

---

# IGTI Fall 2018 Fuels Report Presentation

PowerGen Conference

December 5, 2018

Orlando, FL

[pete\\_baldwin@base-e.net](mailto:pete_baldwin@base-e.net)

Full Report available

<http://www.base-e.net/articles.php>

++1-617-306-7419



---

*“Practical Strategies for Emerging Energy Technologies”*

# Primary Energy Consumption by Fuel 2017 - Mtoe

U.S. = 91.86 Quads

## Primary Energy: Consumption by fuel\*

Million tonnes oil equivalent	2016							2017							Percent of 2017 Total
	Oil	Natural Gas	Coal	Nuclear energy	Hydro electric	Renew - ables	Total	Oil	Natural Gas	Coal	Nuclear energy	Hydro electric	Renew - ables	Total	
US	907.6	645.1	340.6	191.9	59.7	83.1	2228.0	913.3	635.8	332.1	191.7	67.1	94.8	2234.9	16.5%
Canada	107.0	94.1	18.9	21.8	87.6	9.6	339.0	108.6	99.5	18.6	21.9	89.8	10.3	348.7	2.6%
Mexico	90.1	79.0	12.4	2.4	6.9	4.1	194.9	86.8	75.3	13.1	2.5	7.2	4.4	189.3	1.4%
<b>Total North America</b>	<b>1104.6</b>	<b>818.2</b>	<b>371.9</b>	<b>216.1</b>	<b>154.2</b>	<b>96.8</b>	<b>2761.9</b>	<b>1108.6</b>	<b>810.7</b>	<b>363.8</b>	<b>216.1</b>	<b>164.1</b>	<b>109.5</b>	<b>2772.8</b>	<b>20.5%</b>
Brazil	135.7	32.4	15.9	3.6	86.2	19.1	293.0	135.6	33.0	16.5	3.6	83.6	22.2	294.4	2.2%
<b>Total S. &amp; Cent. America</b>	<b>320.8</b>	<b>150.6</b>	<b>34.9</b>	<b>5.5</b>	<b>156.4</b>	<b>28.6</b>	<b>696.8</b>	<b>318.8</b>	<b>149.1</b>	<b>32.7</b>	<b>5.0</b>	<b>162.3</b>	<b>32.6</b>	<b>700.6</b>	<b>5.2%</b>
France	79.2	38.3	8.2	91.2	13.6	8.4	238.9	79.7	38.5	9.1	90.1	11.1	9.4	237.9	1.8%
Germany	117.3	73.0	75.8	19.2	4.6	38.3	328.2	119.8	77.5	71.3	17.2	4.5	44.8	335.1	2.5%
Italy	59.8	58.5	11.0	-	9.6	14.8	153.8	60.6	62.0	9.8	-	8.2	15.5	156.0	1.2%
Spain	64.2	25.0	10.5	13.3	8.2	15.4	136.7	64.8	27.5	13.4	13.1	4.2	15.7	138.8	1.0%
Turkey	47.1	38.2	38.5	-	15.2	5.4	144.4	48.8	44.4	44.6	-	13.2	6.6	157.7	1.2%
United Kingdom	76.3	69.6	11.2	16.2	1.2	17.6	192.2	76.3	67.7	9.0	15.9	1.3	21.0	191.3	1.4%
<b>Total Europe</b>	<b>719.3</b>	<b>434.7</b>	<b>295.1</b>	<b>195.2</b>	<b>146.1</b>	<b>144.2</b>	<b>1934.6</b>	<b>731.2</b>	<b>457.2</b>	<b>296.4</b>	<b>192.5</b>	<b>130.4</b>	<b>161.8</b>	<b>1969.5</b>	<b>14.6%</b>
Russian Federation	152.5	361.3	89.2	44.5	41.8	0.3	689.6	153.0	365.2	92.3	46.0	41.5	0.3	698.3	5.2%
<b>Total CIS</b>	<b>202.8</b>	<b>492.6</b>	<b>156.2</b>	<b>63.3</b>	<b>56.3</b>	<b>0.8</b>	<b>972.0</b>	<b>203.4</b>	<b>494.1</b>	<b>157.0</b>	<b>65.9</b>	<b>56.7</b>	<b>0.9</b>	<b>978.0</b>	<b>7.2%</b>
Iran	80.7	173.1	0.9	1.5	3.5	0.1	259.8	84.6	184.4	0.9	1.6	3.7	0.1	275.4	2.0%
Saudi Arabia	173.8	90.6	0.1	-	-	^	264.5	172.4	95.8	0.1	-	-	^	268.3	2.0%
United Arab Emirates	45.7	62.3	1.5	-	-	0.1	109.6	45.0	62.1	1.6	-	-	0.1	108.7	0.8%
<b>Total Middle East</b>	<b>416.0</b>	<b>437.6</b>	<b>9.1</b>	<b>1.5</b>	<b>4.6</b>	<b>1.0</b>	<b>869.7</b>	<b>420.0</b>	<b>461.3</b>	<b>8.5</b>	<b>1.6</b>	<b>4.5</b>	<b>1.4</b>	<b>897.2</b>	<b>6.6%</b>
South Africa	28.7	4.0	84.7	3.6	0.2	1.8	123.0	28.8	3.9	82.2	3.6	0.2	2.0	120.6	0.9%
<b>Total Africa</b>	<b>192.6</b>	<b>114.5</b>	<b>94.9</b>	<b>3.6</b>	<b>27.1</b>	<b>5.2</b>	<b>438.0</b>	<b>196.3</b>	<b>121.9</b>	<b>93.1</b>	<b>3.6</b>	<b>29.1</b>	<b>5.5</b>	<b>449.5</b>	<b>3.3%</b>
Australia	50.5	35.9	43.6	-	4.0	5.4	139.5	52.4	36.0	42.3	-	3.1	5.7	139.4	1.0%
China	587.2	180.1	1889.1	48.3	261.0	81.7	3047.2	608.4	206.7	1892.6	56.2	261.5	106.7	3132.2	23.2%
India	217.1	43.7	405.6	8.6	29.0	18.3	722.3	222.1	46.6	424.0	8.5	30.7	21.8	753.7	5.6%
Indonesia	74.2	32.9	53.4	-	4.4	2.6	167.4	77.3	33.7	57.2	-	4.2	2.9	175.2	1.3%
Japan	191.4	100.1	118.8	4.0	18.1	18.8	451.2	188.3	100.7	120.5	6.6	17.9	22.4	456.4	3.4%
South Korea	128.9	41.0	81.9	36.7	0.6	3.1	292.2	129.3	42.4	86.3	33.6	0.7	3.6	295.9	2.2%
Taiwan	48.6	17.2	38.6	7.2	1.5	1.0	114.0	49.2	19.1	39.4	5.1	1.2	1.2	115.1	0.9%
Thailand	62.1	43.5	17.7	-	0.8	2.8	126.9	63.9	43.1	18.3	-	1.1	3.4	129.7	1.0%
<b>Total Asia Pacific</b>	<b>1601.1</b>	<b>625.1</b>	<b>2744.0</b>	<b>106.0</b>	<b>368.5</b>	<b>140.8</b>	<b>5585.5</b>	<b>1643.4</b>	<b>661.8</b>	<b>2780.0</b>	<b>111.7</b>	<b>371.6</b>	<b>175.1</b>	<b>5743.6</b>	<b>42.5%</b>
<b>Total World</b>	<b>4557.3</b>	<b>3073.2</b>	<b>3706.0</b>	<b>591.2</b>	<b>913.3</b>	<b>417.4</b>	<b>13258.5</b>	<b>4621.9</b>	<b>3156.0</b>	<b>3731.5</b>	<b>596.4</b>	<b>918.6</b>	<b>486.8</b>	<b>13511.2</b>	<b>100.0%</b>
	34.4%	23.2%	28.0%	4.5%	6.9%	3.1%	100.0%	34.2%	23.4%	27.6%	4.4%	6.8%	3.6%	100.0%	100.0%



13,511.2 Mtoe = 555.4 Quads

“Practical Strategies for Emerging Energy Technologies”

Source: BP Statistical Review of World Energy 2018

# Basic Comparisons 2017

	China	USA	India	Japan	Germany	Russia
Population - July 2014 est	1,379,302,771	326,525,791	1,281,935,911	126,451,398	80,594,017	142,257,519
Population Growth Rate	0.41%	0.81%	1.17%	-0.21%	-0.16%	-0.08%
Area - km <sup>2</sup>	9,596,960	9,826,675	3,287,263	377,915	357,022	17,098,242
GDP - Purchasing Power Parity (\$trillion)	23.1	19.4	9.4	5.4	4.2	4.0
Installed Generating Capacity GW	1,646	1,074	309	322	204	264
% of World at 6301GW	26%	17%	5%	5%	3%	4%
Electric Production TWh	6,142	4,088	1,289	976	559	1,008
Electric Consumption TWh	5,920	3,911	1,048	934	515	890
Aggregate Load Factor	42.6%	43.5%	47.6%	34.6%	31.3%	43.6%
Natural Gas Production - BCM	138.4	766.2	31.2	4.5	8.7	598.6
Natural Gas Consumption - BCM	210.3	773.2	102.3	123.6	79.2	418.9
Refined Petroleum Products Production - mmbbl/d	10.9	20.1	4.8	3.5	2.2	6.2
Refined Petroleum Products Consumption - mmbbl/d	11.8	19.7	4.1	4.0	2.4	3.6
Coal Production - Million Tonnes Oil Equivalent	1827.0	455.2	283.9	0.7	42.9	184.5
Coal Consumption - Million Tonnes Oil Equivalent	1920.4	396.3	407.2	119.4	78.3	88.7

Source: CIA World Factbook

Source: CIA World Factbook

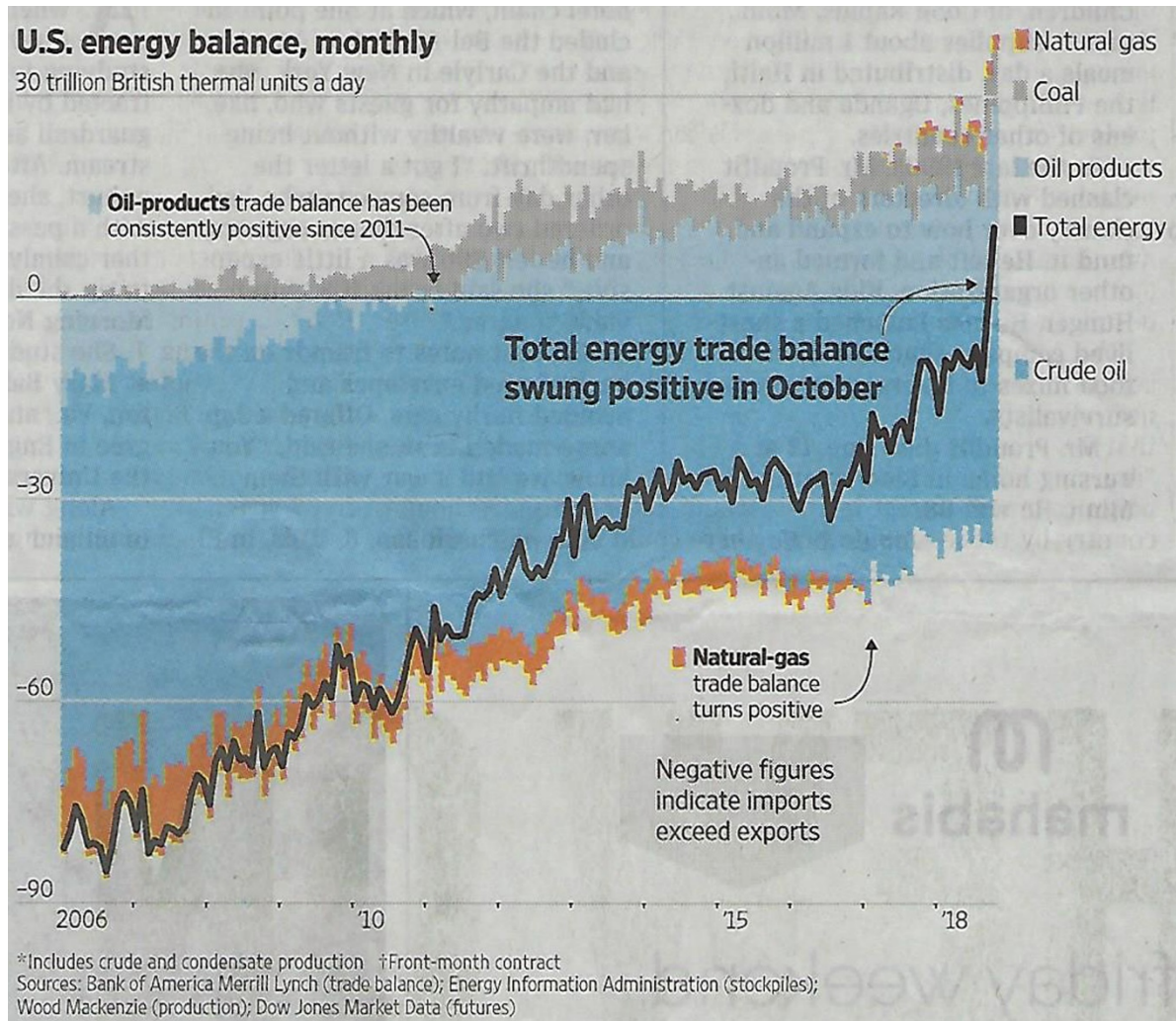
World Total Installed Electrical Generating Capacity **6301GW**

**base**<sub>e</sub>

“Practical Strategies for Emerging Energy Technologies”

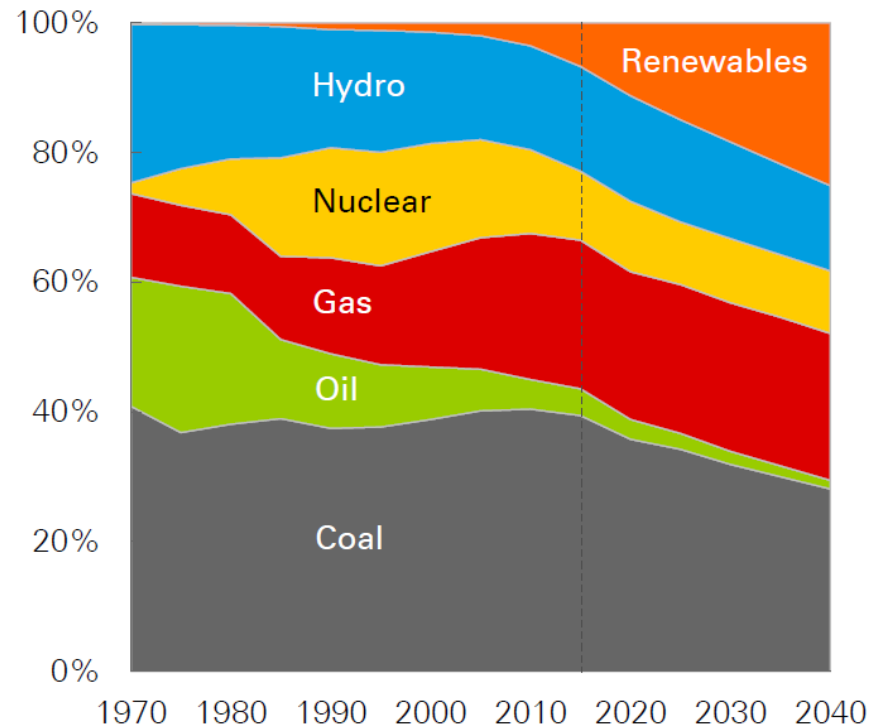
PS... .Total Value of Outstanding Student Loans - \$1.5 trillion  
 U.S. health care cost 2014 - \$3.3 trillion  
 U.S. Household Debt 2017 - \$13.2 trillion

# U.S. Energy Balance



# The World Continues to Electrify

Shares of total power generation

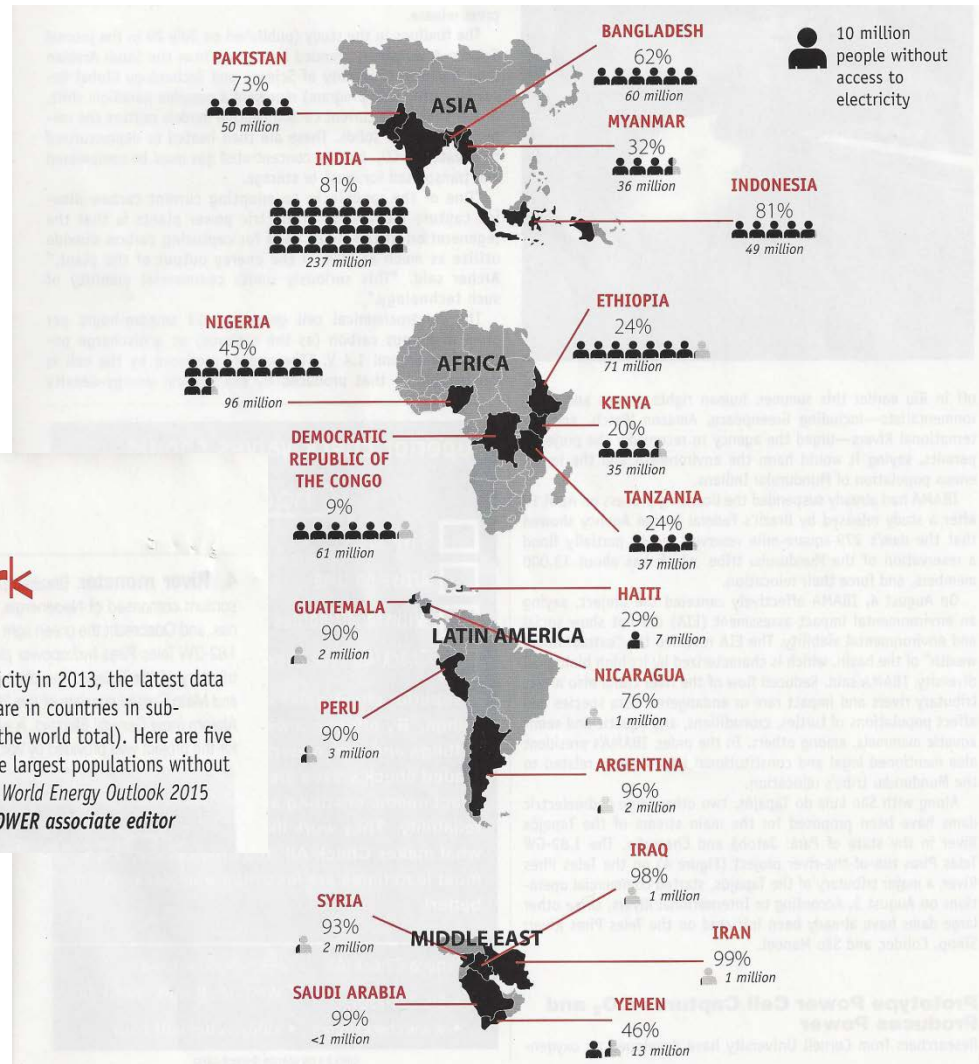


2018 BP Energy Outlook

© BP p.l.c. 2018

# Power – “Still in the Dark”

1.2 billion people  
17% of Global  
Population do not  
have access to  
electricity



GLOBAL MONITOR

## THE BIG PICTURE: Still in the Dark

An estimated 1.2 billion people—17% of the global population—did not have access to electricity in 2013, the latest data from the International Energy Agency show. More than 95% of those living without electricity are in countries in sub-Saharan Africa and developing Asia, and they are predominantly in rural areas (around 80% of the world total). Here are five countries per region (developing Asia, Africa, Latin America, and the Middle East) that have the largest populations without access to electricity. Also noted is that country's national electrification rate (%). Source: IEA, World Energy Outlook 2015

—Copy and artwork by Sonal Patel, a POWER associate editor

**base**<sub>e</sub>



# Current Issues

---

- Climate Change
  - IPCC AR6
  - 4<sup>th</sup> National Climate Assessment
- Iran Sanctions
  - Eight Un-named Country Temporary Waivers
  - China, India, South Korea, Turkey, Italy, the United Arab Emirates and Japan have been top importers of Iran's oil,
- U.S.-China Trade War
- Other Current Issues
  - Transportation
    - The New Silk Road
    - Straights of Malacca
    - South China Sea & Freedom of the Seas
    - Pak/China corridor
    - Panama canal
    - NAFTA/SCP-TANAP-TAP Pipeline
    - Arctic Passage
  - Turkey – The Crossroads of Everything
  - Saudi Arabia vs. Iran
  - New NAFTA
  - Oil (Tar) Sands
  - Arctic Resource
  - Rural Electrification
  - Northeast gas pipeline
- Oil Supply/Demand
  - OPEC + Russia - Qatar
  - USA
  - Iran & Saudi Arabia
  - Canada
  - Mexico
  - Venezuela
  - UK
- Natural Gas Supply/Demand
  - Pipeline vs. LNG
  - Gas to China & China-US Trade War
  - EU Gas Demand
    - Nord2
    - Turk Stream
  - USA Export
  - India Demand Growth
  - Australia
  - Russia

# U.S. EIA Annual Energy Outlook 2018

10 Cases  
Sorted High-Low, 2050

Energy-Related Carbon Dioxide Emissions by Sector and Source (MMmt)									
	2016	2020	2025	2030	2035	2040	2045	2050	Growth (2017-2050)
High economic growth	5174	5207	5138	5170	5225	5372	5568	5814	0.40%
Low oil price	5174	5170	5163	5156	5165	5234	5365	5521	0.20%
High economic growth with Clean Power Plan	5174	5204	5041	4927	4943	5057	5234	5424	0.20%
High oil and gas resource and technology	5174	5132	4999	5014	5020	5069	5152	5307	0.10%
<b>Reference case</b>	5174	5187	5079	5053	5024	5080	5159	5279	0.10%
Low oil and gas resource and technology	5174	5300	5114	4984	4954	4968	5030	5103	0.00%
High oil price	5174	5141	4926	4937	4950	4950	4987	5061	-0.10%
<b>Reference case with Clean Power Plan</b>	5174	5179	4997	4840	4822	4852	4915	5013	-0.10%
Low economic growth	5174	5110	4919	4856	4780	4743	4728	4742	-0.20%
Low economic growth with Clean Power Plan	5174	5115	4861	4697	4611	4586	4561	4562	-0.40%
<b>CPP Impact Ref Case</b>	0	24	43	87	121	205	319	266	

~6°C Trajectory

Clean Power Plan Effect is tiny

Energy-Related Carbon Dioxide Emissions Intensity by Sector and Source (MMmtCO <sub>2</sub> /capita)									
Reference case	16.0	15.5	14.7	14.1	13.6	13.4	13.3	13.3	-0.50%
Reference case with Clean Power Plan	16.0	15.5	14.4	13.5	13.0	12.8	12.6	12.6	-0.70%

Real Gross Domestic Product (\$billion)									
Reference case	16716	18335	20221	22421	24802	27356	30204	33205	2.00%
Reference case with Clean Power Plan	16716	18319	20195	22380	24775	27341	30177	33161	2.00%

Population (millions)									
Reference case	323.7	333.8	346.6	358.6	369.5	379.4	388.6	397.5	0.60%
Reference case with Clean Power Plan	323.7	333.8	346.6	358.6	369.5	379.4	388.6	397.5	0.60%



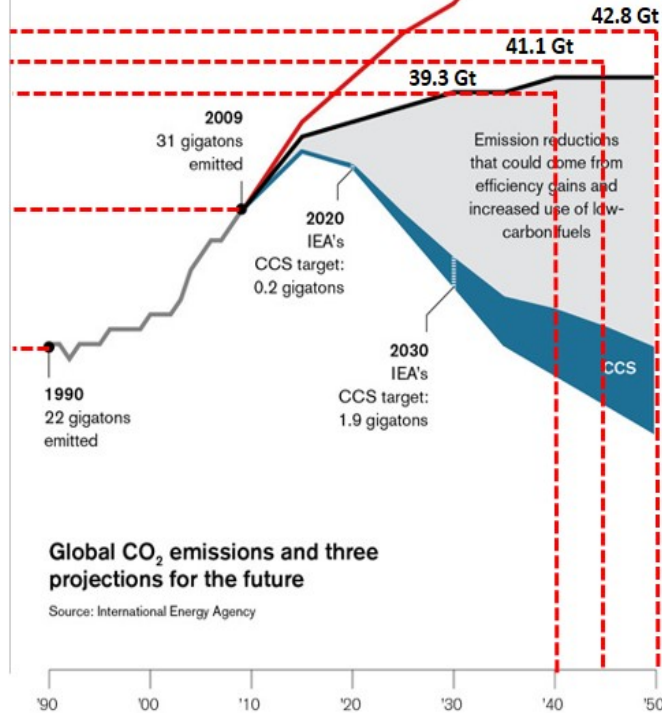


# EIA Annual Energy Outlook 2018

## The Carbon Capture Conundrum

Climate strategists are counting on carbon capture and storage. But can the technology meet its deadlines?

Values from EIA WW Annual Energy Outlook 2017 (slide 19)

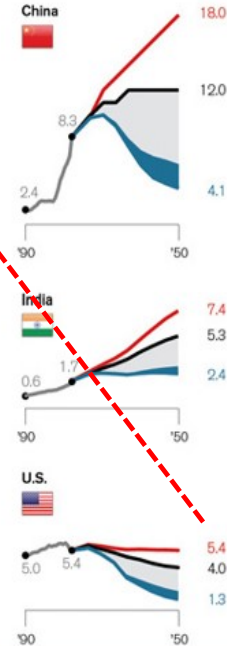


**Current trajectory 58 gigatons**  
This projection assumes that essentially no action is taken to address climate change. Models predict a long-term global temperature rise of 6 °C in such a scenario.

**Global pledges 40 gigatons**  
If countries make good on their pledges to reduce emissions, the projected trajectory is much less steep. Models suggest a long-term global temperature rise of 4 °C.

**Target 16 gigatons**  
Models associate this trajectory with a long-term global temperature rise no higher than 2 °C. That has been a long-standing goal in climate change negotiations.

## Scenarios and CCS targets for the three highest-emitting countries (in gigatons)



The U.S. is on the 6°C trajectory

EIA 2017 International Energy Outlook  
U.S. w/CPP 5.072 Gt  
U.S. w/o CPP 5.554 Gt

EIA 2018 International Energy Outlook  
U.S. w/ CPP 5.013 Gt  
U.S. w/o CPP 5.279 Gt  
High Growth 5.815 Gt

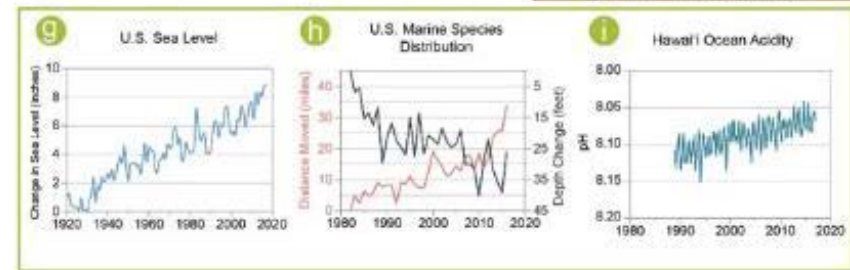
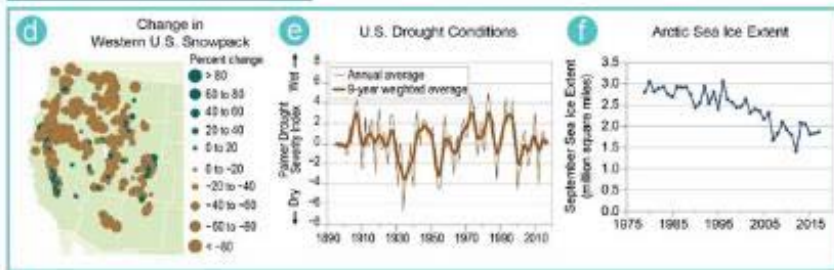
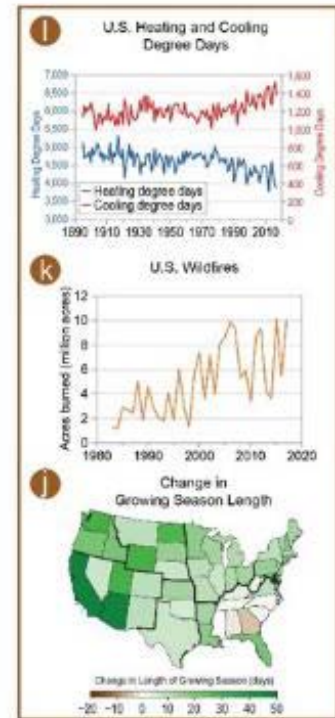
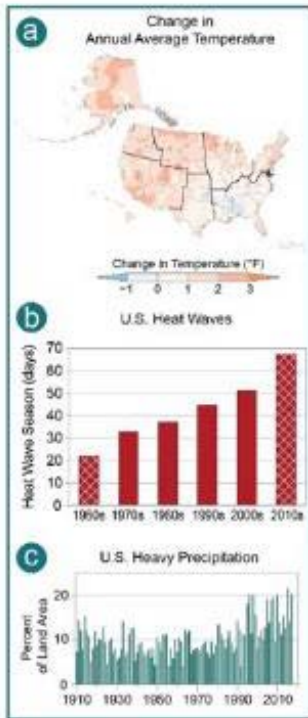
## 1

# Introduction: NCA4 Vol II

---

- Earth’s climate is now changing faster than at any point in modern civilization
- These changes are primarily the result of human activities, the evidence of which is overwhelming and continues to strengthen
- The impacts of climate change are already being felt across the country, and climate-related threats to Americans’ physical, social, and economic well-being are rising
- Americans are responding in ways that can reduce risks, build resilience, and improve livelihoods
- However, neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades

# Climate Change Indicators- 4<sup>th</sup> Assessment



*base*<sub>e</sub>

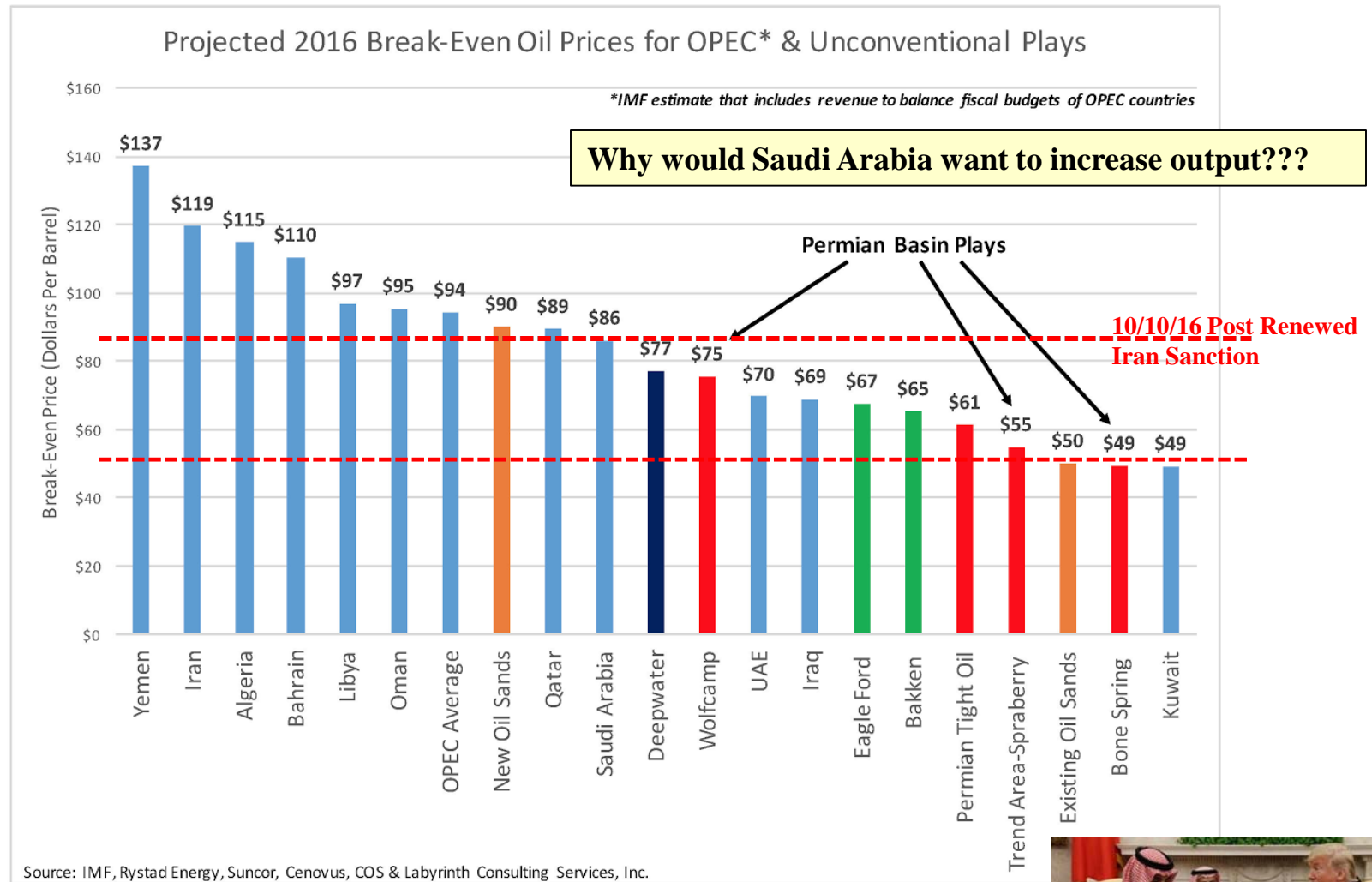
“Practical Strategies for Emerging Energy Technologies”

# Key events during the second quarter of 2018

---

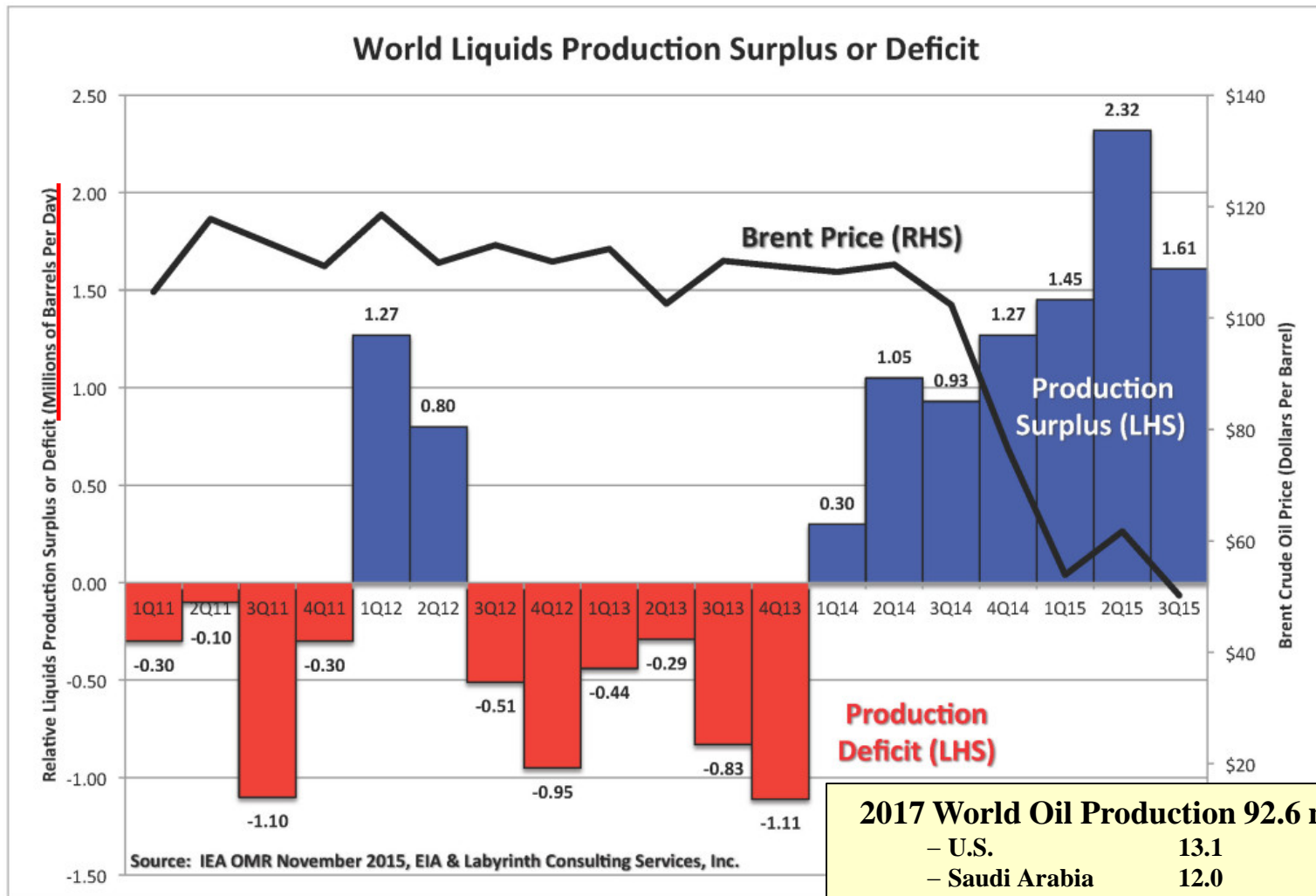
- **Logistical bottlenecks became evident in the Permian Basin.**
  - Most operators and services companies mention production is very close to outstripping pipeline takeaway capacity.
  - Growth and investments are expected to be throttled back until new takeaway is available, with West Texas Intermediate (WTI) Midland having traded at a discount of over \$15 per barrel since mid-July as marginal barrels have begun to move by truck.
- **OPEC met in June**
  - Agreed to increase production by about 600,000 barrels per day.
  - In a coordinated move, Russia also agreed to increase production by about 150,000 to 200,000 barrels per day.
- **Mexico elected a new president, who will take office December 1**
  - Energy policy changes are expected, and auctions of oil and gas blocks could be delayed.
- **Venezuela continued to face political and economic challenges**
  - Which led to oil production dropping by more than 30 percent in the past year
  - From two million barrels per day in June 2017 to 1.34 million barrels per day in June 2018
- **The US government withdrew from the Iran nuclear deal and re-imposed economic sanctions on Iran**
  - The sanctions on Iran could eventually force traditional buyers, especially India, to seek alternate sources of crude oil, although deliberations between those nations continue.
  - Experts predict a sharp reduction, perhaps as much as one million barrels per day, of Iran’s current production level of about 2.5 million barrels per day when the sanctions become effective in November.
  - French national oil company Total has decided to withdraw from Iran, citing uncertain geopolitical environment.
- **Escalating US and China trade tensions continued**
  - The tariffs considered by China included a 25 percent duty on imports of liquefied natural gas (LNG) from the United States, which would reduce, though not eliminate, the advantage US LNG exporters enjoy due to low-cost domestic-gas production.

# Break-Even Price of Oil Selected Locations





# Oil Price – The Supply/Demand Balance

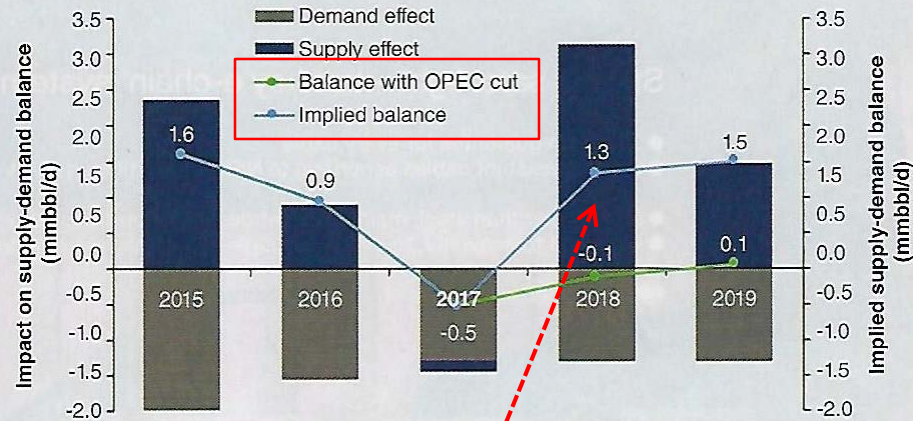


2017 World Oil Production 92.6 mmbbl/d	
– U.S.	13.1
– Saudi Arabia	12.0
– Russia	11.3
– Iran	5.0



# 2015-2019 Supply-Demand Balance

2015-2019 supply-demand balance: base case vs extended OPEC cut



Source: Sectors

OPEC Production cut ~1.8 mmbbl/d

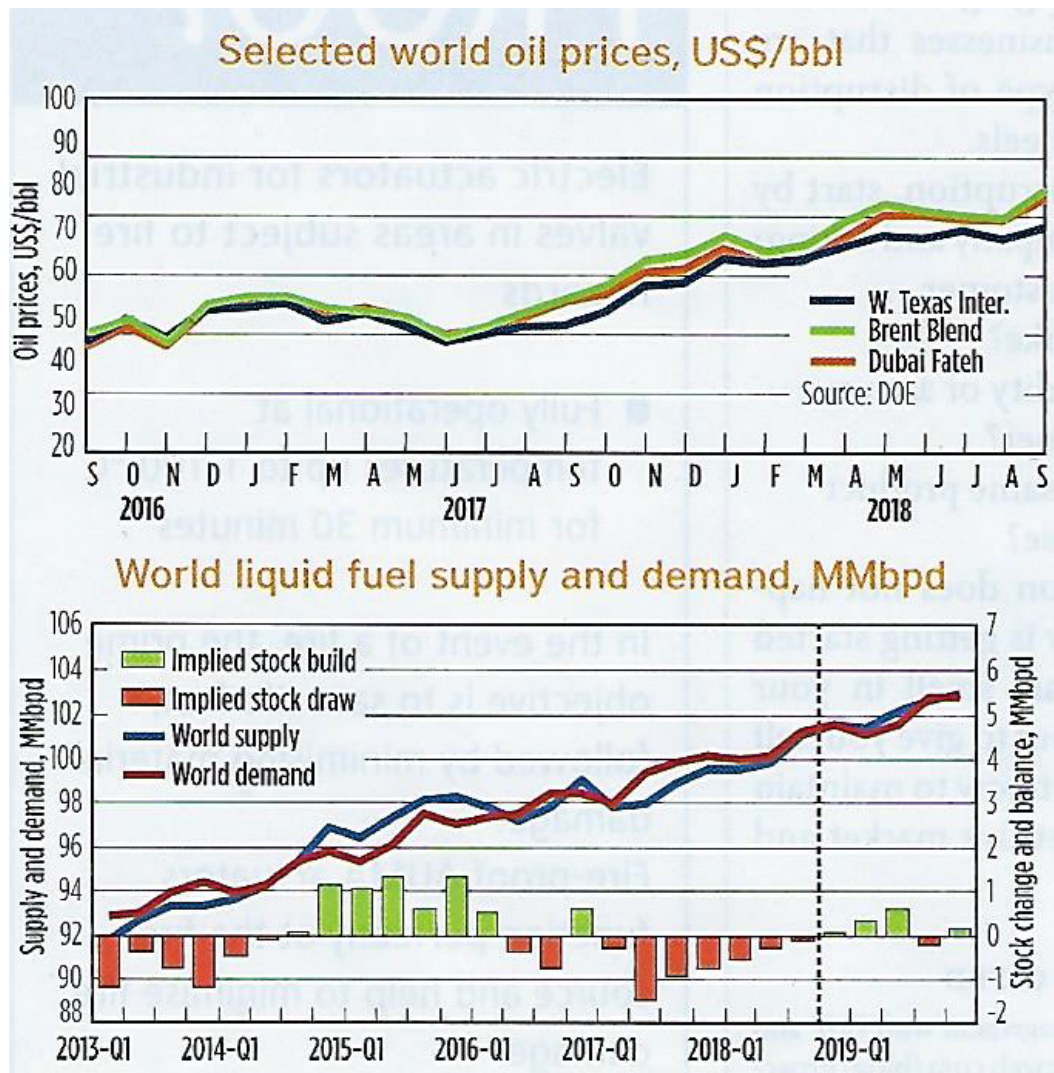
## WORLDWIDE SUPPLY AND DEMAND

	2017					2016				
	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Year	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Year
Million b/d										
<b>DEMAND</b>										
<b>OECD</b>										
Americas	24.5	25.0	25.0	25.1	24.9	24.6	24.9	25.3	25.1	25.0
Europe	13.9	14.3	14.7	14.1	14.3	13.8	14.2	14.7	14.3	14.3
Asia Pacific	8.6	7.8	7.9	8.4	8.1	8.5	7.6	7.7	8.2	8.0
<b>Total OECD</b>	<b>47.0</b>	<b>47.0</b>	<b>47.6</b>	<b>47.5</b>	<b>47.3</b>	<b>46.9</b>	<b>46.8</b>	<b>47.7</b>	<b>47.6</b>	<b>47.3</b>
<b>Non-OECD</b>										
FSU	4.6	4.7	5.0	4.9	4.8	4.7	4.8	5.1	5.0	4.9
Europe	0.7	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.8	0.8
China	12.5	12.6	12.2	12.4	12.4	12.8	12.9	12.6	13.0	12.8
Other Asia	13.2	13.5	13.2	13.6	13.4	13.8	14.0	13.6	14.3	13.9
Americas	6.4	6.6	6.7	6.6	6.6	6.5	6.7	6.8	6.7	6.7
Middle East	7.9	8.5	8.7	8.1	8.3	8.1	8.5	8.8	8.2	8.4
Africa	4.5	4.3	4.3	4.4	4.4	4.5	4.4	4.3	4.5	4.5
<b>Total Non-OECD</b>	<b>49.8</b>	<b>51.0</b>	<b>50.7</b>	<b>50.7</b>	<b>50.6</b>	<b>51.1</b>	<b>52.0</b>	<b>52.0</b>	<b>52.4</b>	<b>51.9</b>
<b>Total Demand</b>	<b>96.7</b>	<b>98.0</b>	<b>98.3</b>	<b>98.3</b>	<b>97.8</b>	<b>98.0</b>	<b>98.8</b>	<b>99.7</b>	<b>100.0</b>	<b>99.1</b>
<b>SUPPLY</b>										
<b>OECD</b>										
Americas	19.9	19.8	20.2	20.5	20.1	21.1	21.1	21.5	21.9	21.4
Europe	3.7	3.5	3.4	3.4	3.5	3.6	3.6	3.5	3.6	3.6
Asia Pacific	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4
<b>Total OECD</b>	<b>24.0</b>	<b>23.6</b>	<b>23.9</b>	<b>24.3</b>	<b>24.0</b>	<b>25.2</b>	<b>25.1</b>	<b>25.4</b>	<b>25.9</b>	<b>25.4</b>
<b>Non-OECD</b>										
FSU	14.5	14.4	14.3	14.4	14.4	14.4	14.4	14.4	14.5	14.4
Europe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
China	3.9	3.9	3.8	3.8	3.9	3.8	3.7	3.7	3.7	3.7
Other Asia	3.5	3.5	3.4	3.4	3.5	3.4	3.4	3.4	3.3	3.4
Latin America	4.6	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.8	4.7
Middle East	1.2	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.3	1.3
Africa	1.7	1.7	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8
<b>Total Non-OECD</b>	<b>29.5</b>	<b>29.3</b>	<b>29.2</b>	<b>29.3</b>	<b>29.4</b>	<b>29.3</b>	<b>29.4</b>	<b>29.4</b>	<b>29.6</b>	<b>29.4</b>
Processing gains	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Global biofuels	1.9	2.4	2.8	2.5	2.4	2.0	2.5	2.8	2.5	2.5
<b>Total Non-OPEC</b>	<b>57.7</b>	<b>57.7</b>	<b>58.2</b>	<b>58.4</b>	<b>58.0</b>	<b>58.8</b>	<b>59.4</b>	<b>59.9</b>	<b>60.3</b>	<b>59.6</b>
<b>OPEC</b>										
Crude	32.1	32.3	32.7	32.4	32.4	32.4	32.5	32.6	32.6	32.5
NGL	6.8	6.9	7.0	6.9	6.9	7.0	7.0	7.0	7.0	7.0
<b>Total OPEC</b>	<b>38.9</b>	<b>39.2</b>	<b>39.6</b>	<b>39.3</b>	<b>39.3</b>	<b>39.4</b>	<b>39.5</b>	<b>39.6</b>	<b>39.6</b>	<b>39.5</b>
<b>Total supply</b>	<b>96.6</b>	<b>96.9</b>	<b>97.9</b>	<b>97.7</b>	<b>97.3</b>	<b>98.2</b>	<b>98.9</b>	<b>99.5</b>	<b>99.9</b>	<b>99.1</b>
Stock change	(0.1)	(1.1)	(0.5)	(0.6)	(0.5)	0.2	0.1	(0.2)	(0.1)	0.0

Totals may not add due to rounding.  
Source: International Energy Agency; OGJ estimate of OPEC crude supply 4Q 2017 through 2018.

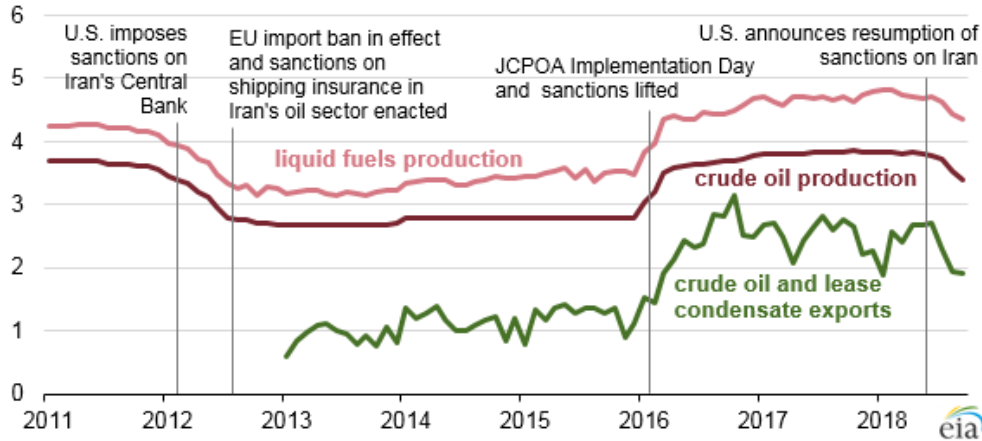
BP 92.6 mmbbl/d

# Oil Supply/Demand in Balance Pre-Iran Embargo

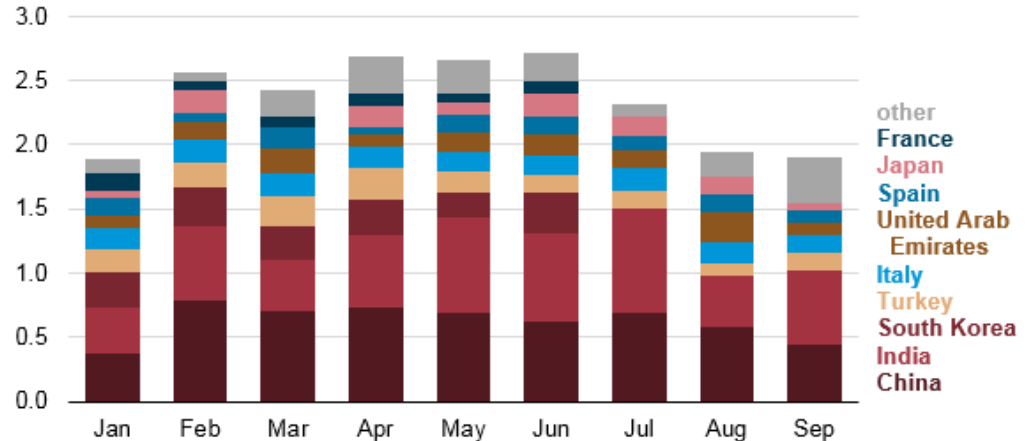


# Iran Sanctions Resume – Exports Decline

Iran liquid fuels, crude oil, and condensate production and exports (Jan 2011- Sep 2018)  
million barrels per day



Monthly Iran crude oil and lease condensate exports (2018)  
million barrels per day



Eight Countries to Receive Waivers

# Saudi Arabia

---

- Saudi Arabia is committed to meeting India’s rising oil demand and is the “shock absorber” for supply disruptions in the oil market
  - India, the world’s third-biggest oil importer, is grappling with a combination of rising oil prices and falling local currency.
  - Retail prices for gasoline and diesel fuel in India are at record highs
  - The Government has cut its excise tax on fuel to ease some of the pain for consumers.
- Saudi Arabia and other major producers will continue to act to cushion the market from oil price shocks.
  - “We could have another (round of) unanticipated disruptions that we have seen in Nigeria, Libya, Venezuela.
  - We have seen sanctions on Iran.
  - These supply disruptions need a shock absorber and the shock absorber to a large extent has been Saudi Arabia.”
- “We have invested tens of billions of dollars to build spare capacity of 2-3 million barrels per day over years,” he added.
- Saudi Arabia has the capacity to produce 12 million bpd and is currently producing 10.7 million bpd adding that production will rise further next month.



# Russia (de facto) OPEC Member?

---

- Saudi Arabia and Russia's 'unparalleled' oil deal gets backing from OPEC
  - Riyadh and Moscow have been engaged in supply cuts over the past year in order to try to clear a global supply overhang and keep prices in check.
  - Yet, in an effort to further their influence over world crude supplies, the two countries are now reportedly working on a deal to actively manage markets for potentially the next 20 years.
  - At the start of the week, Saudi Arabia's Crown Prince, Mohammad Bin Salman, told Reuters: "We are working to shift from a year-to-year agreement to a 10-20 year agreement."

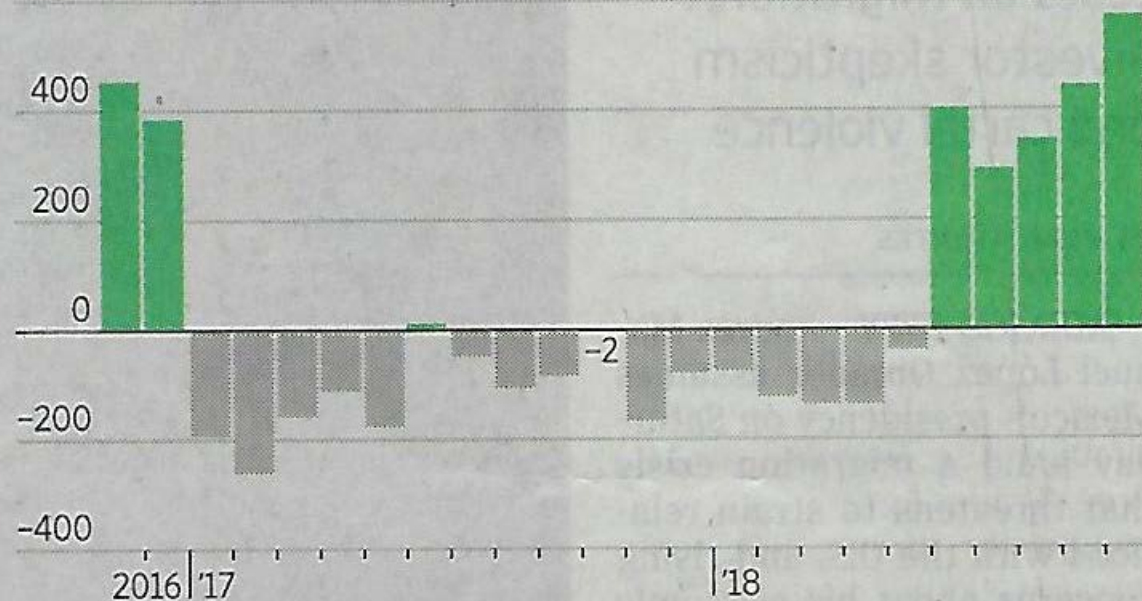
# Saudi Arabia Production Above OPEC Quota

## Pump Up the Volume

Saudi Arabia ramped up production well above its OPEC quota under U.S. pressure.

### Crude-oil production above or below the quota

600 thousand barrels a day



Source: Organization of the Petroleum Exporting Countries THE WALL STREET JOURNAL.



# WTI Crude Oil Prices - 10 Year Daily Chart

---



# WTI Crude Prices – \$/bbl

**Max - 2014**

11:31 am CST 15/11/2018

Technicals

WTI Crude  
**56.75 +0.89%**



1D | 1WK | 1M | 1YR | Max

Share

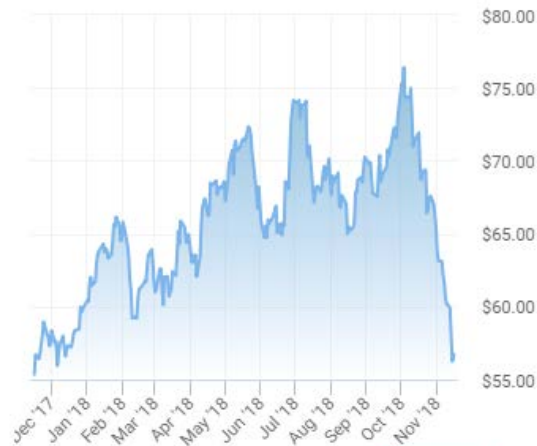


**1 Year**

11:33 am CST 15/11/2018

Technicals

WTI Crude  
**56.74 +0.87%**



1D | 1WK | 1M | 1YR | Max

Share



**1 Month**

11:34 am CST 15/11/2018

Technicals

WTI Crude  
**56.70 +0.80%**



1D | 1WK | 1M | 1YR | Max

Share



**base**<sub>e</sub>

“Practical Strategies for Emerging Energy Technologies”

---

# OPEC Meeting Tomorrow

## December 6, 2018

***base***<sub>e</sub>

---

*“Practical Strategies for Emerging Energy Technologies”*

# 5 Key Findings McKinsey Global Gas & LNG Outlook

---

1. China LNG imports grew by 52 percent year-over-year in the first half of 2018 (<https://www.mckinsey.com/solutions/energy-insights/global-gas-lng-outlook-to-2035>)
2. Asia is expected to fuel 50 percent of 2017-2022 global gas demand growth
3. South Asian gas demand is expected to grow by about 2 percent per annum by 2022, spurring LNG imports by 20 billion cubic meters
4. Europe is expected to require approximately 45 additional billion cubic meters of gas imports over the next 5 years
5. The LNG market is expected to rebalance by around 2022

# LNG vs. U.S./China “Trade War”

Before the discussion of  
tariffs on LNG

- (Reuters) - China's interest in reducing its trade surplus with the United States through increased energy imports could advance plans for U.S. liquefied natural gas (LNG) plants and ethanol sales
  - "China represents an enormous economic opportunity for U.S. LNG and ethanol exports as both products will likely see dramatic demand growth in the coming years"
  - Substantial LNG sales commitments could bring in \$20 billion to \$30 billion annually and ethanol sales could reach \$5 billion to \$7 billion annually.
  - LNG and ethanol markets were not big enough by themselves to meet President Donald Trump's goal of reducing the Chinese trade deficit by \$200 billion per year.
- There are more than two dozen proposed U.S. LNG plants waiting for customer commitments to reach a final investment decision, many of them looking to China for deals.
- China overtook South Korea in 2017 as the world's second biggest buyer of LNG behind Japan.
  - China imported 5.6 billion cubic feet per day last year, is looking to buy more low cost sources of energy, like gas, to reduce its use of coal and cut pollution.
- "If you look at some forecasts for 2035, there are really only two places that have significant increases in LNG imports.
  - Europe goes up about 100 mtpa
  - China goes up about 200 mtpa

# China Stops Buying U.S. Oil in August

- In 2017, China accounted for 20% of all U.S. oil exports.
- It played an out-sized role in the United States' fastest-growing significant export and trailed only Canada for market share.
- How fast-growing? Last year, the value of U.S. oil exports to the world grew 164% and "black gold" advanced 16 positions to rank as the nation's 11th most valuable export.
- This year, oil exports to the world are up a still-pretty-stunning 153% and oil is now the United States' third-leading export, by value.
- Year-to-date China is accounting for 18% of that total, and, still, only Canada is a larger purchaser.
- **But for the month of August, the United States did not export oil to China. Not a drop.**

CURRENT YEAR-TO-DATE ( YTD ) DATA IS THROUGH AUGUST 2018.

## EXPORTS: OIL

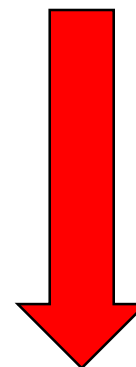
Oil, the No. 5 export by value totaled \$3.58 billion for the month of August, \$28.33 billion through August of 2018, and \$21.83 billion for all of 2017, the latest annual data available, according to U.S. Census Bureau data analyzed by WorldCity. Need more details? [Read more](#)

### TOP MARKETS

RANK	COUNTRY	YTD
1	Canada	\$5.7 B
2	China	\$5.22 B
3	Italy	\$2.3 B
4	South Korea	\$2.29 B
5	United Kingdom	\$2.14 B
6	The Netherlands	\$1.68 B
7	Taiwan	\$1.62 B
8	India	\$1.56 B
9	United Arab Emirates	\$651.55 M
10	Norway	\$610.13 M

### TOP GATEWAYS

RANK	PORT	YTD
1	Port of Corpus Christi, Texas	\$6,77 B
2	Port of Houston	\$6.59 B
3	Port of Beaumont, Texas	\$5.16 B
4	Port of Freeport, Texas	\$1.49 B
5	Port of New Orleans	\$1.4 B
6	Port of Texas City, Texas	\$1.28 B
7	Port of Port Arthur, Texas	\$1.01 B
8	Port of Southern Louisiana, Gramercy, St. James Parish	\$937.17 M
9	Port Huron Blue Water Bridge, Mich.	\$886.66 M
10	Rouses Point / Lacolle Border Crossing, N.Y.	\$533.13 M



Oil Exports to China	August 2018	July 2018	June 2018
Total All U.S. Ports	\$ -	\$ 853,314,780	\$ 1,025,764,923
Corpus Christi	\$ -	\$ -	\$ 303,634,182
Beaumont, Texas	\$ -	\$ 323,938,346	\$ 259,603,038
Port Houston	\$ -	\$ 152,542,034	\$ 200,333,761
Texas City	\$ -	\$ -	\$ 111,994,637
Freeport, Texas	\$ -	\$ 74,999,143	\$ 73,986,480
Skagway, Alaska	\$ -	\$ -	\$ 62,307,825
Portland, Oregon	\$ -	\$ -	\$ 13,905,000

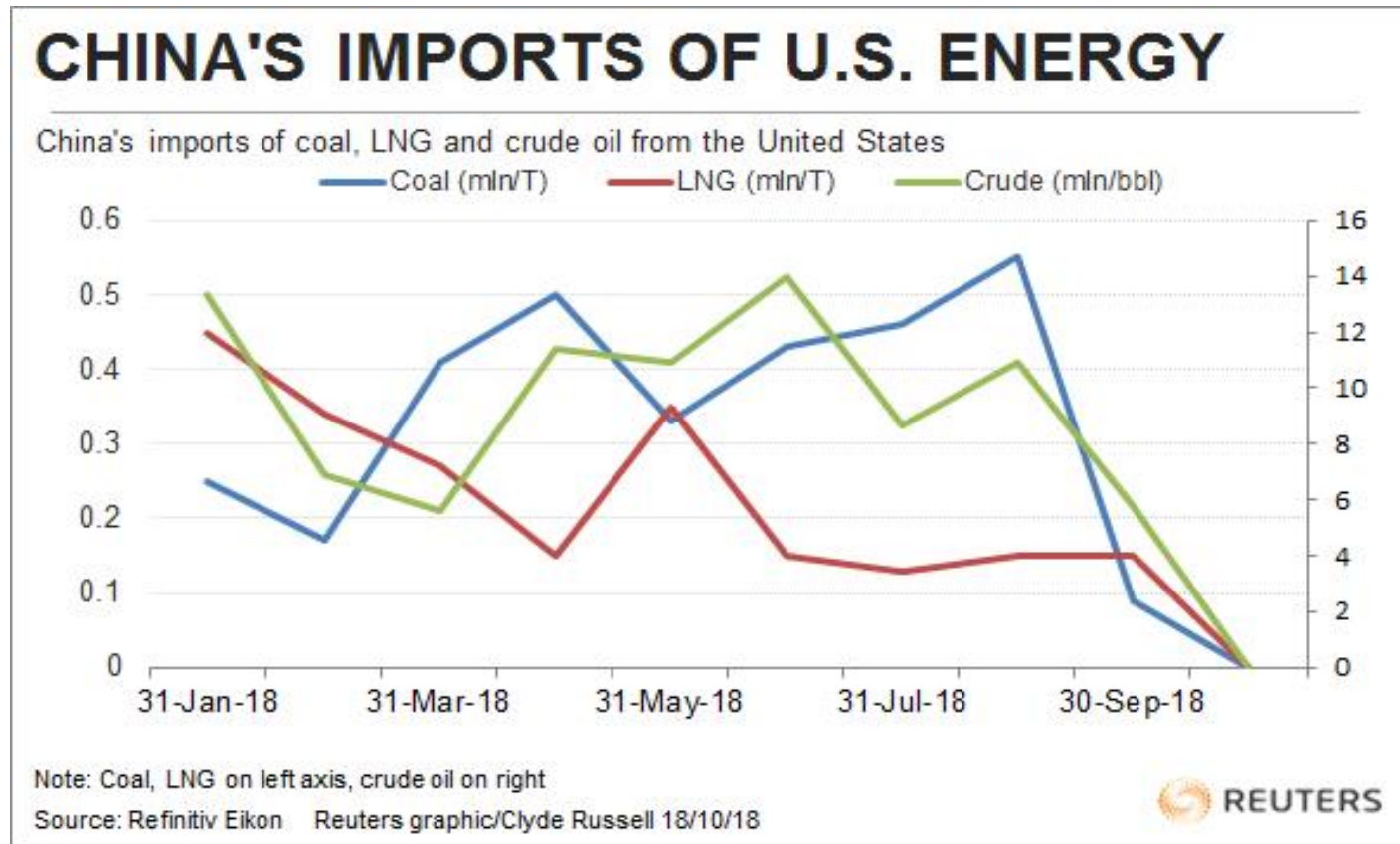


“Practical Strategies for Emerging Energy Technologies”

**Ken Roberts** Forbes Contributor



# .....and, Other things



# U.S. Announces China Export Policy – October 2018

---

- For exports of technology, there will be a presumption of approval, contingent on end-user checks, for amendments or extensions for existing authorizations for technology transferred before 1 January 2018, with the exception of light water small modular reactors (SMR) and non-light water advanced reactors
- There is a presumption of denial for exports related to light water SMRs, non-light water advanced reactors, new technology transfers after 1 January 2018 and any transfer to China General Nuclear (CGN) and/or its subsidiaries or related entities.
- For equipment and components, there is presumed approval for requests for exports to support continued projects such as the construction of AP1000s and "major identical components" similar in type and technology level to those commonly available; and for SMRs and advanced reactors with no technology transfer other than installation and operation.
- There is a presumption of denial for requests related to "direct competition with the United States" such as the Hualong One reactor, and for any transfer to CGN and its subsidiaries and related companies.

There is a presumption of denial for exports related to light water SMRs, non-light water advanced reactors, and any transfer to China General Nuclear (CGN)



Westinghouse-designed AP1000s at Sanmen, China (Image: Westinghouse)

# Seoul Orders 140 LNG Ships

---

- The Korean government will order 140 liquefied natural gas ships, worth 1 trillion won (\$880 million), from the nation’s small and mid-sized shipbuilders by 2025.
- South Korea’s Ministry of Trade, Industry and Energy said the government will provide shipbuilders and suppliers 1.7 trillion won (\$1.5 billion) in financial aid to prop up the country’s ailing shipbuilding industry.
- The report quoted Yoon Sung-hyuck, chief of the Ministry of Trade, Industry and Energy’s shipbuilding and offshore plant industry division as saying that, in order to set small and mid-sized shipbuilders apart from their rivals from China and Japan, it is necessary for them to be first movers in the eco-friendly shipbuilding market.
- There are 78 small and mid-sized builder companies in Korea, whose combined revenue stood at 601.2 billion won last year.
- South Korea's push for LNG coincides with the global movement toward tighter emissions regulations.. The government plans to invest around \$ 2.5 billion by 2025 in building up the LNG sector. The government will also invest in LNG infrastructure to develop bunkering.



DNV GL



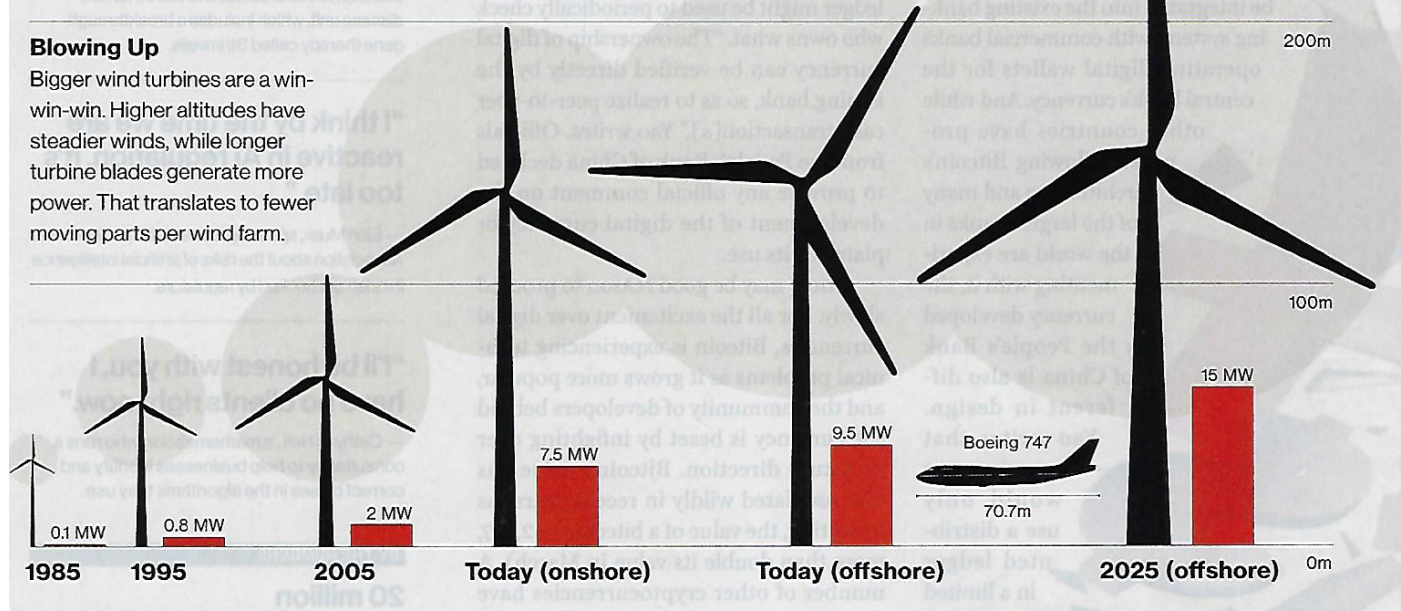
# Wind

## For Wind Power, Bigger Is Better

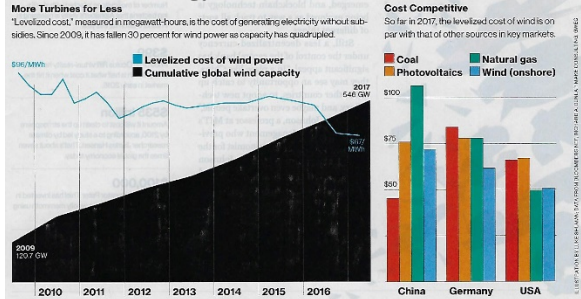
Things are looking up for wind power—way up. Wind is now competitive with fossil fuels in many areas of the world, while the rise of turbines to new heights figures to bring down costs even more.

### Blowing Up

Bigger wind turbines are a win-win-win. Higher altitudes have steadier winds, while longer turbine blades generate more power. That translates to fewer moving parts per wind farm.



### MIT Technology Review Vol 120/ No. 5



### WIND CAPACITY FACTOR, ALL TURBINES, BY REGION

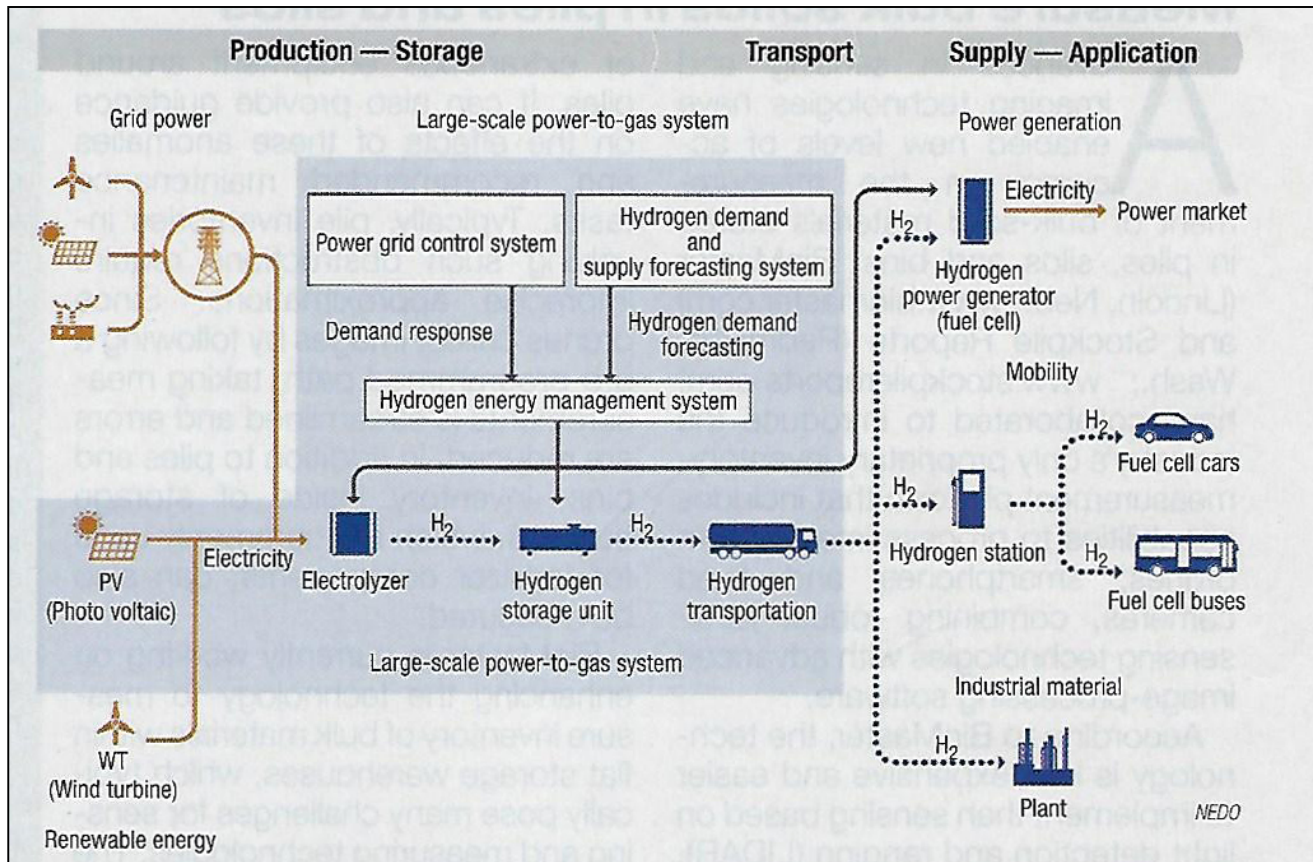
SPECIFIC POWER	WEST	NORTHEAST	GREAT LAKES	INTERIOR
Greater than 400 W/m <sup>2</sup>	22.8%	25.6%	15.4%	27.7%
350 to 400 W/m <sup>2</sup>	24.6%	25.0%	19.6%	29.3%
300 to 350 W/m <sup>2</sup>	24.9%	28.0%	30.0%	35.2%
250 to 300 W/m <sup>2</sup>	27.6%	29.8%	34.2%	40.4%
Less than 250 W/m <sup>2</sup>	32.6%	32.4%	37.4%	44.4%
<b>REGIONAL AVERAGES</b>	<b>25.5%</b>	<b>27.9%</b>	<b>32.6%</b>	<b>37.9%</b>

Data source: 2017 Wind Technologies Market Report



“Practical Strategies for Emerging Energy Technologies”

# METI “Basic Hydrogen Strategy”



Fukushima Hydrogen Energy Research Field (FH2R)

900 ton/year H<sub>2</sub>  
Operational 2020

**base**<sub>e</sub>

“Practical Strategies for Emerging Energy Technologies”