Energy Supply and Prospects for the Future

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The National Economy
Underwhelming Growth
Average GDP growth during each expansion, at an annualized rate

- 1949–53: 7.6%
- 1954–57: 4.0
- 1958–60: 5.6
- 1961–69: 4.9
- 1970–73: 5.1
- 1975–80: 4.3
- 1980–81: 4.4
- 1982–90: 4.3
- 1991–01: 3.6
- 2001–07: 2.8
- 2009–16: 2.1
- 2Q 2016: 1.2

Note: Figures are adjusted for inflation and seasonality
Source: Commerce Department
### RGDP Forecasts (3/18)

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Wells F.</th>
<th>Consensus</th>
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<tbody>
<tr>
<td>17-I</td>
<td>1.2%</td>
<td>1.2%</td>
</tr>
<tr>
<td>17-II</td>
<td>3.1%</td>
<td>3.1%</td>
</tr>
<tr>
<td>17-III</td>
<td>3.3%</td>
<td>3.3%</td>
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<tr>
<td>17-IV</td>
<td>2.5%</td>
<td>2.5%</td>
</tr>
<tr>
<td>18-I</td>
<td>1.8%</td>
<td>2.4%</td>
</tr>
<tr>
<td>18-II</td>
<td>2.7%</td>
<td>3.1%</td>
</tr>
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<td>18-III</td>
<td>3.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>18-IV</td>
<td>2.9%</td>
<td>2.8%</td>
</tr>
<tr>
<td>19-I</td>
<td>2.8%</td>
<td>2.5%</td>
</tr>
<tr>
<td>19-II</td>
<td>2.9%</td>
<td>2.4%</td>
</tr>
<tr>
<td>19-III</td>
<td>2.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>19-IV</td>
<td>2.8%</td>
<td>2.1%</td>
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</table>
Two Key Policy Changes
= More Economic Growth
Fig. 1: Pages in the Federal Registry - 1960-2016

- 1981-88: Avg. = 54,335
- 2016: 95,894
  Highest in History
- Of 10 All-Time Highes:
  7 in Obama Administration
- Trump thru 9/17: 45,678

Source: www.llsdc.org/assets/sourcebook/fed-reg-pages.pdf
Trump Deregulation

10 days after taking office:
- Departments to scour the books for rules they could rescind or repeal w/o damaging the law
- Each new regulation issued, two have to be eliminated
Trump Deregulation

- Naomi Rao - Office of Administration & Regulatory Affairs
- Since Fall 2016:
  - 1,500 planned regulatory actions have been withdrawn or delayed
- 67 deregulatory actions
- Only 3 significant regulatory actions
Policy Change #2: Lower Tax Rates

• Increase in tax-home pay = more consumer spending
• Boost in business investment spending
  - Immediate expensing of capital costs until 2023---invest now
Policy Change #2: Lower Tax Rates

• Watch movements from Europe to US:
  - Germany & France now have significantly higher corporate tax rates, more onerous labor laws & an ageing population
  - There are a lot of chemical firms in these two countries who may be looking for a new home
It is not all good news:
The Anti-Free Trade Movement
The **Law** of Comparative Advantage

There are winners **and** losers

But on the **net**---gain
Louisiana Nondurable Goods Employment

1995-2009:
-31,800 Jobs (32%)
Fig. 2: Total Nonfarm Employment in Louisiana

1990-2000
+330,000 Jobs
(+21%)

Per Capita Income:
1900: $15,224
2000: $23,570
(+54.8%)
Import/Export Ratio

- Canada: 1.04
- Mexico: 1.28
- China: 4.00
Add tariffs: Guess what always happens?

RETALIATION!
Depression –
The Trade Implosion

Production & Jobs in Manufacturing Sector

Index, Jan 1979=100

Manufacturing Production: November @ 202.6
Manufacturing Employment: November @ 63.2
ExxonMobil: 1979 v 2016

• Refinery: 3,500 employees
  - 1,300 ExxonMobil
  - 2,200 Contractors

• Chemical Plant: 2,500 employees
  - 1,000 ExxonMobil
  - 1,400 Contractors
Wisdom

The location of your mailbox shows you how far away from your house you can be in a robe, before you start looking like a mental patient.
Wisdom

• Denny's has a slogan, 'If it's your birthday, the meal is on us.'
• If you're in Denny's and it's your birthday... Your life sucks!
Why Was Mayberry so Peaceful?

• Nobody was married!
• Andy, Aunt Bea, Barney, Floyd, Howard, Goober, Gomer, Sam, Earnest T. Bass, Helen, Thelma Lou, Clara, and of course, Opie -- all single.
• The only married person was Otis, and he stayed drunk.
Natural Gas Prices
Fig. 8: Price of Natural Gas

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
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<tbody>
<tr>
<td>Average</td>
<td>$2.99</td>
<td>$3.10</td>
<td>$3.20</td>
</tr>
<tr>
<td>Low Range</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>High Range</td>
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Per MMBTU
The Supply Side

There is an ocean of natural gas out there
There really was a “shale revolution”
Map of U.S. interstate and intrastate natural gas pipelines

Source: U.S. Energy Information Administration, About U.S. Natural Gas Pipelines
Daily Output Per Well
Haynesville @ 7,500 mcf/d in 2017
Natural Gas Demand

- Production 2016: 79.6 bcf/d
- Additional demand by 2020:*
  - Added Gas-fired power plants: 3.2 bcf/d
## Electrical Power by Source: 2016

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</thead>
<tbody>
<tr>
<td>Natural Gas:</td>
<td>33.8%</td>
<td>39.6%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Coal:</td>
<td>30.4%</td>
<td>28.4%</td>
<td>64.7%</td>
</tr>
<tr>
<td>Nuclear:</td>
<td>19.7%</td>
<td>25.9%</td>
<td>26.2%</td>
</tr>
<tr>
<td>Hydro:</td>
<td>6.5%</td>
<td>2.5%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Wind:</td>
<td>5.6%</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Solar:</td>
<td>0.9%</td>
<td>0.7%</td>
<td>NR</td>
</tr>
</tbody>
</table>
Natural Gas Demand

- Production 2016: 79.6 bcf/d
- Additional demand by 2020:*
  - Added Gas-fired power plants: 3.2 bcf/d
  - Industrial demand: 3.3 bcf/d
Amazing Industrial Boom: Case of Louisiana

• Past: Good year = $5 billion
• GRIMA Survey: $170.4 Billion! Highly concentrated by industry;
  - Basic Chemicals = $50.4 billion
Natural Gas Demand

- Production 2016: 79.6 bcf/d
- Additional demand by 2020:*
  - Added Gas-fired power plants: 3.2 bcf/d
  - Industrial demand: 3.3 bcf/d
  - Mexico exports: 2.5 bcf/d
Natural Gas Demand

- Production 2016: 79.6 bcf/d
- Additional demand by 2020:
  - Added Gas-fired power plants: 3.2 bcf/d
  - Industrial demand: 3.3 bcf/d
  - Mexico exports: 2.5 bcf/d
  - LNG exports: 6.9 bcf/d
Amazing Industrial Boom: Case of Louisiana

- Past: Good year = $5 billion
- GRIMA Survey: $170.4 Billion! Highly concentrated by industry;
  - Chemicals = $50.4 billion
  - LNG Exports = $67.1 billion
Announced LNG Projects

- Cheniere: $20 Bill
- Cameron LNG: $12 bill
- Driftwood LNG: $14.5 bill
- G2 LNG: $11 bill
- Live Oaks LNG: $2 bill
- Magnolia LNG: $3.5 bill
- Monkey Island LNG: $9.3 bill
- Trunkline LNG: $10 bill
- Venture Global LNG: $4.25 bill
- Plus Venture Global LNG: $8.5 bill in Plaquemines Parish
Being 1st to Get Contracts

- **Foreign suppliers** price LNG off of oil price: 14.5%-17% of oil price
  - @15% & $100 oil = $15 mmbtu

- **US Suppliers** off Henry Hub price:
  - Henry Hub = $3.50 mmbtu
  - Plus 15% for liquefaction = 0.53
  - Plus capital recovery = 3.50
  - Plus transportation to Asia = 2.00
  - Total = $9.53

- Result: LT-20 year contracts!
Hard to Get Contracts

• Foreign suppliers price LNG off of oil price; 14.5%-17% of oil price
  - @15% & $50 oil = $7.50 mmbtu
  - @15% & $60 oil = $9.00 mmbtu

• US Suppliers off Henry Hub price:
  - Henry Hub = $3.00 mmbtu
  - Plus 15% for gas/liquefaction = 0.53
  - Plus capital recovery= 3.50
  - Plus transportation to Asia = 2.00
  - Total = $9.03

• Result: No LT contracts! 5 years now
2020 Surplus: 62 Bcma

2025 Deficit: 66 Bcma
The Boost: China Trade Deal Will Help

- 5/11: US-China Economic Cooperation 100-Day Plan
- China now free to negotiate contracts with US LNG exporters
- Potential 75 mm tonnes/year = $26 billion!
Natural Gas Market

• Big increase in demand ahead (+20% over 2017-20)
• But, ocean of supply
A point of wisdom

How to break a blind date
Thinking about the Oil Market
Oil Price Forecast: What Is the “Market” Saying

- Futures market: from “contango” to “backwardation”
  - Spot Sept. 24, 2015 = $44.48
  - Future December 2016 = $50.63
  - Spot Feb. 8, 2016 = $29.69
  - Future December 2016 = $39.53
  - Spot March 17, 2018 = $62.34
  - Future December 2018 = $59.70
Natural Gas Market

• Market is in contango
  - Spot March 17, 2018 = $2.69
  - Future October 2018 = $2.84
Looking Ahead at Oil Prices

Where investment banks in December’s survey see the price of U.S. crude-oil futures in the next few quarters

Nymex crude-oil futures, price per barrel
Through Dec. 28

Sources: WSJ Market Data Group (oil price); the companies (forecasts); Bloomberg (photo)
Figure 6: Oil Price Forecasts

<table>
<thead>
<tr>
<th>Year</th>
<th>Average</th>
<th>Low Range</th>
<th>High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>$50</td>
<td>$30</td>
<td>$90</td>
</tr>
<tr>
<td>2018</td>
<td>$58</td>
<td>$30</td>
<td>$90</td>
</tr>
<tr>
<td>2019</td>
<td>$60</td>
<td>$30</td>
<td>$90</td>
</tr>
</tbody>
</table>
IEA Demand Forecasts

- 2012: 90.7 mmb/d
- 2013: 91.9 mmb/d
- 2014: 92.9 mmb/d
- 2015: 95.0 mmb/d
- 2016: 96.3 mmb/d
- 2017: 97.8 mmb/d
- 2018: 99.1 mmb/d
The November/December 2016 Agreements

- OPEC reduced production to 32 mb/d from 33.7 mmb/d; -1.72 mmb/d (2%)

- 11 non-OPEC countries agree to reduce by 558,000 b/d 1st 6 months of 2017
  - Russia: -300,000b/d

- Oil Prices: Watch Saudi total revenues
  - 10/16: $44.73
  - 5/25: $51.36 (+14.8%)
  - 3/2: $62.34 (+39.4%)
The November/December 2016 Agreements

• Result:
  • 9-Month extension approved 5/25/17
  • Extension approved 11/17 through 2018
## OPEC and Non-OPEC Cuts

<table>
<thead>
<tr>
<th>Country/group</th>
<th>Agreed cut (mb/d)</th>
<th>Sept. actual cut (mb/d)</th>
<th>Sept. percent compliance (est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>-0.49</td>
<td>-0.60</td>
<td>124</td>
</tr>
<tr>
<td>Other OPEC</td>
<td>-0.69</td>
<td>-0.44</td>
<td>64</td>
</tr>
<tr>
<td>Russia</td>
<td>-0.30</td>
<td>-0.32</td>
<td>106</td>
</tr>
<tr>
<td>Other non-OPEC</td>
<td>-0.25</td>
<td>-0.37</td>
<td>149</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>-1.72</strong></td>
<td><strong>-1.72</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**NOTE:** Estimates come from the International Energy Agency’s October 2017 Oil Market Report.

mb/d: million barrels per day

**SOURCES:** International Energy Agency; OPEC.
Why hasn’t the price risen even more?
U.S. Output: 10/17
9.64 mmb/d
• Highest since May 1971
• Expected to increase to 10.6 mmb/d in 2018
• 11.2 mmb/d in 2019
Greater Shale Production at These Prices? How?

F1: Development in Wellhead Breakeven Prices for Key Shale Plays

- **Bakken**: Blue line
- **Eagle Ford**: Red line
- **Niobrara**: Black line
- **Permian Delaware**: Green line
- **Permian Midland**: Grey line

Source: Rystad Energy NASWellCube
How were shale BEs driven down so much?

• Two general ways:
  - Greater efficiencies
1. Sensors behind underground drill report data to office including speed, direction, rock type.

2. Geologist in office crunches numbers, using historic databases and other analysis tools; advises rig of course correction.

3. Rig worker revises course, keeping trajectory in 10-to-15 foot window, which improves well performance and consistency.

Source: the company
Designing completions to allow more rock to be contacted closer to the wellbore.

Version 1.0
Initial Frac Design
(2013 - 2014)
- 1,000 lbs/ft proppant
- 30 bbls/ft fluid
- 60-ft cluster spacing
- 240-ft stage spacing

Version 2.0
Current Frac Design
(Q3 2015 - Today)
- 1,400 lbs/ft proppant
- 36 bbls/ft fluid
- 30-ft cluster spacing
- 150-ft stage spacing
- $40 MM per well vs. initial frac design

Version 3.0
Testing Underway
(Q1 - Q4 2016)
- Up to 1,700 lbs/ft proppant
- Up to 50 bbls/ft fluid
- Down to 18-ft cluster spacing
- Down to ~100-ft stage spacing
- +$0.5MM to $1.0MM per well vs. current frac design
- ~100 well program (70 wells online)

1) Assumes perforated lateral length of 9,000 ft
Daily Output Per Well
(Bakken @ 1,001 & Eagle @ 1,442 & Niobrara @ 1,300 4/17)
How were shale BEs driven down so much?

• Two general ways:
  - Greater efficiencies
  - Price pressure on suppliers
    • Works great when rig count declining
    • Guess what is happening now?
**BREAK-EVEN LIQUIDS PRICE**

**Core subplay break-evens up $3-6/bbl**

**Secondary subplay break-evens up $4-8/bbl**

- Eagle Ford Karnes trough
- Wolfcamp Reeves core
- Bakken Fort Berthold
- Eagle Ford Maverick condensate
- Wolfcamp Ozona
- Bakken West Nesson

*Incorporates play inflation assumptions

Source: Wood Mackenzie
Result?

In easy entry market, oil prices tend to gravitate towards a rising breakeven price
THE CLASH OF IDEAS
Karl Marx

• “From each according to his abilities, to each according to his needs”

• “The theory of Communism may be summed up in one sentence: Abolish all private property.”
Adam Smith

“Competition alone can regulate prices with equity; it alone restricts them to a moderation which varies little; it alone attracts with certainty provisions where they are wanted or labour where it is required.”
The Competition begins July 27, 1953

- **North Korea (2003)**
  - GDP per capita $1,300
  - % below poverty - NA
  - % Ag - 30.2%

- **South Korea (2003)**
  - GDP per capita- $17,800
  - % below poverty - 4%
  - %Agriculture 3.6%
But these are just technical economic measures

Is there another indicator of economic health?
Another measure of an Economy
Dr. Loren C. Scott
www.lorencscottassociates.com