Energy Intelligence

IAEE Distinguished Lecturers Series

"Oil Markets in Transition: Where are We and What's Next?"

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Institute for Energy Economics of Japan, Tokyo, December 6, 2016

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for the global energy industry

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Oil Markets in Transition: Where Are We and What's Next?

Dr. David Knapp Biography

- Dr. David Knapp is President Elect for 2018 of the International Association for Energy Economics and Chief Energy Economist of Energy Intelligence. At EI, he has edited *Oil Market Intelligence* for over 15 years and writes regularly for several other of the company's publications, including *Petroleum Intelligence Weekly*, *Energy Compass*, *Oil Daily, Energy Intelligence Finance* and *International Oil Daily*.

- Before joining Energy Intelligence in late 2000, Dr. Knapp was a senior official with the International Energy Agency in Paris and served as Editor of the IEA's influential monthly *Oil Market Report* through much of the 1990s. He has analyzed energy markets for more than 45 years in the international, government, business and financial sectors as Energy Economist and Energy Team Leader for the Wall Street banking and investment firm of Brown Brothers Harriman & Co. throughout the 1980s, after starting his career at the Federal Energy Administration/Department of Energy and then Chase Manhattan Bank's Energy Economics Division in the 1970s.

- Dr. Knapp holds a Ph.D. in Economics from the University of California at Santa Barbara and is a member of numerous professional organizations in the energy area. He is a founding Member of the IAEE and was also a founder, and currently serves as President of the Board of the New York Energy Forum. He is a Senior Fellow of the US Association for Energy Economics and currently VP for Business. He has served on various USAEE committees, as well as being an Appointed Advisor to five recent USAEE Presidents. Dr. Knapp is a former council member of the IAEE and reviewer for the organization's *Energy Journal* . Dr. Knapp holds the IAEE 2007 Award for Excellence in Written Journalism.

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Oil Markets in Transition: Where Are We and What's Next?

Outline

- **Part 1: The Volume Side of the Story**
  - Saudi Arabia has been for years -- and will continue to be -- at the center of the oil market
  - Several myths about the causes of the "Shale Revolution" need to be overturned
  - There are distinct differences between short-term and longer term oil market rebalancing
  - If the market and Opec is the short-term answer, Saudi Arabia is the answer to the longer term
  - Is current thinking within the Kingdom is evolving to reflect an altered view of the longer term?
- **Part 2: The Ultimate Barometer, Oil Prices**
  - What does all this mean for prices?
  - Why the wide range between bulls and bears?
  - Market outlooks differ mostly on supply, Opec behavior and most recently, decoding Trump
  - A look at aggregate supply demand balances, a peak at some details, and some more details
- **Part 3: More Contrasts Between Short Term and Long Term Oil Market Dynamics**
  - What Comes Next; 2018-2020 Trump vs. Paris and Beyond
  - Oil Markets in an Environmentally Challenged World

Part 1

The Volume Side of the Story

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Oil Markets in Transition: Where Are We and What's Next?

It Used to be All About Saudi Arabia…Until US Shale Arrived

- **A "Willy Sutton" theory of oil markets:**
  - "because that's where they keep the oil;"
  - but Saudi Arabia is not a Central Bank of oil, never was, never will be;
  - In a sense, Saudi Arabia is "too big to succeed" so stays clear of financial side;
  - politically and economically Saudi Arabia is most comfortable with a passive role,
  - "let the market rebalance itself" is an exemplary response to the US shale revolution.
- **Dealing with longer term consequences of an oil market capital investment collapse in marginal oil supply areas raises three questions:**
  - can Saudi Arabia be counted on to fill any future supply gaps? Are they sufficiently motivated?
  - what is the Paris Cop 21 "**green swan**" doing to future demand for Saudi and other Opec oil?
  - how much of the supply expansion burden can be assumed by others -- Iran, Iraq, UAE, Kuwait, Libya, returning US shale, rising of non-US shale? Why US shale can't be the "Swing Producer."
- **What is Opec's role in the post-shale-revolution oil world? Saudi Arabia's role in Opec? Russia's and other non-Opec producers' role in coordinating with Opec?**
  - Opec has added four members in the last five years (three returnees), are they staying are more coming? Can and will IEA add non-OECD members? What about geopolitics, energy security?
  - Can Opec, non-Opec cooperation ever work? What about Opec-IEA cooperation?
  - And what does the Trump Presidency mean for all this? – stay tuned

The US Shale Revolution" Was Not Driven by Market Dynamics

- The Shale Era is more about how geologists think about their job than about the tools and information they have. A good geologist is no longer just the guy who is best at figuring out where the oil stopped, where it stated now matters.
- Source rock as a target -- rather than an academic afterthought -- brought about the US shale surge; not oil prices, not "new" technology, not any "new" discoveries.
- The oil world is now confronted with a new**,** huge**,** producible resource base and has so far been able to produce it economically at supposedly lethal prices and costs.
- The birth of the Shale Era changed oil market rules and roles in place for ½ a century.
- So far the shale revolution is dominated by the US, because of unique individual property rights, upstream experience, technology and equipment. Places like Argentina, Canada, China, Russia and the Mideast/North Africa are far behind the US.
- Saudi Arabia was unable to ignore the existence of this new new resource base, so it rightly chose to change the economics.

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Supply-Demand Roughly Rebalanced If Opec Agreement Holds

2016 Quarterly Oil Market Balances

(million b/d)	Q1	Q2	Q3	Q4f	2016f	Chg. vs. 2015
Demand	**95.63**	**96.34**	**97.15**	**97.61**	**96.69**	***+1.41***
OECD	46.68	45.97	47.10	47.27	46.76	*+0.52*
Non-OECD	48.94	50.37	50.05	50.34	49.93	*+0.89*
Supply	**97.48**	**96.84**	**97.93**	**100.16**	**98.11**	***+1.21***
Non-Opec	57.83	57.15	57.63	59.42	58.01	*+0.01*
Opec NGLs & Other	6.71	6.72	6.82	6.89	6.79	*+0.10*
Call on Opec Crude	**31.08**	**32.47**	**32.70**	**31.30**	**31.98**	***+1.39***
Opec Crude	32.94	32.97	33.48	33.85	33.31	*+1.10*
Implied Stock Chg.	**+1.86**	**+0.50**	**+0.78**	**+2.55**	**+1.42**	

f=forecast. Source: Based on EI, Oil Market Intelligence, *November 2016.*

2017 Quarterly Oil Market Balances

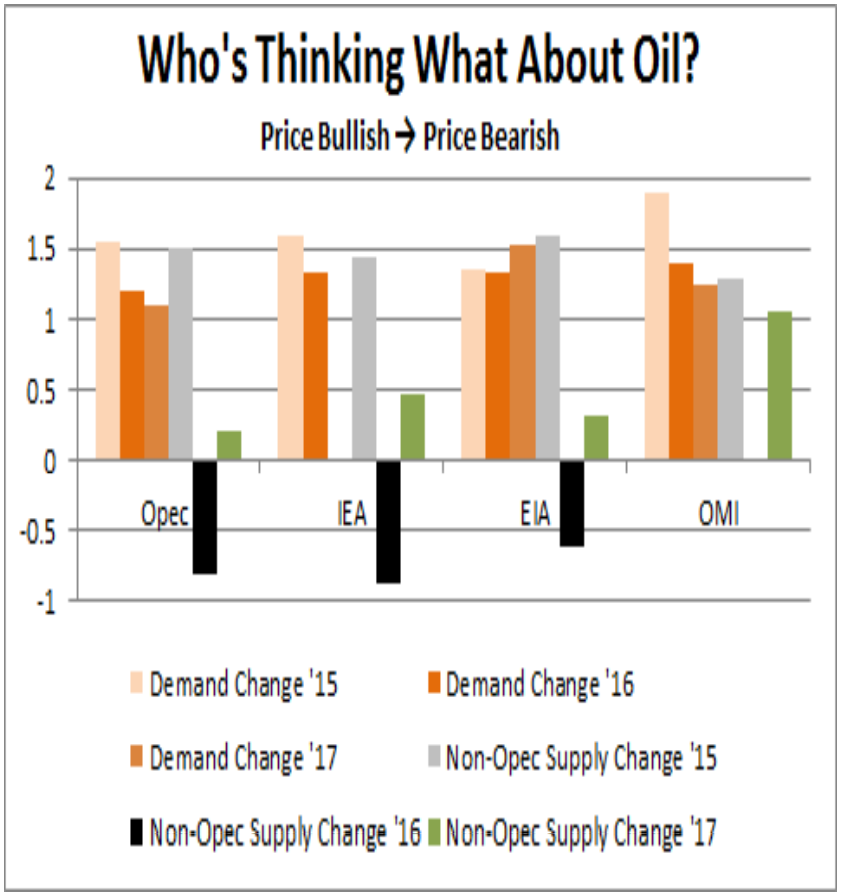
(million b/d)	Q1	Q2	Q3	Q4	2017	Chg. vs. 2016
Demand	**97.45**	**97.72**	**98.16**	**98.37**	**97.93**	***+1.24***
OECD	47.48	46.32	47.04	47.04	46.97	*+0.21*
Non-OECD	49.97	51.40	51.12	51.34	50.96	*+1.04*
Supply	**98.28**	**97.42**	**97.87**	**99.82**	**98.35**	***+0.24***
Non-Opec	58.87	58.38	58.82	60.17	59.06	*+1.05*
Opec NGLs & Other	6.90	6.88	6.97	7.06	6.95	*+0.17*
Call on Opec Crude	**31.68**	**32.46**	**32.37**	**31.14**	**32.00**	***+0.02***
Opec Crude	32.51	32.17	32.08	32.59	32.34	*-0.98*
Implied Stock Chg.	**+0.83**	**-0.30**	**-0.29**	**+1.44**	**+0.42**	

Source: Based on EI, Oil Market Intelligence, *November 2016. Adjusted for Opec Agreement.*

- Absent significant economic events, 2[50.37]**demand growth is slightly slower at 1.24 million b/d** with **non-Opec supply up 1.05 million b/d** vs. **2016 growth** of 1.41 million b/d demand rise and a nearly flat 10,000 b/d non-Opec gain, respectively.
- **Opec NGL & Other** production rise to **170,000 b/d** versus 2016's **100,000 b/d**. But **Opec crude drops 980,000 b/d,** after a **1.1 million b/d** expected **rise** this year**.**
- A key assumption is that Opec **financial pressures** from low oil price, on balance of payments, and government budgets, **don't spawn production-inhibiting upheavals**.
- **Iraqi growth,** depending mostly on KRG, a sputtering **Libyan recovery,** returning **Neutral Zone** and post-sanctions **Iran increases** threaten Opec's Nov. 30 agreement.
- Demand responses will again be depressed by currency movements in favor of the dollar and further devolution of **subsidies.** Supply responses depend on gov't **fiscal policies** and financial health of producing companies, plus related asset transfers.

A Wide Range of Opinions on Volumes Keep Markets Unsure

- Price outlooks already differed based on differing views the state of rebalancing.
- But prices and balances are interactive.
- Higher prices, in anticipation of rebalancing, can be self-defeating given the agility and steep learning curve for US shale production.
- Three of the four forecasting group saw non-Opec declines for this year.
- But with recent higher prices, persistence of US shale and some large one-off non-Opec additions.
- Notably among them are Kazakhstan's infamous Kashagan Caspian offshore field, the UK's Schiehallion and several Brazilian pre-salt fields, plus some deepwater US Gulf of Mexico fields and Canadian incremental I
- And now Opec's deal adds new uncertainties on compliance and Saudi willingness to compensate for Opec/other non-compliance.



Sources: Energy Intelligence, Oil Market Intelligence, *Nov.15'16; International Energy Agency,* Oil Market Report, *Nov.10'16; Opec* Monthly Oil Market Report, *Nov.11'16; US Energy Information Administration,* Short Term Energy Outlook, *Nov.8'16.*

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US Shale is Not the Only, or even the Major, Supply in Play

Oil Supply Changes for Top Non-Opec Crude Producers 2014-17								
					Changes			
'000 b/d	2014	2015	2016	2017	2014	2015	2016	2017
US	13,259	14,137	13,774	13,999	1,780	878	**-363**	225
Russia	11,322	11,517	11,879	11,949	188	196	362	70
China	4,206	4,290	3,986	3,603	-8	84	**-304**	**-383**
Canada	4,228	4,310	4,359	4,707	246	82	50	**347**
Brazil	2,896	3,109	3,218	3,437	259	213	109	219
Mexico	2,801	2,599	2,480	2,286	-91	**-202**	**-119**	**-194**
Norway	1,892	1,945	1,987	1,999	54	53	41	13
Kazakhstan	1,623	1,596	1,587	1,878	-19	-27	-10	**291**
UK	935	1,049	1,126	1,313	16	114	77	187
Oman	965	1,008	1,026	1,039	8	43	18	13
Colombia	989	1,007	952	923	-6	19	-55	-29
Azerbaijan	866	864	879	913	-26	-2	15	35
Malaysia	731	800	859	882	23	69	59	23
Egypt	672	688	694	688	2	16	6	-6
Argentina	563	551	522	540	-22	-12	-30	19
Other	6,359	6,208	6,233	6,371	13	-151	25	137
Total RPG	2,413	2,324	2,449	2,534	110	-89	124	85
Total Non-Opec	**56,721**	**58,004**	**58,008**	**59,061**	**2,528**	**1,283**	**4**	**1,053**
Source: Based on EI, Oil Market Intelligence, November 2016.								
Top 15 non-Opec share	*88.3%*	*88.9%*	*88.8%*	*88.7%*				

- **Russia's** surprise 2015 increase, was supposed to set the stage for a 2016 decline, but things went the other way. **China's drop** is real led by Daqing's "final reckoning."
- Excluding China and the US, **only four** of the other top 15 non-Opec producers are seen declining in 2016, mostly unrelated to price, same as 2015, two less than 2014.
- **Non-Opec growth** has been **dominated by the US** -- 70% of 2014 and still 64% of 2015**;** but growth swings from an **878,000 b/d gain** to a 2016 **363,000 b/d drop.**

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Oil Markets in Transition: Where Are We and What's Next?

US Light, Tight Oil Surge Has Changed US and Global Oil Markets

The US shale liquids are dominated by North Dakota and Texas, Now US Gulf of Mexico is kicking in with a post-Macondo surge, despite lower prices.

2017 Quarterly Non-Opec Oil Supply Details

(million b/d)	Q1	Q2	Q3	Q4	2017	Chg. vs. 2016	2016	2016 Growth	2015 Growth
North America	**21.13**	**20.65**	**20.84**	**21.37**	**21.00**	***+0.380***	**20.62**	***+1.93***	***+1.54***
US	13.97	13.92	13.90	14.20	14.00	*+0.225*	13.77	*+1.78*	*+1.30*
Canada	4.82	4.47	4.66	4.88	4.71	*+0.347*	4.36	*+0.25*	*+0.27*
Mexico	2.34	2.25	2.27	2.28	2.29	*-0.194*	2.48	*-0.09*	*-0.03*
FSU	**15.13**	**14.97**	**14.96**	**15.37**	**15.11**	***+0.381***	14.73	***+0.15***	***+0.26***
Russia	11.99	11.89	11.83	12.09	11.95	*+0.070*	11.88	*+0.19*	*+0.17*
Kazakhstan	1.86	1.82	1.83	2.00	1.88	*+0.291*	1.59	*-0.02*	*+0.06*
Other	1.28	1.27	1.30	1.28	1.28	*+0.020*	1.26	*-0.02*	*+0.04*
South America	**4.78**	**5.21**	**5.56**	**5.63**	**5.29**	***+0.208***	**5.09**	*+0.24*	*+0.05*
Brazil	2.99	3.43	3.66	3.66	3.44	*+0.219*	3.22	*+0.26*	*+0.03*
Colombia	0.89	0.88	0.95	0.97	0.92	*-0.029*	0.95	*-0.01*	*+0.05*
Other	0.90	0.90	0.94	0.99	0.93	*+0.018*	0.92	*-0.01*	*-0.02*
Africa	**2.13**	**2.19**	**2.22**	**2.31**	**2.21**	***+0.046***	2.17	*+0.07*	*+0.10*
South Sudan	0.20	0.26	0.30	0.34	0.27	*+0.083*	0.19	*+0.05*	*+0.09*
Equatorial Guinea	0.38	0.39	0.39	0.40	0.39	*+0.001*	0.39	*+0.03*	*+0.02*
Ghana	0.14	0.13	0.11	0.16	0.13	*+0.006*	0.13	*+0.01*	*+0.02*
Egypt	0.69	0.69	0.69	0.69	0.69	*-0.006*	0.69	*+0.00*	*-0.00*
Other Africa	0.74	0.72	0.73	0.72	0.72	*-0.040*	0.76	*-0.02*	*-0.03*
North Sea	**3.57**	**3.42**	**3.28**	**3.51**	**3.44**	***+0.187***	**3.26**	***+0.05***	***-0.21***
Norway	2.11	1.97	1.85	2.07	2.00	*+0.013*	1.99	*+0.05*	*-0.08*
UK	1.31	1.29	1.28	1.28	1.29	*+0.185*	1.11	*+0.02*	*-0.10*
Other	0.15	0.16	0.15	0.16	0.15	*-0.011*	0.17	*-0.02*	*-0.03*
Asia	**7.03**	**6.84**	**6.85**	**6.84**	**6.89**	***-0.347***	**7.24**	***-0.01***	***+0.02***
China	3.76	3.58	3.56	3.51	3.60	*-0.383*	3.99	*-0.01*	*+1.76*
Australia	0.53	0.53	0.57	0.59	0.56	*+0.064*	0.49	*+0.01*	*0.00*
Other Asia	2.75	2.72	2.71	2.75	2.73	*-0.028*	2.76	*+0.02*	*+0.01*
Other Non-Opec	**12.12**	**11.94**	**11.97**	**11.98**	**12.00**	**-0.147**	**12.15**	***+0.08***	***+0.08***
Total Non-Opec	**58.87**	**58.38**	**58.82**	**60.17**	**59.06**	***+1.053***	**58.01**	***+2.53***	***0.00***

Source: Based on EI, Oil Market Intelligence, November 2016, assuming no meaningful non-Opec cooperative cuts.

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How Shale Changed the Oil MarkeOil Markets in Transition:

Opec Country Level Crude Production Details 2016-17

2016 Quarterly Opec Crude Oil Supply Details

(million b/d)	Q1	Q2	Q3	Q4	2016	Chg. vs. 2015
Opec Crude	**32.94**	**32.97**	**33.48**	**33.85**	**33.31**	***+1.10***
Iraq	4.34	4.29	4.44	4.58	4.41	+0.38
Nigeria	1.64	1.39	1.16	1.44	1.40	-0.32
Ecuador	0.55	0.55	0.55	0.54	0.55	+0.01
Neutral Zone	0.00	0.00	0.00	0.03	0.01	-0.06
Venezuela	1.98	1.98	1.96	1.91	1.95	-0.11
Iran	3.22	3.57	3.68	3.78	3.56	+0.76
Angola	1.80	1.77	1.80	1.84	1.80	-0.01
Algeria	1.06	1.06	1.05	1.04	1.06	-0.07
Indonesia	0.80	0.80	0.81	0.80	0.80	+0.05
Gabon	0.27	0.23	0.23	0.23	0.24	+0.00
Qatar	0.68	0.65	0.64	0.63	0.65	-0.01
Libya	0.42	0.34	0.36	0.57	0.42	+0.01
Kuwait	3.00	2.93	2.97	3.00	2.98	+0.15
UAE	2.94	3.05	3.17	2.96	3.03	+0.04
Saudi Arabia	10.22	10.36	10.65	10.50	10.43	+0.28
Opec Other Liquids	**6.71**	**6.72**	**6.82**	**6.89**	**6.79**	***+0.10***
Total Opec	**39.65**	**39.69**	**40.30**	**40.75**	**40.10**	***+1.20***

Source: Based on EI, Oil Market Intelligence, November 2016.

2017 Quarterly Opec Crude Oil Supply Details

(million b/d)	Q1	Q2	Q3	Q4	2017	Chg. vs. 2016
Opec Crude	**32.51**	**32.17**	**32.08**	**32.59**	**32.34**	***-0.98***
Iran	3.80	3.80	3.80	3.80	3.80	+0.23
Neutral Zone	0.25	0.25	0.25	0.25	0.25	+0.24
Iraq	4.35	4.35	4.35	4.35	4.35	-0.06
Saudi Arabia	9.93	9.93	9.93	9.93	9.93	-0.50
Kuwait	2.58	2.58	2.58	2.58	2.58	-0.39
UAE	2.87	2.87	2.87	2.87	2.87	-0.16
Qatar	0.62	0.62	0.62	0.62	0.62	-0.03
Angola	1.51	1.51	1.51	1.51	1.51	-0.30
Indonesia	0.81	0.77	0.78	0.77	0.78	-0.02
Gabon	0.19	0.19	0.19	0.19	0.19	-0.05
Libya	0.45	0.39	0.52	0.76	0.53	+0.11
Angola	1.51	1.51	1.51	1.51	1.51	-0.30
Ecuador	0.52	0.52	0.52	0.52	0.52	-0.03
Venezuela	1.97	1.97	1.97	1.97	1.97	+0.02
Nigeria	1.62	1.37	1.14	1.42	1.39	-0.02
Algeria	1.04	1.04	1.04	1.04	1.04	-0.02
Opec Other Liquids	**6.90**	**6.88**	**6.97**	**7.06**	**6.95**	***+0.17***
Total Opec	**39.41**	**39.04**	**39.05**	**39.64**	**39.29**	***-0.81***

Source: Based on EI, Oil Market Intelligence, November 2016.

- 2016 Nigeria and Venezuela both down, further by 320,000 b/d and 110,000 b/d respectively.
- Iran and Iraq lead rise by 1.14 million b/d combined in 2016, with sanctions relief for Iran from mid-Jan; active marketing into Asia and Europe, but still payments constraints. Iraq saw higher Basra field expansions, supplemented by more KRG: when companies got paid, and pipelines unbombed.
- Saudis up 280,000 b/d, at all-time high (10.65 million b/d) in Q3, is this a sign of the future?
- Exempted Nigeria is seen down in 2017, but Iran and Libya up 230,000 b/d and 110,000 b/d.
- Neutral Zone return expected to add 240,000 b/d that may or may not come out of Saudi and Kuwait
- Saudi down 500,000 b/d, or about half the expected Opec cut, perhaps strategizing for 2018's Aramco IPO?

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❑ No Oil Market is an Island

- The advent of paper markets brings with it asset allocation influences
- Physical market interactions have also become more intense
- Oil also lives in a world of inter-fuel and inter-factor competition
- Headline driven oil price movements are increasingly financial
- But classic geopolitics still can paly a supporting (or depressing) role
- One great irony of the current oil market is Middle East geopolitics being more threatening than ever while oil production makes records

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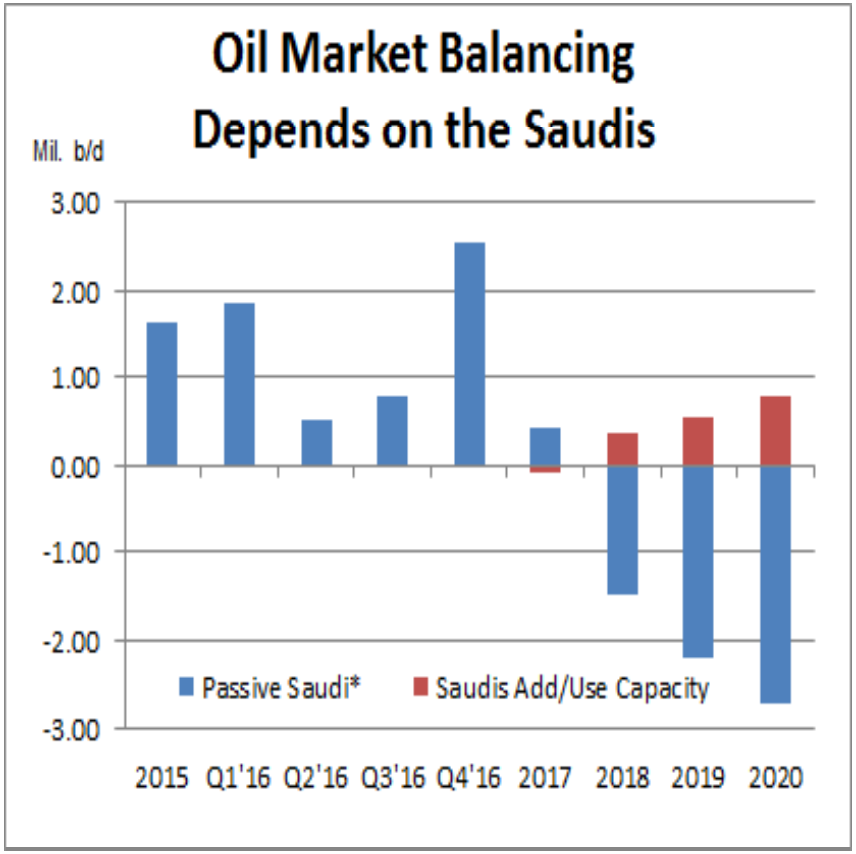
Saudi Play Leading Roll in the Coming Oil Market Drama

- Saudis can use up current spare capacity in 2017-18, but then either add capacity, or produce faster.
- Some capacity may be added in 2018, but existing giant fields could also be used more aggressively.
- Incremental capacity can be added to tap new zones in some older fields -- Berri, Qatif and Abu Sa'fa.
- By 2020 capacity would have to be expanded to around 15 million b/d to keep markets near balance given an accelerating non-Opec slide.
- If maximum efficient rate (MER) to protect ultimate recovery is tossed out, operating volumes can be raised by adding above ground equipment.



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Current Supply-Demand Response Only Half the Story

Medium-Term Oil Market Balances (Passive Saudi Arabia)								
(million b/d)	2014	2015	2016	2017	2018	2019	2020	Yrly Chg.*
Demand	**93.45**	**95.28**	**96.69**	**97.93**	**98.72**	**99.52**	**100.20**	***+1.64***
OECD	45.81	46.24	46.76	46.97	46.48	46.00	45.49	*-0.25*
Non-OECD	47.64	49.04	49.93	50.96	52.23	53.52	54.71	*+1.89*
Supply	**94.14**	**96.90**	**98.11**	**98.35**	**97.24**	**97.31**	**97.49**	***+0.20***
Non-Opec	56.72	58.00	58.01	59.06	56.78	55.81	54.59	*-1.14*
Opec Non-Crude	6.56	6.69	6.79	6.95	7.13	7.33	7.46	*+0.26*
Opec Crude	30.86	32.21	33.31	32.34	33.33	34.18	35.45	*+1.08*
Implied Stock Chg.	**0.69**	**1.62**	**1.42**	**0.42**	**-1.48**	**-2.21**	**-2.71**	
**Average 2015-20. Source: Based on EI, Oil Market Intelligence, November 2016*								

- For us, Saudi/Opec's strategy has always had a **longer-term** component: to assure **oil's role into the next decade and beyond**, likely with accelerated Saudi production rates.
- Arguably the bigger "success" for the **market share strategy** is the delays and cancellations of the next tranche of **competing non-Opec** oil from **deepwater** and, to a lesser extent the **Arctic, not** the immediate reversal of **US shale** area growth.
- A small **surplus** from 2014 more than doubled in 2015 and fell only modestly **this year**, but if Opec's deal holds together that could drop to 420,000 b/d next year**.**
- Given current trends of non-Opec project cancellations, assuming Saudi capacity stays flat, and even with more from **Iran, Iraq and Libya** balances turn negative for 2018-20.
- However, **Saudis can push harder on existing fields,** or **higher prices** appear by the end 2020, something not in Saudi (new) longer term interest.

What are the Risks to the "New" Saudi Arabian Leadership

- Deputy Crown Prince Mohammed bin Salman and Crown Prince Mohammed bin Naif look like a very thin coalition in a largely conservative 7,000 member Saudi royal family.
- But a mantle of legitimacy was bestowed on Mohammed bin Salman after a weeklong session with ailing King Abdullah; making him the "vessel of change" for the kingdom.
- And these changes are profound -- economically, socially and politically. Much of the royal family are reported to be nervous, if not outright angry, as are the Wahhabis.
- So far the relationship between bin Naif and bin Salman has been fully functional, but the first tactic by disaffected other princes could be to drive a wedge between them. It is now the relationship between President Trump and Saudi Arabia that is in play.
- So is yet another episode of the oft-played the "Fall of the House of Saud" upon us?
  - As the guy who has been on the other side of the table saying, "Do not underestimate the ability of this highly pragmatic family in this culture and the part of the world to find a way to survive,"
  - I am still on that side of the table, but frankly I have never been more uncertain and nervous.
- What we do know however, is that whomever sits in the chair will be sitting on possibly the largest potential stranded asset in the history of the planet, unless the oil can be converted, relatively promptly, into other productive physical and/or financial assets.

Part 2

Oil Prices: Uneven Path More Uneven Outlook

How and Why Did The 2014-16/17 Price Collapse Happen?

- The prime cause of the oil price collapse was **NOT** Opec's decision in November, 2014 to follow a low price/market share strategy.
- The price decline started in late June, 2014 as a result of the impact of US light oil production on Atlantic Basin balances.
- Opec decision merely spread the global surplus to Asia and from light oil to medium - our oil that dominate the Mideast-to-Asia oil trade.
- The size of the surplus and the resultant inventory overhang have effectively removed geopolitical concerns from the oil price equation.
- Demand side responses to low prices were muted by currency movements, reduced subsidies and high taxes
- Supply side responses were overwhelmed by ongoing cost reduction for US shale and forward momentum of projects elsewhere well advanced in the development process.

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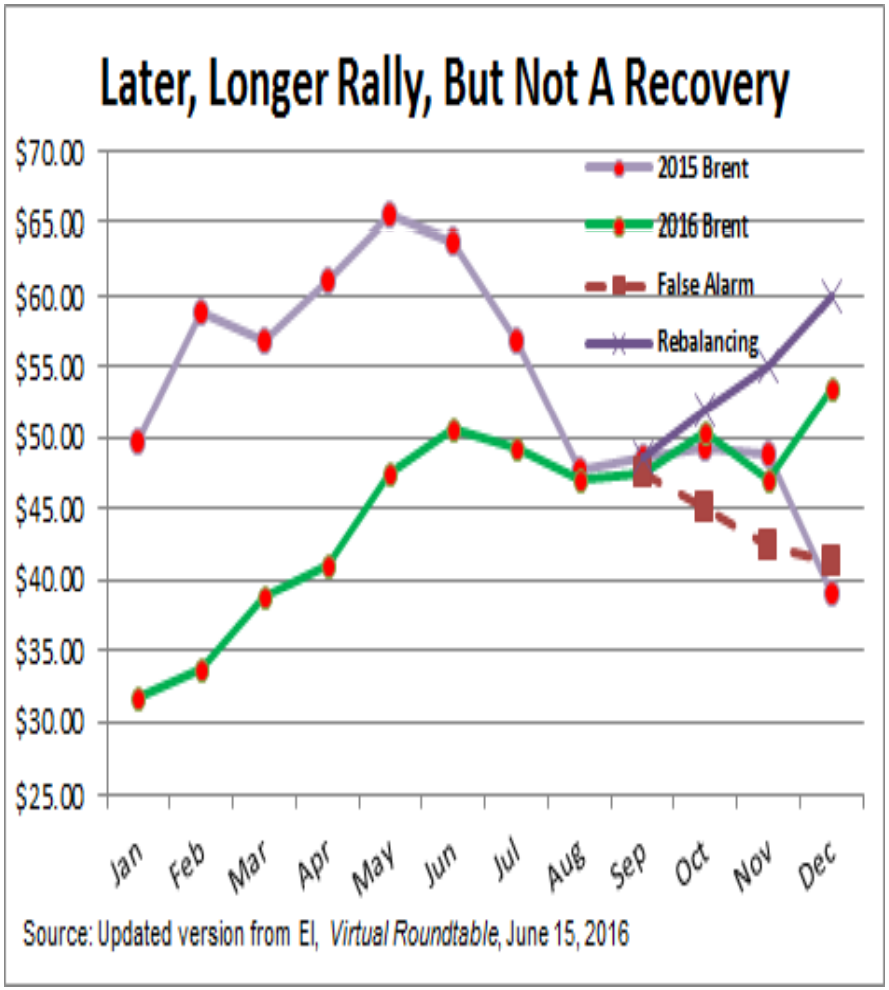
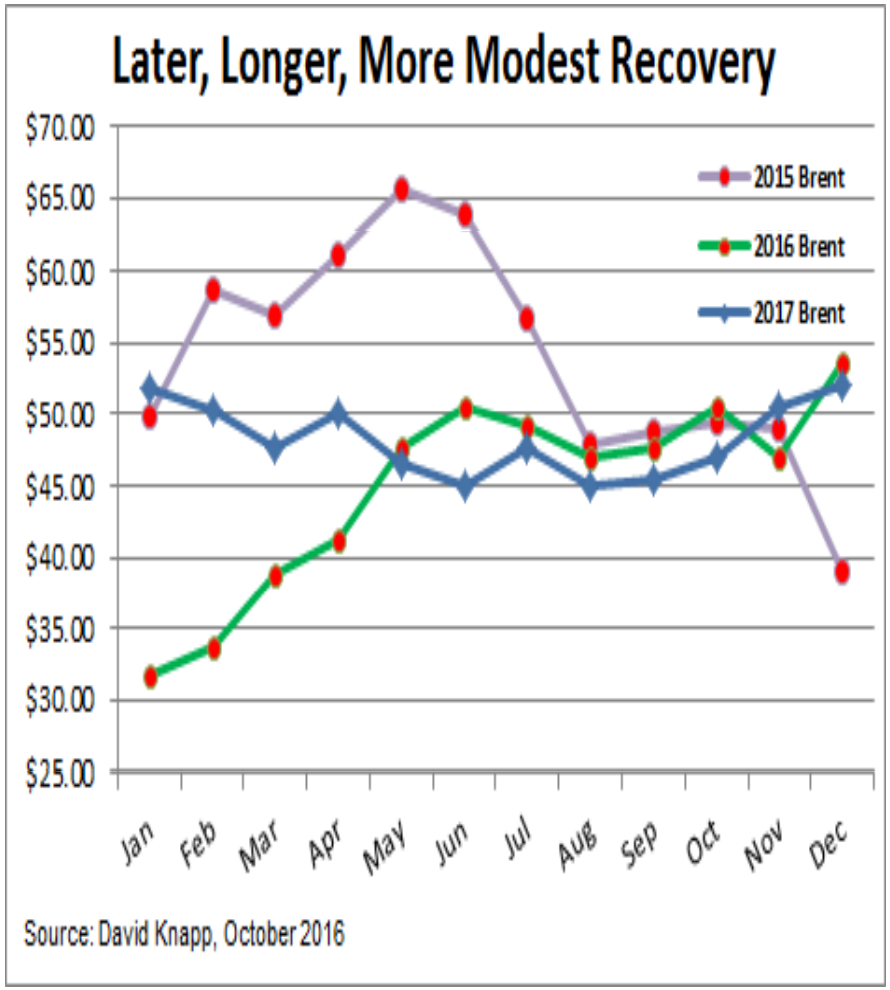
Oil Markets in Transition: Where Are We and What's Next?

Stark Differences in Price Outlooks: Bears vs. Bulls





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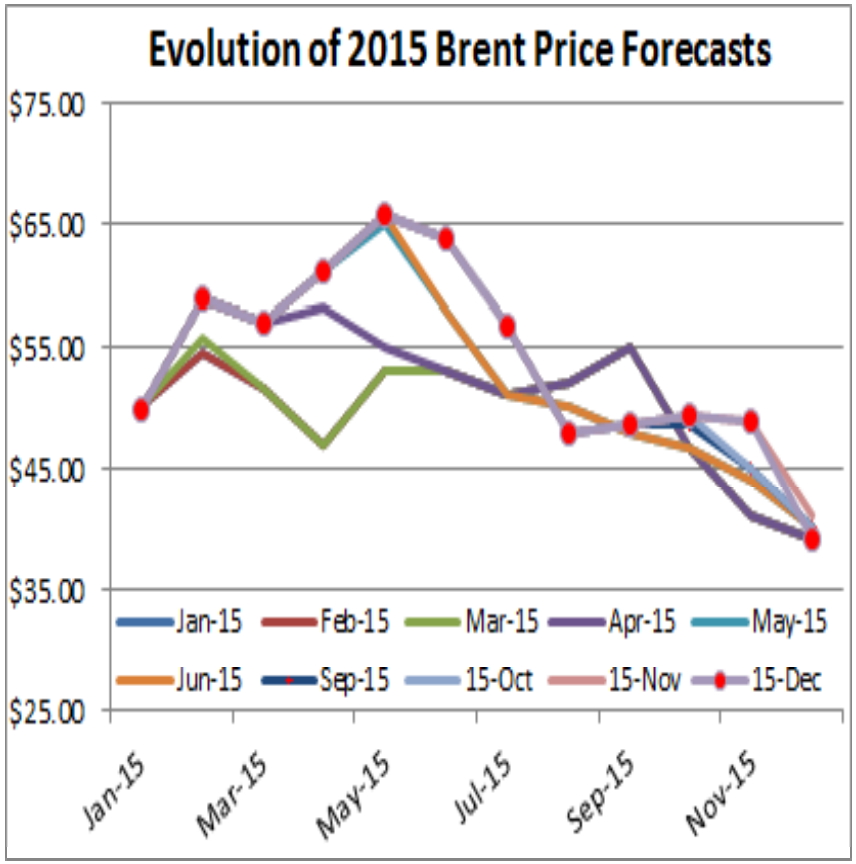
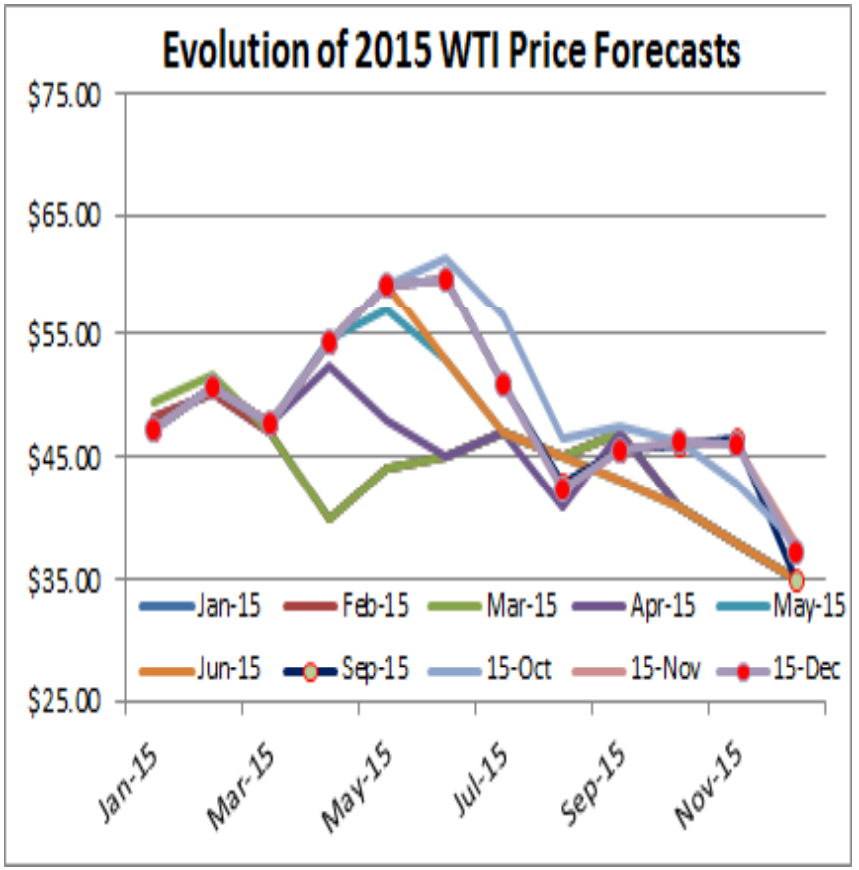
Is Successful 2015 Price Forecast Affecting 2016 Strategy





Source: Jan.'15 - New York Energy Forum, "2015 Oil Market Outlook"; Feb.'15 - CSIS, "Energy Market Impacts of Low Oil Prices"; Mar'15 - Saudi Aramco Energy Week, "Global Oil Markets in a New Lower Oil Price 'Shale Era'"; Apri'15 - CERI World Oil Conference, "Energy Market Impacts of Low Oil Prices"; May'15 - client presentations in London, Paris and Madrid, "Energy Market Impacts of Low Oil Prices"; Jun'15 - client presentations in Houston, "Shale Era Challenges Oil Market Traditional Structures"; Sep'15 - client presentations in Europe. Nov-Dec'15 Houston clients, China International Oil & Gas Trade Congress, Tokyo client presentations,

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Oil Markets in Transition: Where Are We and What's Next?

Oil Prices 2014-17 -- One Man's View (subject to major changes without notice)

- **Since the fundamentals continue to be choppy, next year due to inventories** rather than on and off optimism about S&D.
- **Much of the work was already done on prices during 2nd half of 2014 and 2015**, in 2016 and 2017 fundamentals catch up.
- **Brent should be more volatile than WTI,** since it is more global and geopolitics have a bigger Brent effect. WTI is more about improving US shale supply logistics.
- **Last year's** Jan-Feb, Q2 and Q3 prices **bumps**, were **based the on financial side positioning and expectations**, ultimately merely delaying the supply adjustment process with hedge and re-hedging.
- **This year** has already seen more of the same, this time was about a **low-probability production cut** that may now be happening.

Updated Outlook for 2016-17 Benchmark Crude Oil Prices

	ICE Brent Front Month				WTI Front Month			
Month	2014	2015	2016	2017	2014	2015	2016	2017
Jan	$108.12	$47.71	$31.75	$51.95	$94.86	$47.33	$31.58	$50.45
Feb	$108.91	$58.10	$33.64	$50.25	$100.68	$50.72	$30.62	$49.00
Mar	$107.48	$55.89	$38.90	$47.75	$100.51	$47.85	$36.55	$47.00
Apr	$107.66	$59.64	$41.14	$50.00	$102.03	$54.38	$39.02	$49.00
May	$109.52	$64.06	$47.58	$46.50	$101.85	$59.37	$46.80	$46.00
Jun	$111.80	$61.47	$50.54	$45.00	$105.11	$59.83	$49.51	$44.00
Jul	$106.86	$56.55	$47.62	$47.75	$102.39	$50.93	$45.79	$46.00
Aug	$101.61	$46.51	$46.99	$45.00	$96.08	$42.89	$44.80	$43.00
Sep	$97.34	$47.61	$47.60	$45.50	$93.03	$45.47	$45.24	$44.00
Oct	$87.46	$48.42	$50.48	$47.00	$84.34	$46.29	$48.81	$45.00
Nov	$79.00	$48.93	$47.04	$50.50	$75.81	$45.97	$45.76	$48.00
Dec	$62.33	$39.07	$53.57	$52.00	$59.29	$37.33	$51.37	$50.00
Avg.	*$99.01*	*$52.83*	*$44.74*	*$48.27*	*$93.00*	*$49.03*	*$42.99*	*$46.79*

Part month; forecast. Source: David Knapp, December, 2016.

Part 3

What Comes Next?

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Oil Markets in Transition: Where Are We and What's Next?

❑ The Middle East: The Oil Market's Next Main Actors

- Non-Opec investment has declined by between $800 billion-$1.5 trillion.
- The differences in global balances will likely show up in 2018-2020.
- The Mideast Gulf is the obvious willing candidate to fill the global gap:

  higher oil prices favor other fuels over oil, lower prices preserve a market for oil,

  higher prices accelerate consuming gov't anti-oil measure, lower prices don't;

  higher oil and other energy prices lower energy's share vs. capital labor and materials.
- Saudi Arabia and its neighbors have a need, to convert large volumes of oil resource into other productive assets, while oil market is viable.
- Geopolitical risk in the Middle East has never been higher, but neither has its oil production.

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Oil Markets in Transition: Where Are We and What's Next?

❑ Saudi Arabia: The Star of the Late-Decade Oil Market Drama

- If Saudi Arabia ignores maximum efficient rate (MER) assessments it can produce enough from existing fields to meet the market needs.
- The demand for Saudi oil will depend on demand growth (moderate), non-Opec supply declines (large) and production of other Opec (mixed),
- Non-Gulf Opec members are expected to be of limited relevance,
  - possible increases from Libya, Nigeria, Ecuador and Angola
  - big losses from Venezuela, slow declines for Algeria, Indonesia, and Gabon
- Non-Saudi Gulf Opec members are expected to grow for the same reason the Saudis are pushing, except for Qatar's gas shift and old oil.
- Iraq and Iran will lead the way, but with help from UAE and Kuwait (outside of Burgan, on return of and possible expanding Neutral Zone).

❑ How would Saudi Arabia Bridge a Possible Late-Decade Gap

- Saudi expansion will likely first involve pushing harder on Ghawar;
- Accelerating additional onshore development at Khurais and Shaybah;
- Offshore giants Safaniyah and Manifa have much more to give, albeit not very pretty oil
- Refining capacity has been upgraded to handle lower quality crude -- more capacity could be coming.
- Natural gas development (hopefully from possibly prolific shale gas areas) could be stressed for domestic substitution to maintain or increase exportable surplus.

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Oil Markets in Transition: Where Are We and What's Next?

❑ US Shale: Still an Important Agent of Change for Oil Markets

- Trump is good for US shale, so is the price reaction to Opec's cut deal.
- US oil shale area output 2007-15 surge reversed a multi-decade decline.
- Eagle Ford and Bakken core areas dominated the initial shale phase.
- More vertically diverse Permian, horizontally widespread Niobrara and "gassier" Marcellus/Utica getting attention as Eagle Ford and Bakken slip.
- High-grading kept up momentum in "sweet spots" at expense of future performance of main shales' marginal areas and secondary shales.
- Financial factors will determine who stays and who goes in the shale parch; break-even costs matter less than debt-equity ratios, debt service costs, values of reserve collateral and bank regulatory rigor.
- Asset reallocation was a victim of "slower for longer" with sellers plentiful, with buyers scarce, but that has swung in the last few months.

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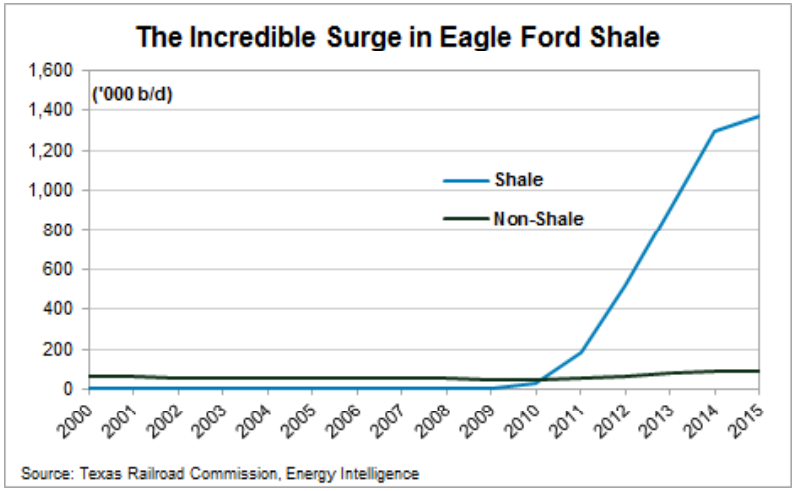
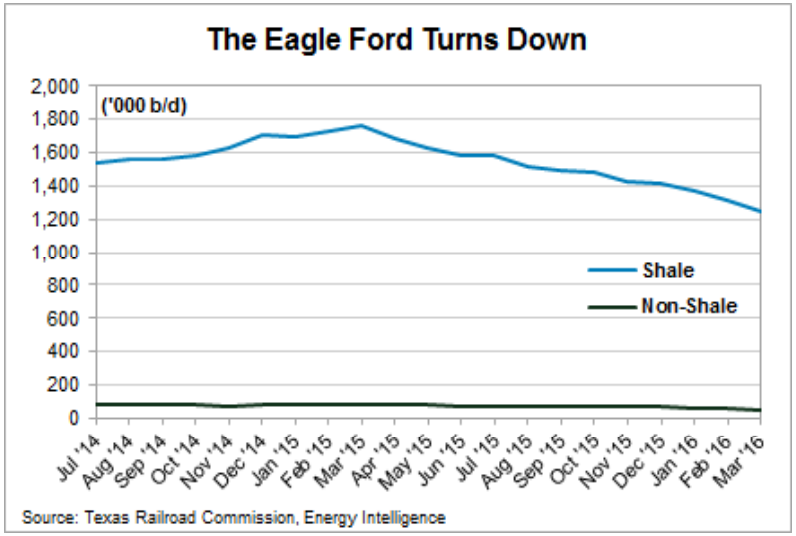
The Texas Eagle Ford the "True Shale Play"

Location and developed infrastructure give it an advantage over the Bakken

- Bakken is conventional oil in a shale environment, Permian is a mixed shale/non-shale play with the non-shale portion dominant.
- Shale zones account for most of the Eagle Ford area liquids under 24 counties in eastern and southern Texas, Twelve fields currently produce liquids often from under multiple countries. Output now exceeds 1.3 million b/d. Infrastructure is highly developed, the political environment strongly positive



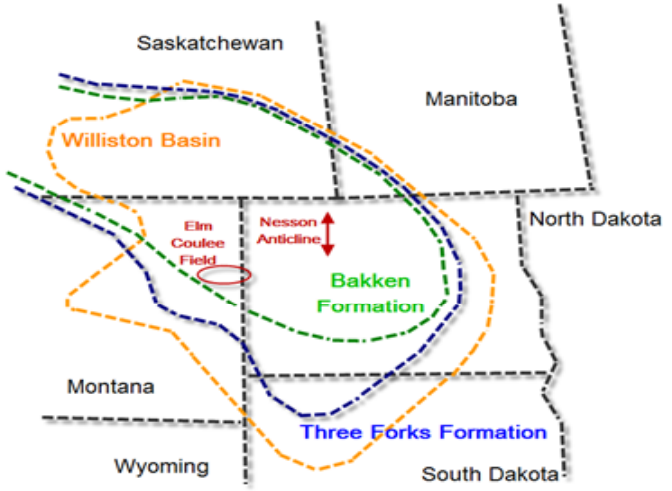
Stark Differences in Performance of Eagle Ford Shale vs. Other Zones							
	2015	5-Year Average		2014		2015	
	('000 b/d)	Shale	Other	Shale	Other	Shale	Other
Karnes Trough*	798	176.3%	19.2%	5.1%	21.9%	37.7%	36.6%
Southern Eagle Ford†	344	190.0%	8.6%	2.7%	4.5%	49.8%	20.7%
Maverick Basin‡	208	138.4%	8.3%	12.1%	-10.7%	41.5%	-15.0%
Northern Eagle Ford (10)	23	261.0%	11.8%	15.8%	-17.5%	178.5%	3.5%
Eagle Ford Total	**1,372**	**170.6%**	**12.2%**	**5.6%**	**-3.2%**	**42.3%**	**9.1%**
*Karnes, De Witt, Wilson, Lavaca, Gonzales, Atascosa, Live Oak, Bee.							
†La Salle, McMullen, Webb. ‡ Maverick, Frio, Dimmit, Zavala.							

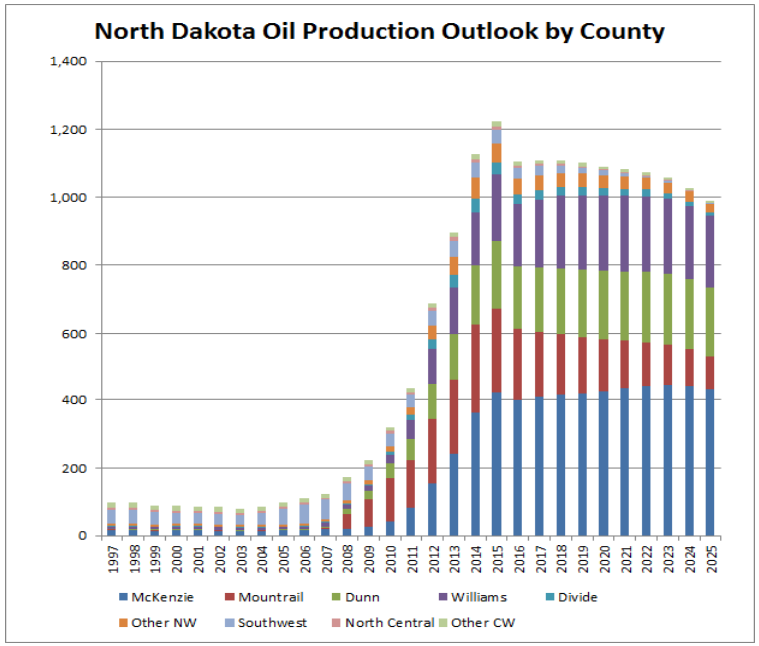


Understanding the Bakken "Shale" Oil Area

A Key US growth area

- Geographically, the Bakken area is a part of the larger Williston Basin extending into Montana and Saskatchewan containing a number of other productive sands but nothing close to the productivity of the Bakken/Three Forks.
- Bakken output, primarily using the same method as shale areas, is now 95% of state output
- With Bakken's remote location/short pipeline capacity, rail costs have become more important than production costs.
- With its harsh climate and small population as additional disadvantages the North Dakota Bakken remains on the front lines of price-induced production cuts.
- Producers are cutting spending but continue to exercise drilling options to hold leases but not completing some wells. Some already-completed wells are not hooked up yet for lack offtake space.
- Duc's (drilled uncompleted) wells could turn around production decline any time now.





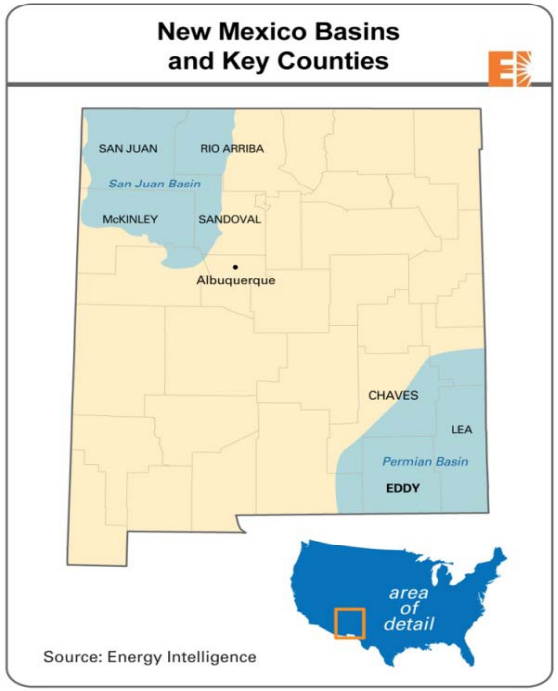
North Dakota Crude Oil Production Growth									
	2009	2010	2011	2012	2013	2014	2015	Q1'16	Q2'16
Bakken Area	83.0%	72.6%	49.7%	70.0%	25.3%	34.2%	5.6%	-5.5%	-9.3%
Non-Bakken	-15.4%	-9.5%	-10.4%	-1.7%	-0.5%	-0.6%	-8.6%	-12.0%	-12.3%

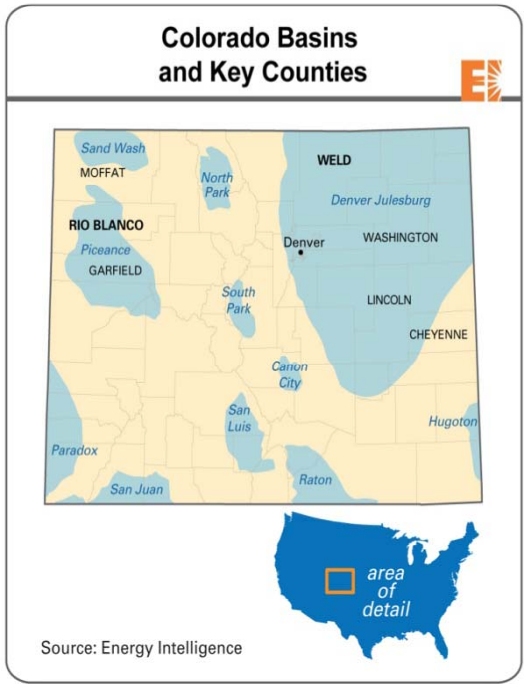
Source ND Department of Mineral Resources. Energy Intelligence calculations.

Three Other States Are or Could Contribute to Shale's Revolution

New Mexico and Colorado localized but significant gains, and Oklahoma lurking

- Virtually all of New Mexico's oil output comes from two counties, Lea and Eddy, with only small amounts from Chavez and county all n the southeast corner of the state**.** Northeast corner is a gas area.
- Five of Texas' Delaware Basin Permian sands cross the border into New Mexico and are being exploited by a number of small and medium sized companies.
- Water resources are an issue but the state is generally seen, like Texas and North Dakota, remains "development friendly." Shale growth dominates declines from non-shale areas.





- Colorado has a much larger number of basins, but only the Denver-Julesburg (DJ) in the northeast part of the state is a significant shale liquids area, primarily Niobrara shale in the Wattenberg field ..
- Colorado's other large conventional field Rangely in the Piceance Basin has been in decline for a number of years. The state is decidedly split and is a battleground on hydraulic fracturing.
- A number of D-J fields have potential to contribute and there are a couple of other untapped Niobrara basins like the North Park Basin in the north central part of the state and some of the western basins.

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Oil Markets for the Next Four Years Depend on Trump

- Like Brexit, the surprise Trump victory in the US presidential Election has added serious uncertainties;
  - How much of his campaign rhetoric will show up in Administration policy?
  - Who will be appointed to key positions in the administration?
  - How will the answers to these two questions affect US international relations?
  - When will all this be clearer?
- The reversal of US positions on Climate Change and a reworking of US-Mideast Gulf relations, Russia-US relations and US-Mexico relation have critical oil market implications.
- Geopolitical events involving Syria, Yemen, Ukraine and China all figure to test Trump and his administration's skills, if he takes a Reagan-like figurehead role?

Trump Administration and Oil Markets	
Oil Market Positives	**Oil Market Negatives**
US Shale Oil Support	Worsening Mideast Relations
Keystone XL	Anti-Opec, Anti-IEA Stance
Domestic Pipelines	Anti-Mexico Policy
Reduced Regulation	Nafta Unwinding
No Carbon Tax	Geopolitical Uncertainties
Republican Congress	Cop21 Resistance
Expanded Offshore Leasing	Obama Legacy Hangover
Opening Federal Lands	Bad Oil Trade Relations
Source: Oil Market Intelligence, November 2016	

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Thank You For Your Attention

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