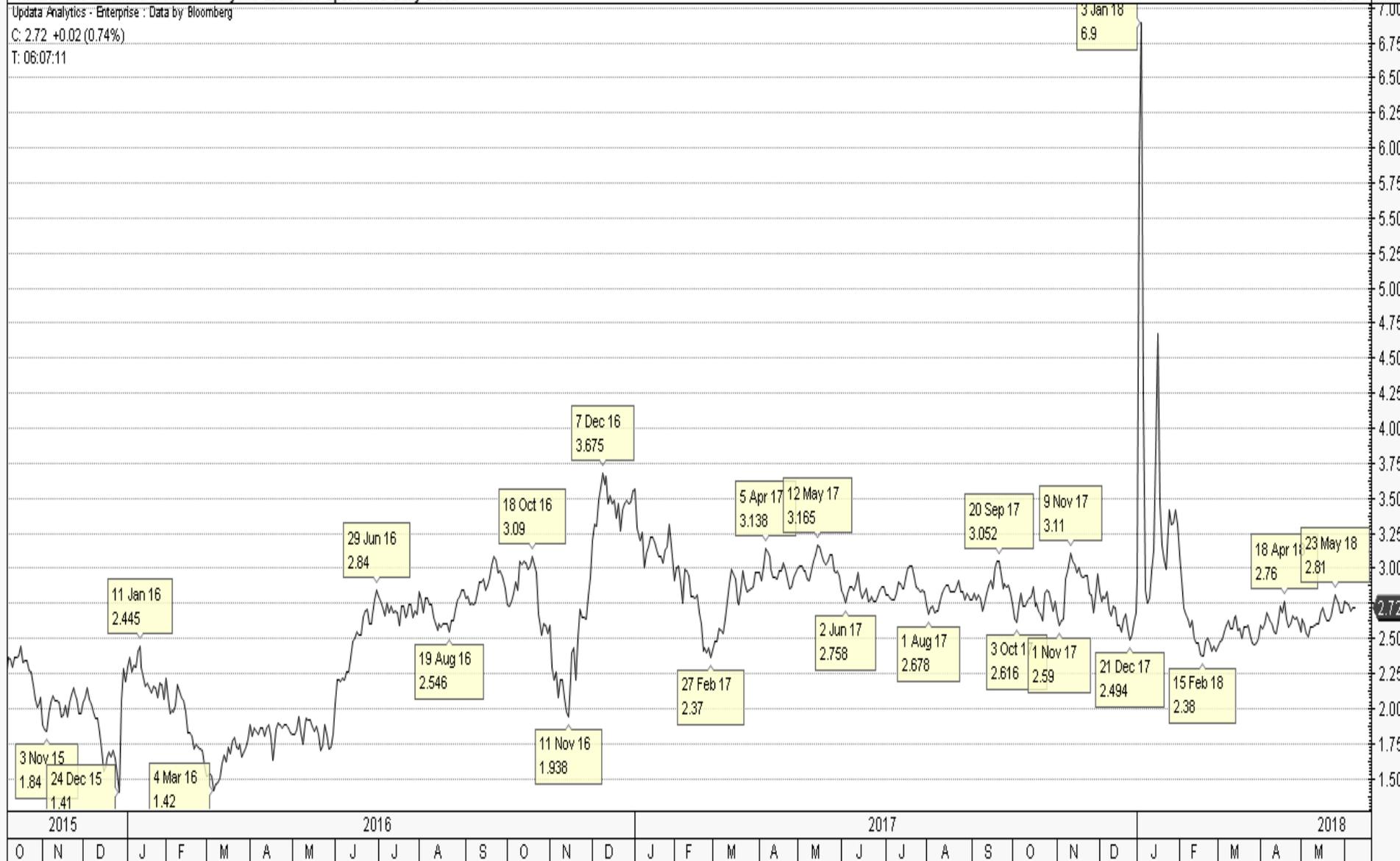
Natural Gas Columbia Mainline/Perryville Louisiana Spot Price Daily Close

7 Jun 2018 Ar

Update Analytics - Enterprise : Data by Bloomberg

C: 2.72 +0.02 (0.74%)

T: 06:07:11



# Florida Gas Z3

Florida Gas Transmission Zone 3 Natural Gas Spot Price (NGGCFG3 BNGC Index)

User



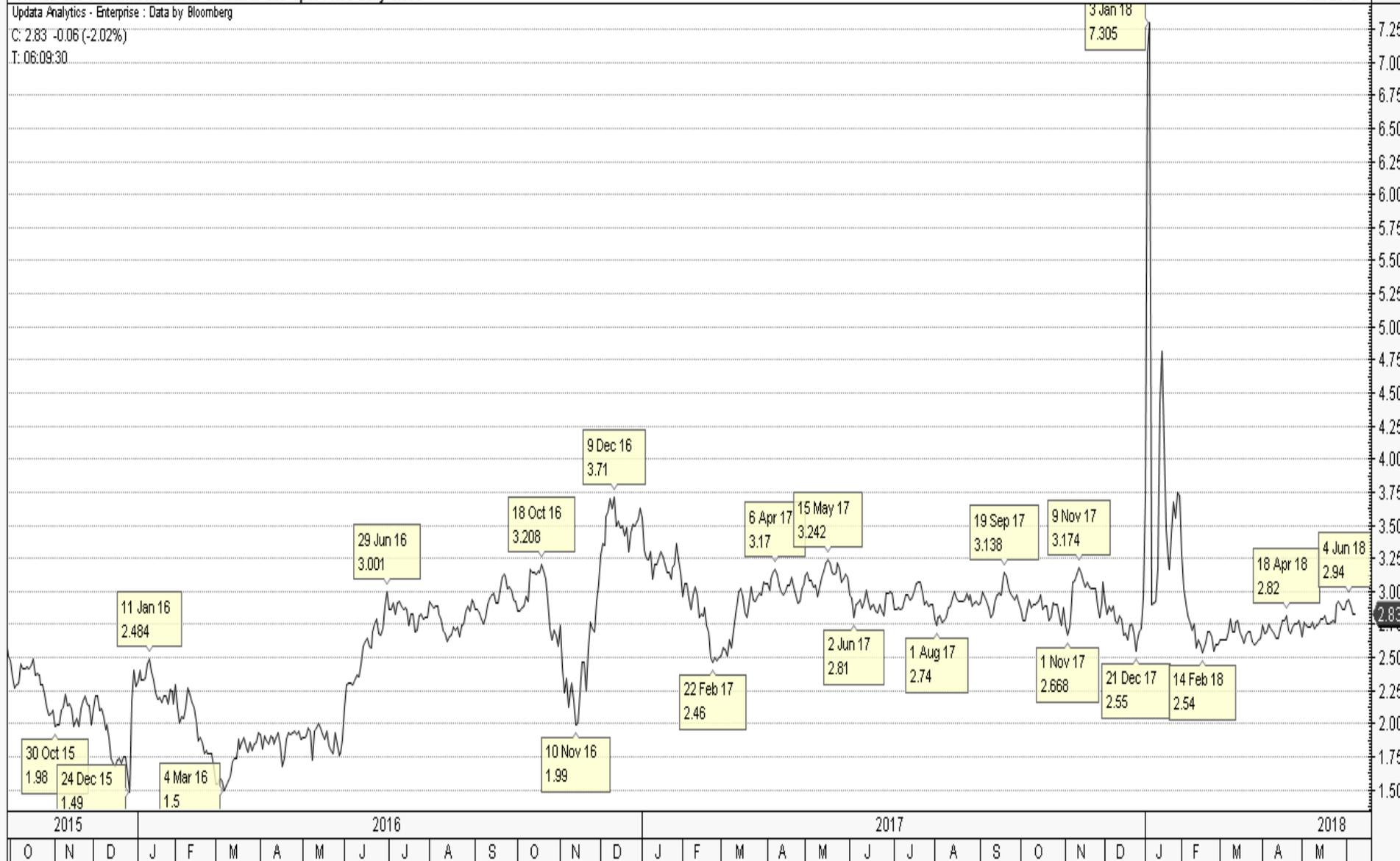
## Florida Gas Transmission Zone 3 Natural Gas Spot Price Daily Close

7 Jun 2018

Update Analytics - Enterprise : Data by Bloomberg

C: 2.83 -0.06 (-2.02%)

T: 06:09:30



# Florida Gas Z3

Florida Gas Transmission Zone 3 Natural Gas Spot Price (NGGCFGT3 BNGC Index)

User



Florida Gas Transmission Zone 3 Natural Gas Spot Price Daily Close

7 Jun 2018

Ar

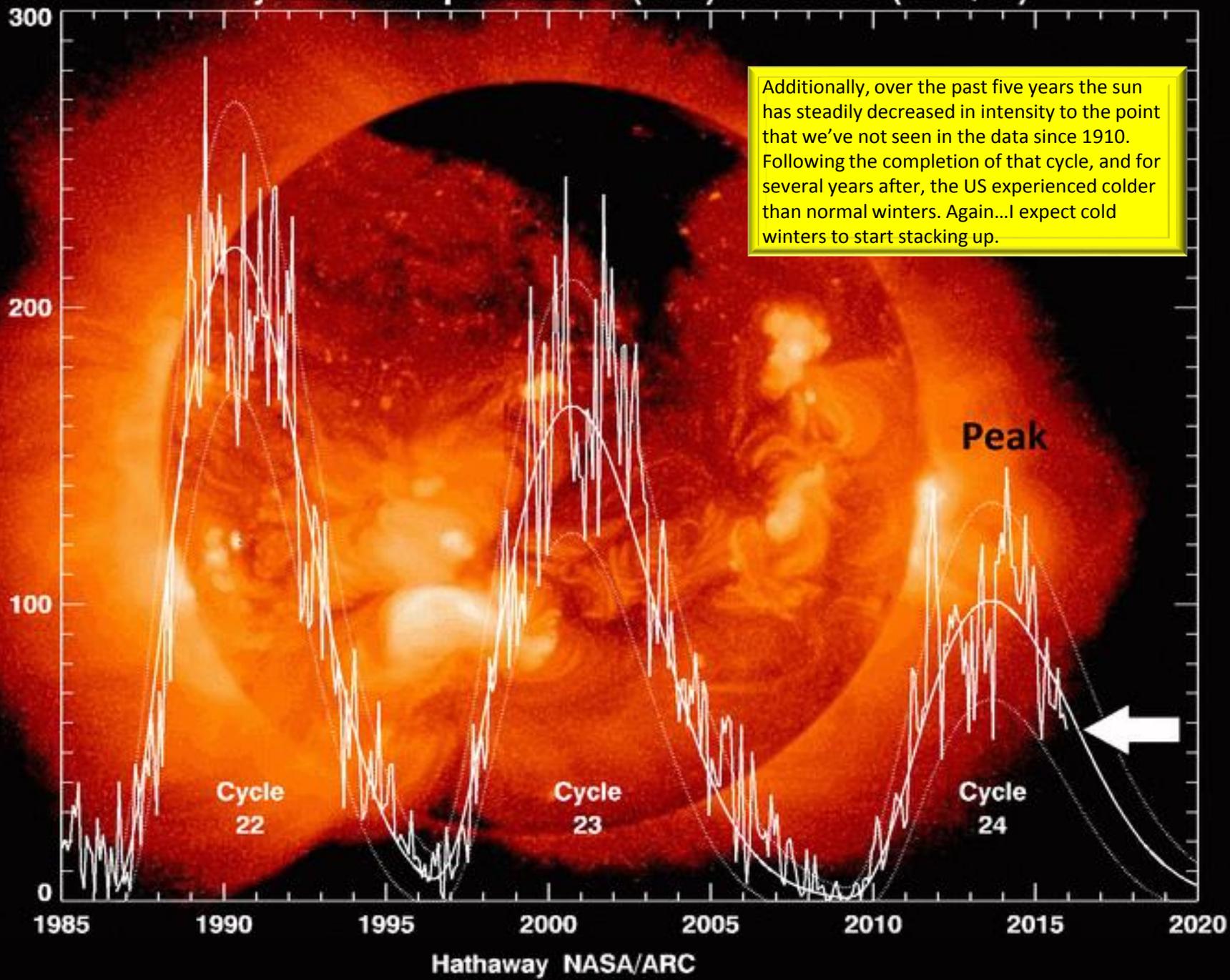
Analytics - Enterprise : Data by Bloomberg

2.83 (-2.02%)

T: 06:09:30



# Cycle 24 Sunspot Number (V2.0) Prediction (2016/01)



Additionally, over the past five years the sun has steadily decreased in intensity to the point that we've not seen in the data since 1910. Following the completion of that cycle, and for several years after, the US experienced colder than normal winters. Again...I expect cold winters to start stacking up.

Peak

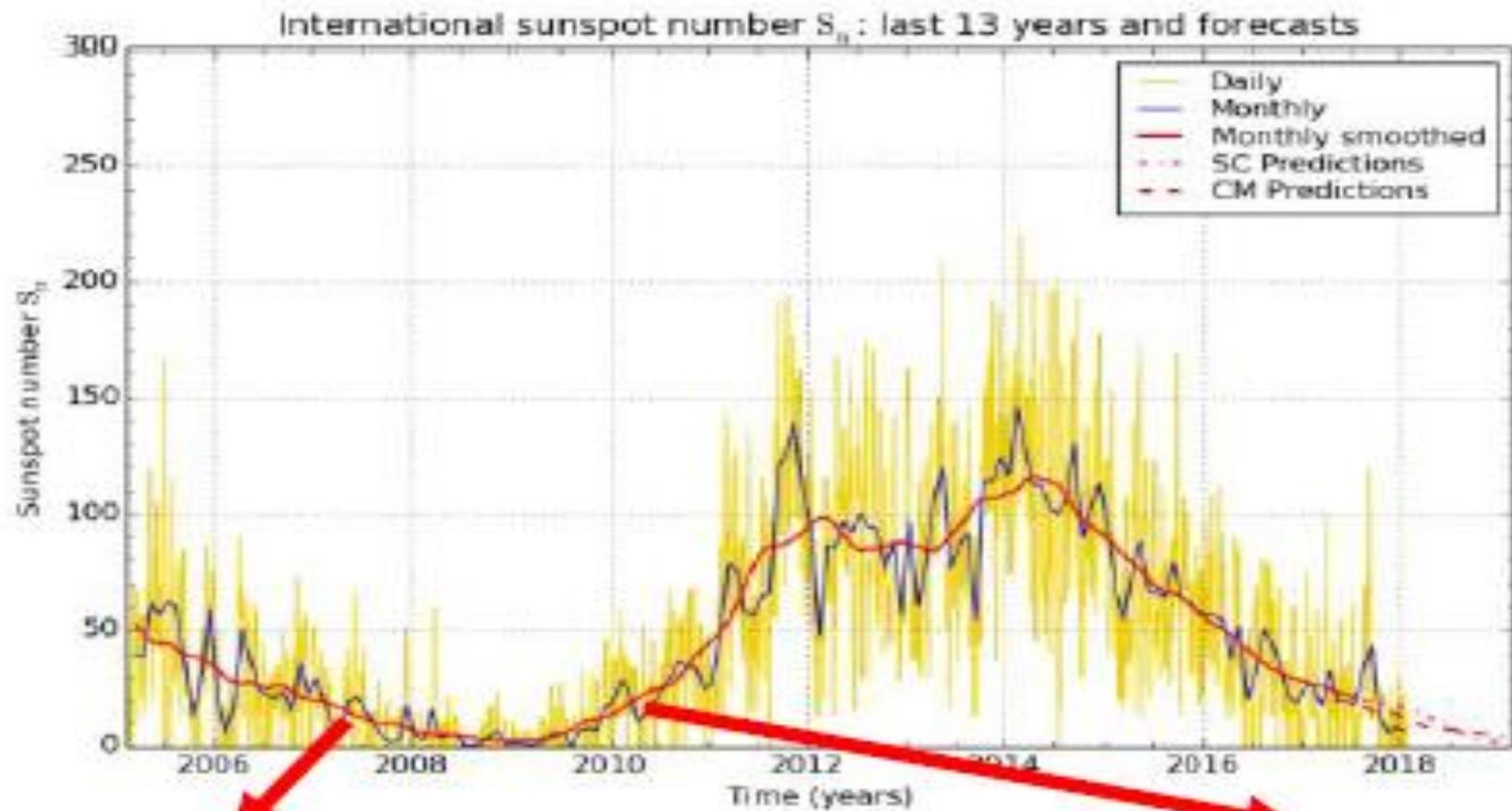
Cycle 22

Cycle 23

Cycle 24



# Summer Weather Outlook



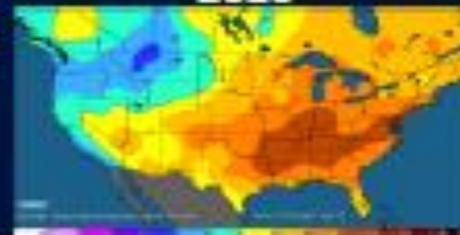
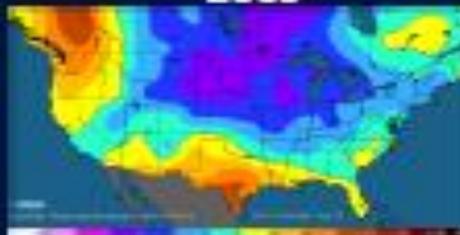
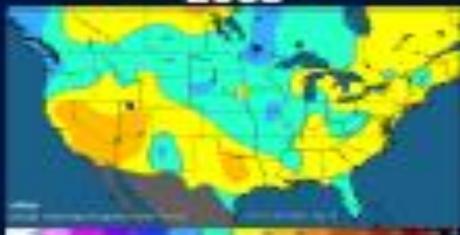
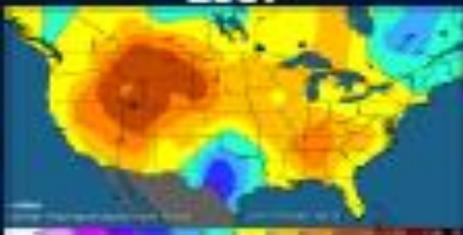
SILSO graphics (<http://sdr.be/silso>) Royal Observatory of Belgium 2018 February 1

2007

2008

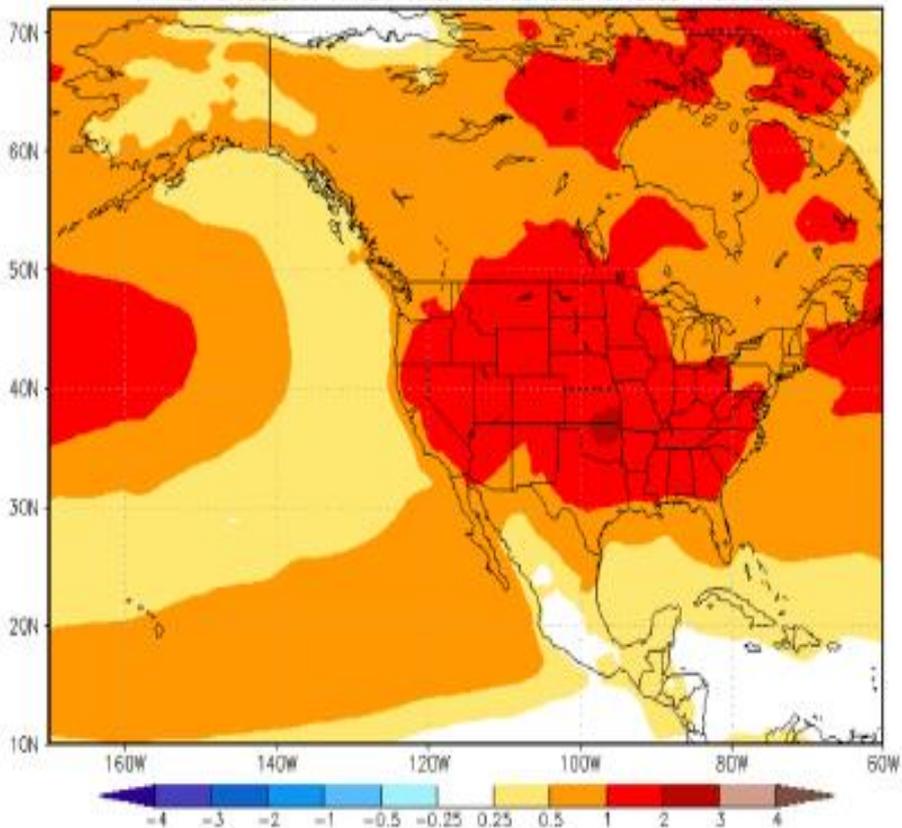
2009

2010



# Summer Weather Outlook

NMME Forecast of TMP2m Anom IC=201802 for Lead 4 2018JJA



NMME 2018 Summer Temperature Anomaly Forecasts

ECMWF Seasonal Forecast

Mean 2m temperature anomaly

Forecast start is 01/02/18, climate period is 1950-2016

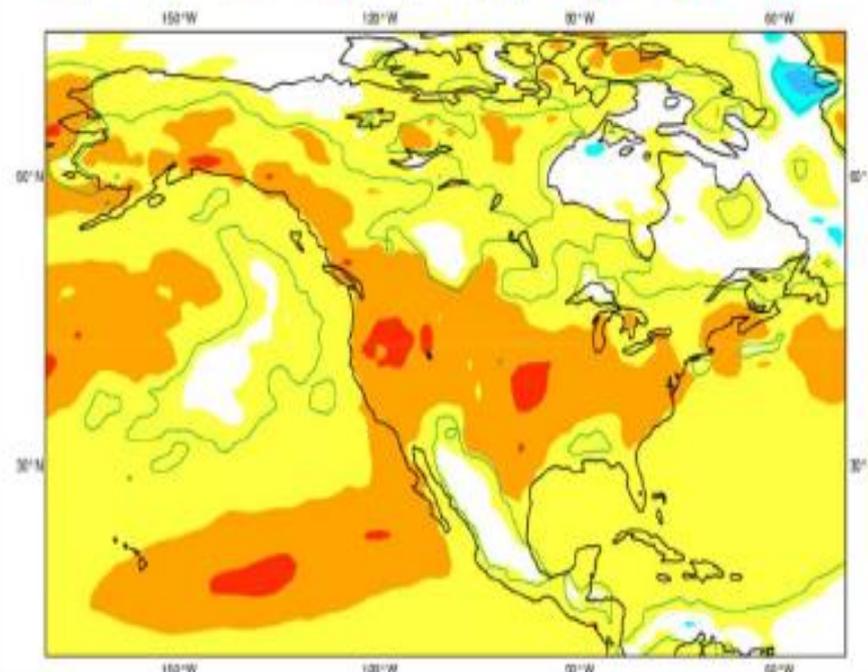
Ensemble size = 51, climate size = 600

System 5

JJA 2018

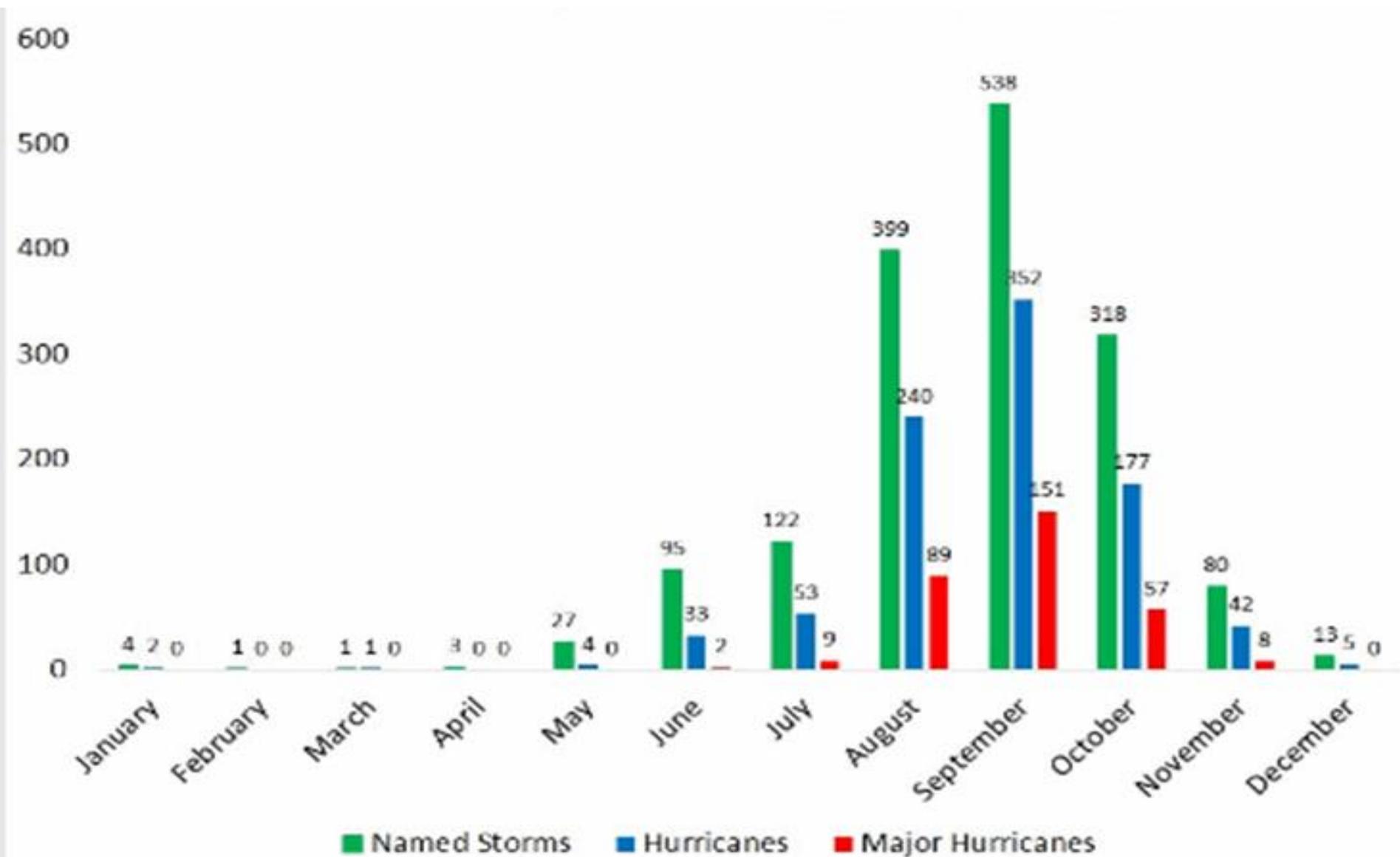
Shaded areas significant at 10% level

Solid contour at 1% level



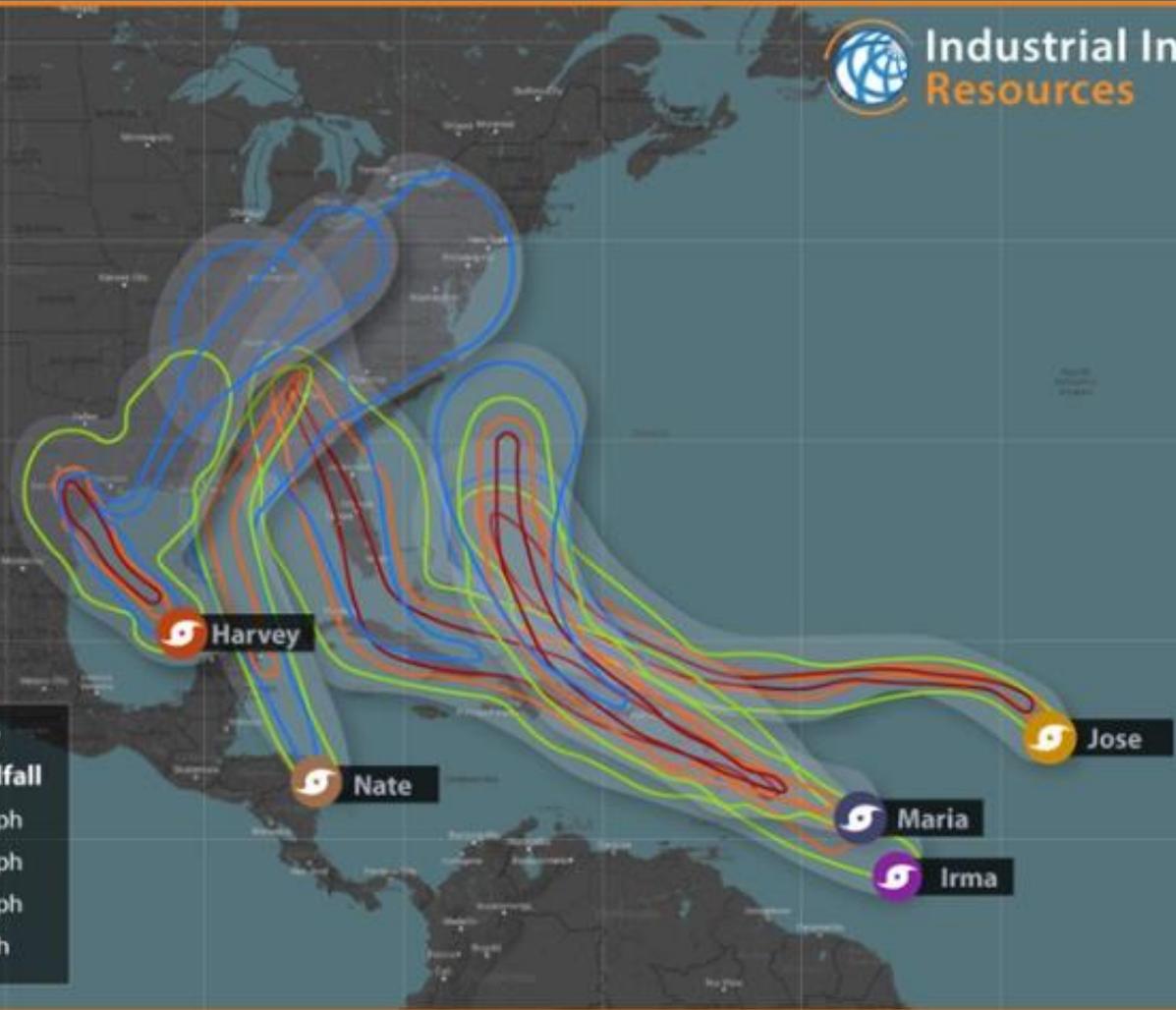
ECMWF 2018 Summer Temperature Anomaly Forecasts

# Atlantic Tropical Cyclone Formation by Month (1851-2017)



# The 2017 Hurricane Season

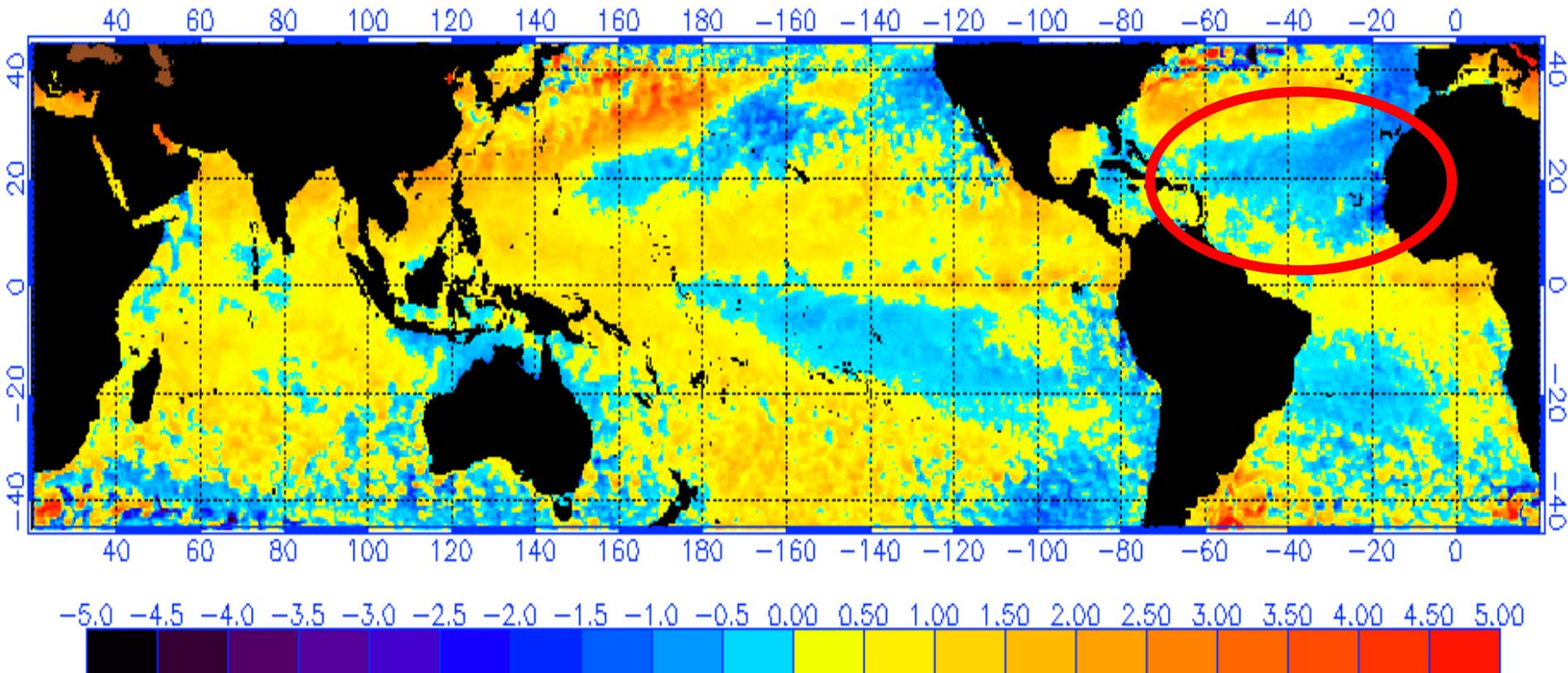
Storm	Date of Gulf Coast/ US Territory Landfall	Category/ MPH at Landfall
 Harvey	August 26, 2017	Cat 4 / 130 mph
 Irma	September 10, 2017	Cat 4 / 130 mph
 Maria	September 20, 2017	Cat 4 / 155 mph
 Nate	October 8, 2017	Cat 1 / 85 mph



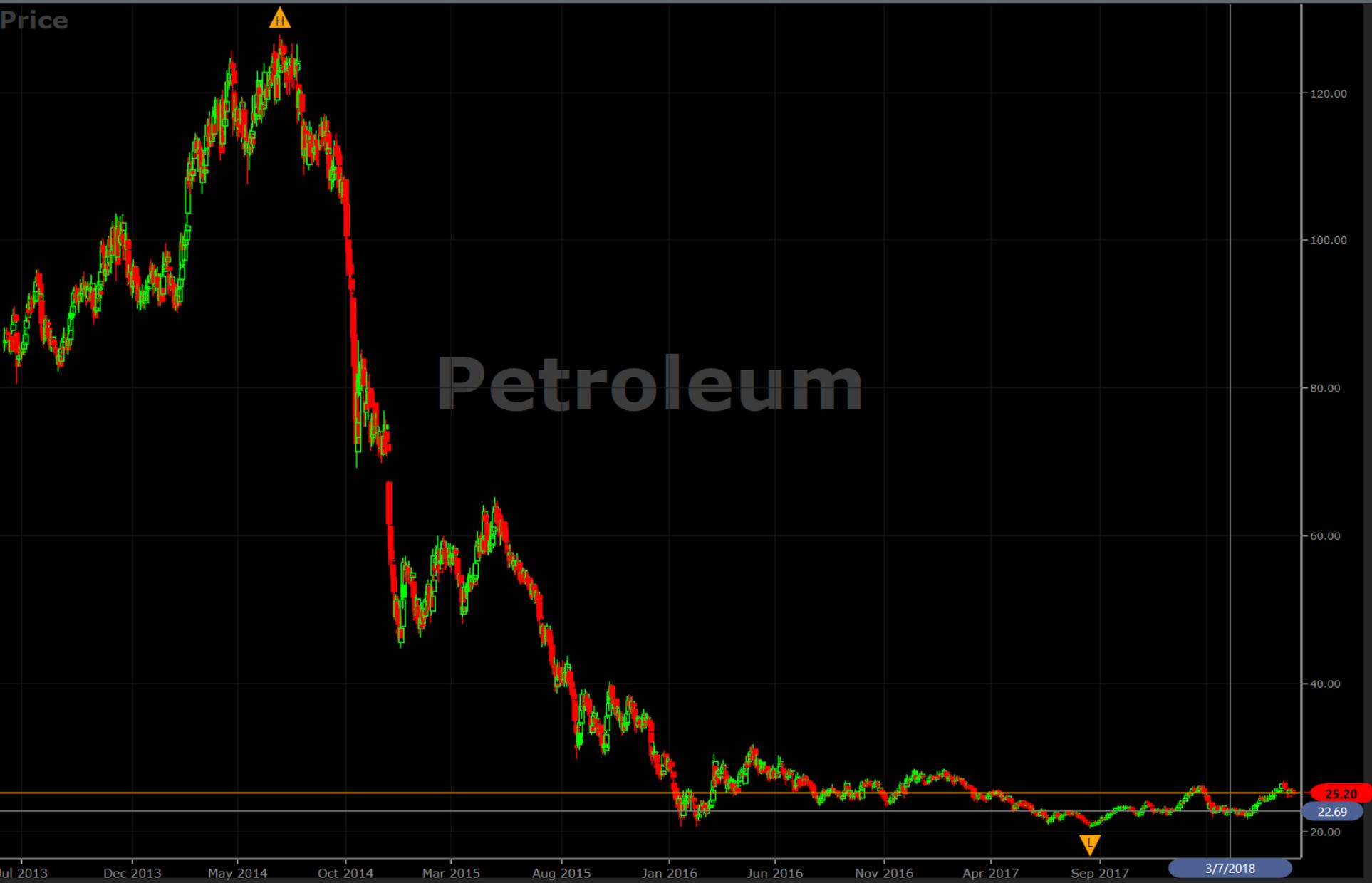
**Back to Back 2 Cat. 4 Hurricanes hit the Gulf Coast and Florida**

# The 2018 Hurricane Season

NOAA/NESDIS SST Anomaly (degrees C), 6/4/2018



# The Petroleum Industry Has Made Positive Moves



Source: NYMEX/CME, Udata

ConocoPhillips

# The Shale Oil & Gas Players – 10 Year Average



Source: NYMEX/CME, Updata



**ConocoPhillips**  
*Thank-You*



# Questions from our Customers

## Analytics

- **Will the new federal tax plan encourage dramatically expanded capex in 2018?**
- Our forecast for capital and maintenance investments was revised up by approximately \$10 billion for 2018 from the 4Q17 revision produced in October. The overall U.S. economy should improve by 2 to 4 tenths of a percentage point with its passage. We expect slower growth to come in 2019 and 2020.
- **How are federal policies changing international trade volumes across different categories (manufactured goods, wood products, metals...)?**
- It's a wait and see situation with the current administration and its "America First" initiative. On one side of the equation, renegotiating trade deals can help American manufacturers compete on price, but consumers could be the losers by paying higher prices for goods. The recent washing machine tariff is sparking retaliatory action by South Korea (Home of LG and Samsung) and Mexico. Imposing tariffs on imported solar panels and cells will help the few manufacturers in the U.S. but may slow development of solar farms if prices escalate up. Steel and Aluminum will be next, coming under Section 232 of the Trade Expansion Act of 1962, along with NAFTA, which President Trump has stated many times that it's a bad deal for the U.S. This will be the year we see protectionist trade policies implemented, hopefully for the better good of the country.
- **How does the new tax reform effect growth and expansion in the Gulf region?**
- Our expectation is that we would see a higher degree of projects being executed and a lesser degree of fall out and construction start slippage occur. Counter to that, protectionist trade policies may cause delays in project execution if they create the possibility for higher import tariffs upon U.S. manufactured goods.
- **Of all capital projects in North America, what percentage are brownfield projects? This question is for all industries.**
- Of the \$57 billion USD, active brownfield projects in North America, the Metals & Minerals industry is the largest making up \$28.6 billion from 183 projects, followed by the power industry that makes up \$10.4 billion or 36 projects, then Chemical Processing at \$7.5 billion or 16 projects, and Industrial Manufacturing with \$6.9 billion from 61 projects.
- **When do you estimate the upturn in project spending will occur, mid to late 2018?**
- At this point, the upturn relative to the dollars spent will come in the mid to late time period of 2018. A higher number of project starts are occurring in the first half of the year, but this is mainly due to the volume of maintenance turnarounds and shutdowns occurring.
- **What is the single major factor in 2018 that is preventing an upturn in markets?**
- With the economy performing on all cylinders this year, uncertainty around trade negotiations could be the major pull back for project execution.
- **What is the percentage of projects that were shelved during the downturn that have been reactivated?**
- In the U.S. there are 1,443 worth \$198.6 billion that have been restarted since 2009. These are projects that were placed on hold or cancelled due to market conditions, etc. that have since been brought back as an active project, in development or completed at this point. Over this period, there are a total of 74,163 projects valued at \$2.99 trillion. This represents a 1.9% return on activity or 6.6% return on value.
- **What are the biggest upcoming projects for Water and Wastewater in the US & Canada?**
- The largest projects are in the Desalination industry. Most of these projects are in California. Moving forward, the probability of these projects can be low, but due to the need for water resources, we could see some moving into construction over the next couple of years. Projects include: West Basin Municipal Water District's \$400 million Seawater Desalination Plant in Rodondo Beach. A \$313 million Seawater Desalination Plant is being proposed by California American Water in Monterey Peninsula. In northern California, a \$150 million Seawater Desalination Plant proposed by East Bay Municipal Utility District in Pittsburg, California. Texas also has seen its share of Desalination projects. One is Texas General Land Office planning a Grassroot Saltwater Desalination Plant in Corpus Christi, Texas for \$150 million.
- **Where do you feel the next big area of expansion is going to take place?**
- The Gulf Coast region is still the best place for industrial process expansion and holds the largest amount of billion dollar projects proposed for the future. The second area of notice for future expansion would be the northeast region around the Marcellus and Utica shale play. With the amount of natural gas produced in the region, the next petrochemical expansion could occur in this area. IIR has already realized double digit growth in the Northeast driven by new natural gas-fired power plant construction, natural gas pipeline activity, Dominion's LNG export facility, and Shell's ethylene complex.

- **Can you discuss the trends for lithium and rare earths?**
- Two of the hottest minerals for mining project development today, lithium and rare earths, are in growing demand as ingredients for new technologies, such as rechargeable batteries, ceramics, alloys, and catalyst production. With President Trump's Executive Order signed December 19, 2017, more attention will be given to the development of mining projects in the U.S. for "Critical Minerals," which include lithium and rare earths. Globally, Industrial Info is tracking 244 lithium projects and 159 rare earth mining projects.
- **What is the outlook in 2018 and beyond for concrete-production facilities (precast, block/pavers, ready-mix, etc.)?**
- Cement consumption in the U.S. has been up for the past five years. The majority of cement is used in ready-mix concrete and concrete products. Concrete-product producers should benefit from an increase in demand for residential and commercial construction. Some analysts are expecting 3% to 5% growth in concrete products over the next two years.
- **What is your view on Chinese aluminum production cutbacks, and do you believe China will continue to trim illegal capacity throughout 2018?**
- In order to reduce pollution, the Chinese government cut production about 30% at several mills in the provinces surrounding Beijing from November 2017 to March 2018. This had a temporary impact on the market, which improved into early 2018. Nonetheless, a lot of capacity is coming online, which should have a downward impact to the market in 2018.
- **Is the new administration implementing any new requirements to utilize U.S.-based companies for construction materials used in new projects and plant expansions?**
- The administration reviewing Section 232 reports for steel and aluminum, and it could implement quotas or tariffs on imports of those products. This will support domestic production of fabricated structural steel over imports, but likely will increase costs for these materials.
- **Will the heavy-metal fabrication industry meet the needs of the projected 2,000 projects in the Texas & Louisiana Gulf region?**
- The outlook for metal fabricators along the U.S. Gulf Coast is good. Bidding activity is up for the metal fabricators in the region, but increased raw-material cost and heavy competition are hurting bottom lines.

# Questions from our Customers

## Oil & Gas/LNG

- **Are you still monitoring the second wave of crackers in the Gulf Coast region? How do you see that impacting the construction labor force in the Gulf Coast region?**
  - Demand for labor seems to have peaked and the expectations are that the number of additional large petrochemical projects currently being planned will keep labor demand close to its current level for potentially a couple more years.
- **After the drop in the oil price, the number of Oil & Gas projects has been reduced significantly, and in project spending in general. What is the market expectation for projects being financed during the next few years (2018-2020) for all Oil & Gas projects, including: Canadian Oil Sands, Other North American shale plays, Offshore Gulf of Mexico, Liquefied Natural Gas (LNG) Export Terminal Projects and others I've missed in North America?**
  - Most of the sectors that have been listed were covered during the presentations and can be viewed on our website. In general, we are seeing an uptick in market conditions over the next couple of years.
- **From your perspective, does 2018 look to be the year oil prices start to rise? And if so, how high will they get?**
  - Increases in oil prices were seen in 2017 and have continued into 2018. This is due to many factors, including fairly buoyant world economies and the closer merging of the supply and demand curves for oil. As to how high it will get is almost impossible to predict as there are many organizations out there trying to answer this question.
- **What is the future of Oil & Gas compared with the rise of renewables?**
  - It is very difficult to make a comparison here as the drivers for each of the subject matters are very different. It is expected that renewables will continue their percentage increase in the power market and as a consequence, the use of natural gas is expected to increase as a fuel of choice over others.
- **How do you foresee the recovery of the Oil & Gas sector in the following 6 to 24 months?**
  - For most sectors of the Oil & Gas Industry, we are seeing an uptick in market conditions. However, some areas may take a bit longer to recover, such as the Canadian Oil Sands and Deepwater Gulf of Mexico.
- **How do you prepare for market fluctuations?**
  - We continually look out for market fluctuations across all the industries that we cover. In doing so, we take this and many other factors into account in assessment of future projects and their likelihood of moving forward.
- **How is the outlook for Oil & Gas, Power and Mid/Downstream project activities? Is the recession over or does it still continue?**
  - All indications are that the recession is over.
- **How long can OPEC/non-OPEC producers continue extend their oil output cut while they see U.S. shale oil production growing?**
  - This is very difficult to predict, but signals from the main players in this output cut seem to suggest that this will continue well into 2018.
- **How long will it be before the rest of the world catches up with the U.S. in gas gathering and allow pricing levels to be similar in the world markets?**
  - There are many other variables that dictate gas prices around the world. Also, other regions of the world have comparable gas gathering. In fact, some areas of the world can produce gas cheaper than the U.S.
- **How will the industry address declining demand?**
  - The industry is slowly but surely raising this question, when not so long ago, the discussion centered around declining supply. We think that declining demand (for oil) is still quite some time away, leaving the major oil companies time to diversify.
- **In light of the ability of producers of unconventional oil to be able to rapidly shut in or restart oil production, and in light of forecast growth in future demand for refined fuels, how long do you believe that oil price volatility will continue?**
  - We believe that the whole market will still have some volatility as there are always unseen issues that arise in this industry. Recent reports seem to suggest that the demand for refined products has somewhat cooled down, but things can still change.
- **Is the Eagle Ford Shale play coming back?**
  - The Eagle Ford Shale Play region reached peak production in 2015. However, due to the subsequent drop in oil prices, producers moved to lower-cost regions (Permian as an example). Now that the price of oil has increased, we may see increased production over the next couple of years. Drilling permits increased in 2017 and into 2018.
- **What do you see as a date for offshore activities to increase?**
  - Recent project announcements in certain offshore regions would seem to announce more confidence in sustainable increased oil prices, thus suggesting that if not in the later part of 2018, more probably 2019 could be the breakout year for deepwater activities.
- **What laws will impact the Oil & Gas Industry negatively and what ones will have a positive impact?**
  - The lifting of the previous ban on offshore drilling in certain waters could see an increase in offshore activity, but that may be a number of years off - this could be positive. In contrast, the Canadian Government is looking to impose stricter regulations that could have a negative impact on future development in the Oil Sand Regions.
- **What regions of Texas are scheduled for the greatest expansion and growth in the Oil & Gas sector?**
  - Our data suggests that the Permian Basin will continue to lead the growth in spend in the Texas Oil & Gas Industry. However, should another liquefied natural gas (LNG) project receive a financial investment decision (FID), then the coastal areas will also see significant investment.
- **What's the outlook for the price of a barrel of oil for 2018 and 2019, and what are the probabilities that the Oil & Gas market will re-emerge at the levels of 2013, and first quarter of 2014?**
  - Increases in oil prices were seen in 2017 and have continued into 2018. This is due to many factors, including fairly buoyant world economies and the closer merging of the supply and demand curves for oil. As to how high it will get is almost impossible to predict as there are many organizations out there trying to answer this question.
- **Where do the experts see the barrel prices in 2018 and 2019, and what are the trends do we need to watch? What are the some of the growth areas for downstream companies and refineries?**
  - Increases in oil prices were seen in 2017 and have continued into 2018. This is due to many factors, including fairly buoyant world economies and the closer merging of the supply and demand curves for oil. As to how high it will get is almost impossible to predict as there are many organizations out there trying to answer this question. Refiners' have the ability to export more product. For Chemicals, growth continues due to the relatively cheap price of feedstock, thus allowing producers the ability to export product.
- **Where will the additional revenue generated from higher oil prices and Trump's tax reform be spent?**
  - Increased dividends, stock buybacks, new capital projects, debt repayment, employee bonuses, etc. It is hard to say and probably includes all the above.
- **Will the mid-term elections have an effect on the forward progress that the Oil & Gas Industry has seen under the current governmental regulating bodies?**
  - Generally, the Oil & Gas Industry is driven by the demand and supply sides of the business along with the ever-changing price of oil, and less to do with government policies. It is doubtful if the mid-term elections will have any effect on the industry.
- **What will be the impact of the recent approval of the XL pipeline be for the Houston Industrial area?**
  - In general, the impact will be limited as the Southern portion of the pipeline has been built and is in service.
- **How do you see offshore drilling vs shale oil and the size of future projects in each? Is shale growing over offshore drilling?**
  - Offshore drilling (especially exploration drilling) was severely cut back during the downturn in the Oil & Gas Market. Now that the price of oil has increased, we should see an upturn in late 2018 into 2019. Shale drilling in 2017 returned to 2015 levels, but well below the peak that we saw in 2014.
- **However, the latest technology in drilling has meant less rigs are needed per production ratio.**
  - 2017 was a question year, which means no one knew what would happen. Do we have any idea what the oil market will do in 2018?
- In general, we are seeing an uptick in market conditions over the next couple of years.
- **What will the offshore upstream market look like in 2018 and beyond? Are oil prices expected to remain above \$50 per barrel and continue to rise? Is the rig count expected to remain where it is at; is this a permanent market adjustment?**
  - Offshore drilling (especially exploration drilling) was severely cut back during the downturn in the Oil & Gas Market. Now that the price of oil has increased, we should see an upturn in late 2018 into 2019. Increases in oil prices were seen in 2017 and this has continued into 2018. This is due to many factors, including fairly buoyant world economies and the closer merging of the supply and demand curves for oil. As to how high it will get is almost impossible to predict as there are many organizations out there trying to answer this question.
- **With the current major focus on renewable energy, how do we see this affect the oil and gas industry in terms of expected growth in the mid- to long-term? This is considering it's very unlikely we will have a major collaboration toward demand vs supply like we had with OPEC.**
  - It is very difficult to make a comparison here as the drivers for each of the subject matters are very different. It is expected that renewables will continue their percentage increase in the Power Market, and as a consequence, the use of natural gas is expected to increase as a fuel of choice over others.
- **Offshore maintenance spending in 2018 and 2019: Are specific regions forecasting higher growth in spending this year, and why?**
  - Presuming this is a question related to worldwide offshore regions, then this was not discussed at the Outlook as it mainly centered around North America. That being said, we have not identified any specific region that stands out as forecasting higher maintenance spending.
- **Oil pricing and its influence on projects?**
  - The oil price, whether low or high, will always have an effect on projects, depending on the type, time to bring to market and risk factors.
- **With the new tax plan, what new capital spending, if any, should be expected?**
  - Generally the Oil & Gas Industry is driven by the demand and supply sides of the business along with the ever-changing price of oil, and less to do with government policies.
- **What is the magic number for oil to be able to stimulate activity downstream/midstream/upstream?**
  - Generally there is no "magic" number for the oil price to be set at, as each of the sectors mentioned can be affected differently by a low or high oil price. For example, both the Refining and Petrochem Industries remained healthy during the recent low oil prices.
- **What is the economic outlook for Oil & Gas? Do you see any consolidation opportunities to reduce costs?**
  - Much of this was presented at the Outlook and general opinion is that we are seeing more confidence in the market going into 2018. Much of the consolidation already occurred during the low points of the downturn and will probably continue as a means of reducing costs.
- **Will there be increased or decreased spending on liquefied natural gas (LNG) projects this year? What percentage of all spending in 2018 will be capital vs maintenance? What is the outlook on the Alberta Oil Sands?**
  - Much of the outlook on LNG in Canada was presented at the Outlook and can be viewed in our website by those that registered.
- **What is the (near- and mid-term) outlook for the upstream conventional offshore projects in the Gulf of Mexico, considering the shale revolution?**
  - The near/mid-term outlook for conventional offshore projects still remains fairly flat. However, versus shale, oil companies looking for longer-term production still value offshore as being more sustainable and predictable. This could mean new offshore projects moving forward, most probably starting in 2019.
- **With the price per barrel of oil up, does it look like the capital projects that were put on hold will now happen in the near future?**
  - There are still a number of projects that were put on hold and still remain on hold pending sustained stability of the current oil price.
- **What will be sequentially the biggest to smallest trend for budgetary growth within the existing Oil & Gas sites regarding maintenance and inspection expectations for 2018 (TAR, outages, capital expansions, etc.)?**
  - We feel that capital expansions will continue to be responsible for the largest growth in dollar terms within the existing O&G sites, followed by planned turnarounds and the unit outages.
- **How do we see the effect of \$70 oil this year?**
  - If we are able to reach and maintain \$70, this will have a positive effect on the market, especially higher-cost development areas, such as offshore and the Canadian Oil Sands, as well as associated infrastructure (pipelines and terminals).
- **What measures are suspected of OPEC?**
  - It is very difficult to predict, but signals from the main players in this output cut seem to suggest that this will continue well into 2018.
- **What is the outlook for 2018 regarding Oil & Gas industry recovery from the 2014-2016 downturn?**
  - In general, we are seeing an uptick in market conditions over the next couple of years.

# Questions from our Customers

## Chemical Processing

- **Aside from market demands, what technologies are most affecting growth in the Petrochemical industry?**
  - The move away from naphtha as a primary feedstock in the petrochem market and replacing that with NGLs feedstocks, primarily ethane, has been one of the largest contributors to spend in petrochemical investments.
- **Does \$50/barrel oil drive any major amount on investment in new petrochemical plants--and if so, which areas?**
  - The increased cost of crude oil does indeed influence a higher level of spending in the chemical industry. The unit cost of oil isn't as much the driver as the ratio between crude oil and natural gas. As that ratio remains in double digit territory, 20:1 at the moment, this will continue to have a very positive impact on the industry. The USA Gulf Coast has been a primary beneficiary in recent years, although the cost advantage is also seen in the Northeast market region where NGLs are discounted even greater.
- **Has investment in the US chemical sector now peaked?**
  - The last peak in USA Chemical Spending was in 2014 when numerous unit additions got underway for ethylene capacity additions. While we don't expect to achieve a peak at that level again in the near future, overall spending has remained constant for the past three years with expectations that spending for 2018 will remain very strong.
- **There seems to be an increasing interest in building methanol plants on the Gulf Coast, especially Louisiana. How long do you believe this will last? What is driving this demand? Do you see an over saturation of supply occurring once some of these come online?**
  - The primary demand component for methanol is coming from China, where methanol is being used as a feedstock for MTO (Methanol to Olefins) processes. Methanol is cost-advantaged against higher priced naphtha. When the price of oil and naphtha increase, this lifts the demand for methanol to support MTO investments in China. There has been an abundance of methanol capacity projects proposed in recent years and we believe it's a matter of who can get to market first. Inevitably there will be some projects delayed for many years or even cancelled based on the number of projects currently being proposed.
- **What are the current early indicators telling us in regards to future project activity in the area? Including fabrication yards, vendors loading, and equipment pricing?**
  - Each of our project reports are published with a Probability Factor (PF). The PF assigned to each project considers availability of labor, constraints in the region's market, and numerous other items to help illustrate our confidence in a project moving ahead as planned.
- **What does the ethylene supply balance look like?**
  - Considering we are witnessing the development of at least two fairly large ethylene export terminals, it appears that we are approaching a point where producers will need to begin exporting product to foreign markets to support at least a portion of the new capacity currently being built.
- **What is the strength of the olefins market and how will it react to all of the new capacity coming online in 2018 and 2019?**
  - Considering we are witnessing the development of at least two fairly large ethylene export terminals, it appears that we are approaching a point where producers will need to begin exporting product to foreign markets to support at least a portion of the new capacity currently being built.
- **What steps are chemical manufacturers taking in order to be compliant with federal and state air emission regulations specifically for VOCs, HAPs, CO, and NOx knowing that there is a long lead time to secure operating permits and progress through the project Decision Stage Gates? Who are the consulting firms that specialize in assisting chemical manufacturers to navigate the permitting process, as well as help determine the best pollution control technology for their plant?**
  - We have witnessed chemical plant owners spending considerable dollars on permit applications and environmental consulting even prior to the completion of FEED or formal approval of a project in order to expedite the ordering process for key pieces of equipment that might slow the progress of a project once it makes it to the construction phase.
- **Where do you see the next wave of ethylene crackers or polyethylene production more prominent - Asia or the Americas?**
  - There is a considerable amount of new ethylene capacity being developed in both parts of the world in tandem. Each world region has advantages unique to themselves. In the Americas we have very inexpensive NGL feedstock. In Asia new ethylene capacity is being fed by cheap methanol, coal and even naphtha in some cases. Demand for this commodity is growing primarily in East Asia and South Asia making the certainty for new capacity in that region even more promising.
- **What do you see as the biggest constraint to \$250-\$500 million 'add on' plants that further process petrochemical offtake?**
  - Global demand. The derivative products we produce from our petrochemicals are increasingly dependent on global demand and consumption. The growth or expansion of global demand will dictate much of what is built here in the USA in coming years.
- **How will the forecasted U.S. economic growth impact the Gulf Coast CPI and have we seen any evidence of this bolstering the Houston-area EPC operations?**
  - Growth of the US market will continue to benefit the chemical industry with increasing demand from industrial manufacturing and other industries. The Gulf Coast region is still home to the largest concentration of chemical plants in North America and will continue to benefit first over other regions thanks to the connectivity and concentration of chemical plant assets in the region.
- **What does the market for Methanol projects look like for the Gulf Coast?**
  - There is a record level of new methanol capacity being proposed in Texas and Louisiana, over \$9.5 billion in construction starts planned for 2018. Due to the high level of competing capacity it seems likely that several planned projects will be deferred to a future year, or yet worse, cancelled entirely.
- **How will some of the larger mergers affect capital spending in 2018?**
  - We haven't discovered any large projects delayed or cancelled as a result of completed or planned mergers so far in 2018.
- **What are the biggest barriers for U.S. petrochems to have we overbuilt our capacity on the Gulf Coast?**
  - The connectivity of industrial assets along the USA Gulf Coast along with export access to global markets will continue to be a major attraction for new investments. Investments are likely to continue at a strong pace as long as producers in the region maintain a significant cost advantage over competing products produced in Asia and similar advantaged regions.
- **What is the outlook for the Chemical Processing Industry as fewer mega projects are planned for the next couple of years? Will increasing oil prices cause a slowdown in the Chemical Processing Industry, or will cheap shale gas keep this industry on an upward path in the U.S.? Will available labor continue to be in short supply?**
  - The number of in-plant capital projects continues to rise even in the wake of mega projects for major unit additions and grassroots construction. Increases in the cost of oil actually have a mostly positive impact on the domestic chemical industry, considering large markets like Asia and Europe are still very dependent on oil (naphtha) as a feedstock for their petrochemicals. This increases the cost advantage of our petrochemicals that are based on ethane (NGLs). Labor continues to be a challenging factor for EPC firms and plant owners, with the expectation those constraints will remain tight for the near future.
- **Is it accurate that we will continue to see robust growth in this market as long as low-cost feedstocks stay on course?**
  - Yes, inexpensive and abundant NGL feedstocks in the USA and Canada are the number one proponent behind the big spend witnessed in recent years and we expect this trend to continue.
- **Where do you see the spend in chemicals, beyond just talking ethane crackers?**
  - The downstream derivatives market is showing great potential. Chemicals like polyethylene, ethylene oxide and other commodities. The number of projects and investment values in specialty chemicals is also increasing.
- **Are you still monitoring the second wave of crackers in the Gulf Coast region? How do you see that impacting the construction labor force in the Gulf Coast region?**
  - Demand for labor seems to have peaked, and the expectations are that the number of additional large petrochemical projects currently being planned will keep labor demand close to its current level for potentially a couple of more years.
- **chem companies with regard to export? Is it demand in certain countries, export regulation in US, geopolitical, etc.?**
  - This varies wildly by commodity. For ethylene it is mostly the cost from the amount of time it takes to load and ship product in comparison to the ability to produce low-cost derivatives of ethylene in greater quantities that are simpler and easier to ship, although there are currently two ethylene export facilities under development at this time. For other commodities like ammonia, the U.S. is still a net importer and the question is whether or not the domestic producers can displace the remainder of imports and compete in a global market.
- **Are we going to see a Chemical Plant boom in the US in the next few years? If so, what are the economic drivers of this?**
  - The Oil to Gas ratio is the largest contributor to the increase in chemical industry investments witnessed in recent years. The current outlook suggests that inexpensive NGL feedstock will remain abundant and attractively priced here in the U.S., continuing to drive increased investments for several years to come.
- **Are most current projects on track or do you think they will be delayed?**
  - There are a record number of delayed chemical projects at this time; some have been delayed for three to five years since their original construction starts. The high level of optimism in the industry is keeping many projects alive for years at a time while they wait for the right time to be approved and executed.
- **Will there be a second-wave of large petrochem expansions along the Houston Gulf Coast? If so, how much is anticipated in expenditures? Has the concern over hurricanes and flooding changed any company plans?**
  - The oil to gas ratio continues to drive optimism and momentum for large scale petrochemical projects. The USA Gulf Coast remains a hotspot for these investments and current projections suggest we will enjoy the same level of spending we have witnessed for the past five years in a row. We have heard nothing concrete about concerns with flooding specific to new construction plans.

- **Do you see manufacturing in the Houston area shifting some to non-energy industry focuses (automotive, aerospace, etc.) because of the prolonged downturn in the energy industry, or will manufacturing go back to the energy sector as the industry becomes healthier?**
- The Houston area has always had a robust manufacturing infrastructure of plants. While many revolve around the oil and gas industry, there are also a significant number of other types of plants that have continued to thrive even with oil prices lower than ideal. As those prices come back up, we certainly expect to see the oil and gas support portions of the industry revamp their operations to accommodate the expected increase in demand. However, given the pure size of Houston and the manufacturing the city is home to, that will not and has not defined the area's manufacturing base for many years. Houston has an incredibly diverse manufacturing base and while oil prices on the rise will certainly help boost spending, activity remains robust without those higher prices. There are no current plans for sectors such as automotive to make the move to the Houston area and that is not likely to change.
- **What growth initiatives are seen in the next 12-24 months regarding industrial manufacturing in the Gulf Region?**
- There is nothing specific at this time. The Gulf Region is not a powerhouse region for IM. There is a significant amount of plants, but many of them are related to the Oil & Gas industry in a support role, such as plants that manufacture rigs and other equipment. Until oil prices rise, we will not see significant increases in spending in that area, and even when oil prices increase, the spending will not be huge, as these type of plants are not complicated and do not take much investment to expand.
- **What's the outlook of work for projects with Marine Construction Components?**
- We are currently tracking 84 port projects worth \$6.8 billion in the Gulf Coast region. The majority of these projects are aimed at expanding the existing port infrastructure, such as new wharfs and berths, along with dredging projects. In the past several years, the focus had been on making ports capable of handling Post-Panamax ships for the expansion of the Panama Canal. The majority of that work is now completed, but significant additional work continues to be planned each and every year for the region's ports.
- **I would like to know if the upcoming projects are requesting Buy American, or if they will be utilizing imported materials.**
- We have not seen any significant increase in a "Buy American" sentiment among manufacturers in the region or across the US. They are interested in getting materials from whomever provides the best price more than anything else.

# Questions from our Customers

## Power

- **Will President Trump's love for coal reverse the closure of coal-fired power plants, even though it has been well established that natural gas generation is cheaper, cleaner, and requires less manpower?**
- We expect the closure of coal plants to continue moving forward. Many of these plants are older in nature and no longer economical to operate considering the low cost of natural gas.
- **Do you expect the price of natural gas to impact electricity prices once the LNG facilities currently under construction come on line?**
- We expect natural gas prices to remain affordable for power generation for the next few years even considering the potential for LNG Exports.
- **Do you see any substantive interest in industrial cogeneration ?**
- With the low cost of natural gas we do see the likelihood of more onsite power generation moving forward. Not all of this will be cogeneration. It could include installation of simple cycle gas turbines, internal combustion engines, micro grid installations, etc.
- **How does the current political climate stimulate new build power plants?**
- Demand growth for electricity is the lowest on record. Many parts of the country have sufficient reserve margins through 2020. Continued industrial and economic growth could drive greater demand over time leading to construction of more power plants.
- **If/when do you see federal subsidies for wind generation going away?**
- The Production Tax Credits for Wind are in place through 2019.
- **Is there a glut of excess power generation in specific areas of the USA?**
- Most of the USA has sufficient reserve margins through 2020.
- **With the new administration, is gas-fired Power Station planned the future growth?**
- By some estimates natural gas-fired generation will represent well over 50 percent of new capacity through 2020.
- **What are the chances that offshore wind industry could have in the US in a medium term?**
- Development of offshore wind in the USA has great potential but is slow to develop over the near term.
- **What is the outlook for Hydroelectric power generation projects over the next 3-5 years?**
- There is undoubtedly the potential for growth in the hydroelectric sector. How rapidly this moves forward remains to be seen. Most of this new capacity would be through expansion and upgrading of the existing fleet. Some estimate there is potential for an increase of over 6 gigawatts through these types of projects but many will likely happen beyond the 5 year window.
- **Are more closures of coal fired plants expected?**
- We are tracking an additional 107 units and over 26 gigawatts of coal fired capacity scheduled for closure over the next 5 years in the United States.
- **Is coal-fired power generation dead?**
- It is unlikely we will see any development of new coal fired generation for the near term. The majority of spending in this sector will be dedicated to modernization, upgrades and environmental compliance.
- **Will new plants be built as coal is phased out and natural gas is the primary fuel?**
- Yes, we expect more natural gas fired plants to be developed to replace capacity lost from retiring coal fired units moving forward.
- **What is the future outlook for renewables and nuclear power industry in the US, especially considering the government policy of renewable energy?**
- The nuclear sector in deregulated markets is experiencing difficulty competing against low natural gas prices and subsidized renewable energy. States such as New York and Illinois have taken steps to support the nuclear sector in their states. Taking into consideration natural gas prices are expected to remain low and tax subsidies for renewables are in place at least until 2020, we are not expecting to see near term development of new nuclear capacity. Costs for constructing both solar and wind has been steadily declining making these forms of energy competitive with natural gas even if the subsidies were to be removed.
- **How many megawatts of power generation have been retired over the last five years?**
- Over the past 5 years in the United States, there have been over 78,000 megawatts (78 gigawatts) of generating capacity retired. This includes all fuel types with the majority being coal fired capacity with just over 43 gigawatts.

# Questions from our Customers

## Labor

- **What are the projected manpower needs from 2018-2020?**
- According to our Gulf Coast Labor Forecast which includes projects with a 70% confidence factor or greater, there will be a combined need of 230,000 workers with a deficit of 11,500 workers.
- **How much impact do you see from the maintenance requirements for the numerous facilities that are coming on line to the craft labor availability issues in 2018?**
- Any additional demand will have some effect on the already strained labor market. Older construction workers may opt to settle down for a 40 hour maintenance job if the money is right, causing a loss of skills in the construction workforce.
- **With the downturn occurred in O&G Spending during the last couple of years since 2014 and loss of more than 500,000 jobs (or more), what options do the panel of experts see as a real alternative of Career Development for those unemployed people? In other words, I'm sure there are many skills that are transferable from one industry to another and could apply when the right attitude and opportunity are matched. What are those Transferable skills? What industries are in the up-turn looking for people?**
- As far as field crafts go, there are only a few skills that could transfer over but they may not be at the skill level required. Electricians, equipment/crane operators, welders, laborers and possibly some pipefitters.
- **Is the industry going to be able to overcome the lack of experience in the field at EPC firms and owners in the next 3-5 years?**
- As far as the field goes, owners and EPC firms have only wanted Journeyman level craftsmen on their projects for the last 10 years or so. This lack of helpers learning the trades coupled with the fact that parents want their kids to go to college has created a perfect storm of sorts for the labor market. This will not be corrected in the next five years, but may take ten or more. More craftsmen are falling out every day for one reason or another and there are not enough kids or adults entering the industrial market to keep up. The industry will have to take drastic steps and make smart decisions to draw workers.
- **With labor production in the gulf coast regions vastly decreasing and field labor cost rising in the gulf coast, will the owners/builders in the gulf coast try to reach out to the large fabricators in the region and turn to a modularize construction approach, utilizing that capacity and labor force.**
- Companies are definitely looking at this as an option, and there have been projects that have went modular due to the craft labor shortage, some however cannot due to logistics.
- **What is the net outlook for industrial labor in USGC, are new workers keeping pace with workers leaving the workforce (baby boomers, and disenchant)?**
- Currently there are not enough entrants to the industrial sector to overcome the attrition rate that is being seen. In the US, according to BLS, in November of 2017 there were 256,000 hires and 325,000 separations for a loss of 69,000 construction workers.
- **Turnaround labor market for the Gulf Coast for next 6-18 months and how the Hurricane has had an impact on near term labor?**
- Demand has increased for specific crafts in the areas that were affected by the storms. Some sites still have units down due to storm damage while other sites moved projects forward and took the option to start early since they were down for the storm.
- **What kind of draw will the upcoming projects have on union labor versus non-union labor?**
- In the gulf coast region, the unions have not had a large presence in the industrial sector for various reasons, merit contractors have always been the prominent source for labor. Unions have been offering economic packages as well as concessions to attempt in gaining market share. It is estimated that the unions have less than 3-5% market share in the gulf coast zones.
- **What training programs will help to develop a shortage of skilled trades in Texas \$385 Billion in projects for 2018 ?**
- Increased skills and craft training and mentoring programs. Incentivize the training with clear goals and rewards.
- **How will Corpus Christi supply labor for their \$1 billion projects?**
- Labor demand will have to be filled by travelers.
- **Which of the craft labor will be hardest to find in the coming months and years? Top 3?**
- Mechanical Crafts, Welders, Operators and Soft Crafts show to be the main groups that will be in shortage in the near future. Of these the Pipefitters, Scaffold Builders and Operators will have the highest deficits.
- **What welding process is most needed for these projects Pipe or Structural?**
- Most sites from what we hear are wanting 6G welders so they can be used for all types of welds, while other sites will take what they can get.
- **Do you see the market trending towards OEM support for work at site, going to 3rd party, or in house?**
- Over the last ten or so years the move to 3rd party (contractors) has been the most prevalent for plant maintenance with some plants keeping a skeleton crew of in house personnel. OEM support typically has been associated with major equipment that comes with warranty support (large turbines, compressors etc.).
- **What is the projection of labor shortages over the next 5 years?**
- Over the next 5 years with all GC zones and all crafts combined there will be a deficit of approximately 151,000 workers with is an approximate deficit average of 31,000 per year according to our forecast.
- **Is it possible that the GCs and Operators standardize the protocol for background checks and testing for different disciplines or trades?**
- We have to send technicians to submit multiple tests to different consortiums in order to have the person qualified for multiple customers. The cost for multiple "clearing house requirements" for the different customers is becoming onerous. Plants want to control their sites, they want to have a say in who works in their facility. There has been some work towards a standard background, mainly the TWIC Card, however not every plant feels this is enough or the plant may not meet the requirements for the TWIC Card. As far as training, most GC's on the merit side adhere to the NCCER for most crafts and the NCCCO for operators and Riggers. The problem I believe is at the plant level where every plants wants to have their own requirements.
- **How does the labor market effect the cost and scheduling of projects?**
- If there is a skilled labor shortage, shouldn't the cost go up and/or the construction time schedules be longer. Economics 101 as supply goes down the demand go up. Are we seeing that in the market? Project cost and schedules are affected by the lack of labor. When you have a lack of skilled workers, you have to spend more time training or dealing with rework. For so long, companies were so worried about the cost and schedule they only wanted journeymen level craft workers on site thus shutting out the entry level workers and helpers. This was a short term gain, but long term loss mindset that has come back to haunt the industry.
- **What is Gulf Coast Labor forecast for next 3 years?**
- The gulf coast will remain in the 98% - 100% utilization rate for local labor, which of course means travelers will have to fill the voids left by the lack of local labors. Some crafts may see pressure ease, but not to all level where there will not be quality issues.
- **How long should one expect the impact of Harvey in terms of craft labor availability?**
- What impact does it have on per diem. The impact from Harvey is dependent on the level of damage and amount of repair a particular site had. Some had little to no damage and restarted quickly, while others are still down and may be down for another few months. Another affect is that projects that were planned for 2018 were moved up as the units were already down. Owners took advantage to start projects early.
- **You mention the labor shortage as a topic. Is there a marked difference between the labor needed for Petrochemical and Refining versus Upstream (drilling and completions)? If so, how and who will win the people?**
- The main difference is that the majority of Upstream workers are not the same skill sets as used in the Petrochemical industries. Therefore, there is not an apple to apple comparison. Naturally, the Refining and Petrochem industries are much larger and require more workers than Upstream.
- **How is the downturn affecting the labor?**
- There has been a labor shortage for quite some time and if there has been a down turn in one area, there is an increase in another. With this in mind, the labor supply is very fluid in that the worker go where the demand is.
- **When is the manpower crisis that everyone is talking about going to start?**
- There has been a shortage of skilled and qualified workers for quite some time prior to 2015, and it has only been exasperated by the increase in labor demand from 2015 through the present.
- **What is the North America labor demand for construction and maintenance workers over the next 3 years (2018-2020) within Oil and Gas and Chemical Processing? What are the key industry or market drivers that will impact the direction labor demand (reduced, constant, increased) projections?**
- Total manpower for the three next years in the O&G and Chemical industries is approximately 460,000 workers.
- **How to combat labor productivity/skilled labor shortage issues?**
- Train more people and utilize the skilled workers better. Pair up two or three helpers per journey person to pass on the knowledge. Pay incentives for mentoring.
- **Is the workforce available to get all these projects done on time for the Gulf Coast and West Texas (pipelines from WTX to STX). What about Mexico and the buildout, any delays due to workforce?**
- We are seeing a labor shortage not only in North America, but globally. Projects will get done, maybe not on time or projected cost originally anticipated.
- **How is the labor market trending towards per diem and travel pay to retain quality individuals on the Gulf Coast?**
- We have seen this becoming more prevalent not only to draw workers, but to keep workers. Per diems being paid for all days not just days worked, per diem being paid for local works sometimes at half the rate of travelers. Travel in and travel out as long as the workers stay for the duration, have no safety violations or days missed/tardiness.
- **How can the heavy industries best motivate the youth of our nation to have genuine interest in construction jobs to ensure the long term sustainability of the aging, but relied upon and in need of expansion, infrastructure that they rely upon for their comfort in their daily lives?**
- You have to exploit their interest, technology and money. Show them the new tools that are being developed or develop new tools and how they can apply them to the job and show them how much money they can make straight out of high school. Money motivates.

# Questions from our Customers

## Refining

- **Can \$100 Oil be reached again?**
- It is possible to reach \$100 in the future, due to geopolitical tensions, however the major oil companies are now discussing peak demand situations.
- **What is Future on Refining projects related to environmental regulations?**
- Refiners are currently investing in projects to comply with the EPA's Tier 2 low sulfur gasoline mandate by 2020. They are also evaluating projects to meet the new bunker fuel specification, by 2020 as well.
- **Can you expand on refining regulations and impacts to industry, timing, and product slate mix?**
- Compliance to the IMO Marpol bunker fuel specification will be the next hurdle for the refining industry, globally, by 2020. There has yet to be a clear path the industry will take, therefore, how this will impact the product mix is uncertain at the moment.
- **What is the demand outlook for inspection and turnaround maintenance services related to refineries & related midstream infrastructure?**
- Specific to refining, spending is projected to increase in 2018, compared to the last 2 years.
- **What is the percent increase or decrease in the number of turnarounds scheduled for 2018 vs. those that were completed in 2017?**
- The number of turnarounds scheduled to begin in 2018 is projected to increase by 9 percent compared to 2017.
- **What will be the primary direction refinery upgrades will go?**
- Refiners continue to strategize and evaluate opportunities to diversify their crude slate options, which will reduce feedstock costs.
- **With the ethylene boom going on right now, is there any future plans for rebuilding our wore out fuel refineries?**
- There are several large scale multibillion projects currently being evaluated, but for the most part, asset owners will continue to optimize current operations to meet demand needs.
- **With the price of Oil up some will the Refining Industry look at proceeding with projects that has been on hold since the price of oil was below \$50 a barrel? Also, is it looking any better for Grassroot Refineries to start up?**
- As oil prices continue to drive higher in the beginning of 2018, refining margins are decreasing and becoming challenged, not only in the US but in Europe as well as Asia. There could be several large scale projects that move forward, to improve refining margins. However, the narrowing margin will be a challenge for grassroot facilities.
- **What will be the price for the barrel by end of 2018?**
- There are many variables and factors that will influence the price of crude oil. The prediction is split, with analysts predicting a \$55-\$80 range by end of year.
- **Do you forecast any plant upgrades or modifications related to the new IMO low sulfur bunker fuel standard?**
- Yes, the entire industry will need to address this, however, the US does not produce a high amount of finished bunker fuel, therefore, the capital investment needed will be greater outside the US.
- **What is the prognosis or health projections of the downstream market going into 2018 and beyond?**
- As we roll into 2018, current profit margins for the US industry are becoming squeezed, as a result of higher oil prices.

- **What are the one- and two-year outlooks for North American Pharma/Biotech capital investment?**
- It continues to be strong--albeit not with the huge amount of growth that might be seen on a global basis, as it is a mature market. But it is the largest market with the highest demand. Growth of 1% to 3% is expected, with new projects uncovered daily. Although the full extent of hurricane-related damage in Puerto Rico is unknown, the island may account for a slight uptick in expected activity. About \$21 billion in reported projects for 2018 are on the books, with another \$10 billion (and growing) for 2019 and beyond.
- **This industry has been growing rapidly in the last few years. Do you expect this to continue, or do you expect a cyclical pattern, like what happened in the Oil & Gas Industry?**
- It is expected to grow, by the very nature of its products. As new drugs and treatments are developed, new production processes are put in place. It is a non-cyclical business.
- **What about the outlook for the Houston area vs. other major biotech markets? How is life science industry growth trending in Texas?**
- With its world-class medical center, Houston lags behind where many feel it should be. But the region is slowly gathering steam, intent on becoming a major player. Lonza took a big step forward with its \$150 million cell-culture manufacturing investment in Pearland. Big Pharma is claiming a presence, as Johnson & Johnson is helping to fund development at the Texas Medical Center in support of nascent life science companies. A look at College Station and Bryan shows how hundreds of millions have been invested by Texas A&M, GlaxoSmithKline and the federal government in vaccine research and manufacturing. Fujifilm Diosynth is boosting capacity and investing millions at its biologics manufacturing plant in that area as well.
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