Thank you to our Spring 2017 Sponsors
Is the Oil Bust Really Over?
And What Does It Mean for Houston?

Robert W. Gilmer, Ph.D.
C.T. Bauer College of Business
May 11, 2017
Perilous Times for the Houston Economy: But Where Are We Now?

- Houston has slowed to no-growth for two years, but has seen no major economic reversal.
- Where are we now?
  - We have probably put behind us the worst downturn ever for American oil.
  - The U.S. economy continues to grow at a healthy rate.
  - The East Side petrochemical boom is over.
  - All forward momentum from the Fracking Boom is now lost, and it can only be rebuilt slowly.
- Where are we going now? Is the recent job growth real? Can it continue? Just tell me the price of oil, please.
For Houston, Our Problems Are Still All About Oil Prices
Houston Job Growth Rides Oil’s Boom and Bust

<table>
<thead>
<tr>
<th>Sector</th>
<th>Before Revision Dec to Dec</th>
<th>After Revision Dec to Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jobs</td>
<td>Jobs</td>
</tr>
<tr>
<td>2012</td>
<td>118,600</td>
<td>118,800</td>
</tr>
<tr>
<td>2013</td>
<td>89,800</td>
<td>90,400</td>
</tr>
<tr>
<td>2014</td>
<td>117,800</td>
<td>118,200</td>
</tr>
<tr>
<td>2015</td>
<td>15,200</td>
<td>200</td>
</tr>
<tr>
<td>2016</td>
<td>14,800</td>
<td>18,700</td>
</tr>
</tbody>
</table>

Texas Workforce Commission
Current Slowdown Marked The End Of a Decade-Long Fracking Boom
(annual percent change)

Note: December to December changes, except 2017 which is year-to-date, annualized, and seasonally adjusted. TWC estimates.
Slow But Positive Again : Houston Job Growth Revised Down to 18,500 Jobs In All of 2015-16

(3-month percent change at annual rates, s.a.)

Texas Workforce Commission and Bureau of Labor Statistics
Oil-Related Job Losses Grow to 77,200 After Revisions
(Net Change in Jobs, Dec. to Dec.)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Dec ‘14 – Dec ’16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New Jobs</td>
</tr>
<tr>
<td>Total Payroll</td>
<td>17,300</td>
</tr>
<tr>
<td>Mining</td>
<td>-29,400</td>
</tr>
<tr>
<td>Construction</td>
<td>3,200</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-40,300</td>
</tr>
<tr>
<td>Machinery</td>
<td>-18,700</td>
</tr>
<tr>
<td>Fab Metal</td>
<td>-20,500</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>-5,700</td>
</tr>
<tr>
<td>Prof/Buss Services</td>
<td>-3,000</td>
</tr>
</tbody>
</table>

*Revised Texas Workforce Commission estimates. Oil-Related Jobs = Oil Producers and Services, Machinery and Fabricated Metal, Wholesale Trade, and Professional and Business Services.

Energy Sectors Begin to Turn in Oct 2016 (000, s.a.)

Added back 10,000 Oil Jobs By March
Growth Of Selected Services Revised Down But Remains Strong

Number of Jobs in Key Services Revised Down, seas. adj.

New Jobs Added Dec 2014 to Dec 2016 (with recent revisions)

- 22,971 health care (-3,425)
- 20,836 food service (-7,850)
- 16,805 local government (+3,342)
- 10,756 retail trade (-8,679)
- 5,954 finance (+3,440)
- 4,207 arts/entertainment (-14)
- 4,148 private education (+394)
- 1,202 accommodation (-492)
- 86,026 all 8 sectors (-14,098)

Texas Workforce Commission
Where Has This Service Sector Growth Come From?

• Where did this services growth come from?
  • Strong national markets: United Airlines, Sysco, AIG, HP
  • Petrochemical construction boom in East Houston
  • Past momentum, built on Houston’s 700,000 new jobs from 2004-2014
  • In-migration continues strongly for several quarters after job growth slows
  • Most direct damage is still confined to oil producers, oil services, and manufacturing ... so far

• BUT ... we are now 30 months into this slowdown. The chemical boom is over; momentum has waned; population growth is evaporating. Only the U.S. economy left to help out ... and the renewed drilling activity. How strong will it be?
Plenty Of Other Signs Of A Big Slowdown Or Mild Reversal

Houston unemployment rate moves above U.S. to 5.9%

Quarterly Sales and Use Tax Collections Down 11.4 and 8.5 Percent for City & METRO MTA

Bureau of Labor Statistics

Texas Comptroller, seasonally adjusted; To 2016Q4 by date of economic event
Auto Sales Struggle, While Purchasing Manager’s Index Looks Forward

Auto and Truck Sales Down 29.5% Since 2015Q3 (monthly rate)

Houston PMI Says Growth Ahead (Index, s.a.)
Was It Recession? Ask The Dallas Fed Business Cycle Index

Tracks local business cycle with four variables

We were on brink of recession in 2016, if not in it

Trough Comes in June 2016
Houston in Five Drilling Downturns: So Far, This One Is a Possible Mild Recession

<table>
<thead>
<tr>
<th>Economic Event</th>
<th>% Decline Rig Count</th>
<th>% Loss Local Jobs</th>
<th>Quarters Decline</th>
<th>% Decline</th>
<th>U.S Economic Performance</th>
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</thead>
<tbody>
<tr>
<td>1980's</td>
<td>-82.4</td>
<td>-13.3</td>
<td>20</td>
<td>-17.6</td>
<td>- +</td>
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<tr>
<td>Asian Financial Crisis</td>
<td>-46.0</td>
<td>None</td>
<td>No Recession</td>
<td>+ +</td>
<td></td>
</tr>
<tr>
<td>2001 Tech/Enron</td>
<td>-35.4</td>
<td>-1.3</td>
<td>9</td>
<td>-2.9</td>
<td>-</td>
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<tr>
<td>Great Recession</td>
<td>-50.9</td>
<td>-4.1</td>
<td>5</td>
<td>-7.5</td>
<td>- -</td>
</tr>
<tr>
<td>Fracking Bust ... so far</td>
<td>-75.4</td>
<td>-0.5</td>
<td>6</td>
<td>-1.7</td>
<td>+</td>
</tr>
</tbody>
</table>

Note: In the first half of 2016, revisions show Houston lost 16,500 seasonally-adjusted jobs. These jobs were restored by year-end.
What Does Oil Mean for Houston’s Economy?

• It makes us a global engineering and technology center for one of the world’s most important industries

• Makes a major machinery manufacturing center, a major national refining center, and a global producer of petrochemicals and plastics

• It is a major driver of our business cycle
  • For decades it has provided an edge in economic growth that has moved us to the fifth largest U.S. metro area
  • A volatile, commodity-driven industry, it has made the local economy highly cyclical
  • Diversification? It does not come free! To get stability you trade away a faster growth rate
Define the Economic Base as the Jobs that Drive Local Economic Growth

<table>
<thead>
<tr>
<th>Economic Base</th>
<th>Energy Base</th>
<th>Upstream</th>
<th>Downstream</th>
<th>Rest of Base</th>
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<tbody>
<tr>
<td>Oil Producers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Oil Services</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fab Metal</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Machinery</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Refining</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Chemicals</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Other Mfg.</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ex Air Transport</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ex Pipelines</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ex Wholesale</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ex Prof Services</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ex Construction</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Houston’s Economic Base Leads an Exciting Life! Non-Basic Follows Later
(3-mo percent change at annual rate)
About Four Non-basic Jobs In Houston Supported By Each Base Job

Too many Non-Basic Jobs? Base Shrinks and Services Just Keep Growing
How Dependent Is Houston on Oil versus Other Factors?

Total Energy and Non-Energy Base Jobs?

Houston’s Energy Share near 50% for Decades

Energy Share %

Percent Share Energy
There Are Some Problems Here!

- Nothing definitive can be said about the 1980’s. The industry classifications system changed forever in 1990.
- The level of detail from payroll employment (used in our example) is very limited and deficient.
  - More detailed data (like *County Business Patterns*) comes only annually and with a two year lag, and the regional definition changes over time.
  - Detailed data is counted very differently than payrolls. There is no accounting consistency between reports in some very important categories.
- Out-sourcing crosses up the concept of counting energy base jobs
  - Outsource accounting, and workers move from the oil industry to financial services.
  - What changed? Yes, it is true the energy base got smaller. But the energy multiplier got bigger. There was no diversification.
Let’s Try A Statistical Approach: And Answer Two Questions

• How much of Houston’s employment, measured over the business cycle and measured from one quarter to the next, is driven by the oil industry’s drilling cycle? By the national business cycle?

• Over longer periods of time – which turn out to be 10 to 12 quarters, how do these factors – and others -- come into play?
  • Population growth, local labor force quality and quantity, infrastructure, regulations, pro-business attitudes, etc. These factors all evolve slowly over time
  • We share in broad economic growth trends along with the rest of the U.S. economy. Plus, we get special impetus from the success of the U.S. and global oil industry

The model used is an error correction model from 1990Q1 to 2016Q4 with total payroll employment as the dependent variable, and local upstream employment, U.S. employment, and a trend term as independent variables. Log first differences are stationary; there is no autocorrelation; and no serious inter-correlation among independent variables. There is a significant long-term relationship over about 10 quarters, and no evidence of structural change through the entire period. Percentage estimates shown in the next slide are based on the standardized coefficients from an unrestricted version of the ECM.
How Houston Withstood the Blow from Oil in 2015-16

• What drives quarter-to-quarter job growth?
  • Momentum from the prior two quarters: **36.2%**
  • U.S. economic expansion: **41.5**
  • Local upstream oil-related job growth: **22.4%**

• What drives growth over 10 or more quarters?
  • Long-term factors that drive local population growth and productivity: **28.3%**
  • U.S. economic expansion: **38.6%**
  • Local oil-related job growth: **33.2%**

Taking a the Latest Shot from Oil

• Over the business cycle, 1/3 oil and 2/3 U.S. cycle.
• Over the longer-term, 1/3 is oil-driven, and the rest by non-oil factors
• Houston’s response to oil or U.S. growth is stable and unchanged over the entire period, indicating little diversification away from oil in the last 26 years
• Remember these figures are on average! There are periods like 2009-2014 when oil booms, but U.S. economy performs poorly. Or the late 1990’s when U.S. booms and oil lags badly.
Oil Markets and Oil Price
The Commodity Super-Cycle Is Over
(price index: Jan 2001 = 100)
But Global Oil Demand Has Grown Steadily Since 2014: This Has Been a Supply Problem

(million bbl./d)
Global Economy Still Trapped in Prolonged Period of Sub-Par Growth
(percent change in GDP)

Slow Global Growth Led By Developed World

IMF World Economic Outlook, April 2017
Growth In The Demand For Oil Comes From Emerging Markets

(million b/d)

International Energy Agency
On Supply Side? U.S. Shale Reversed
40 Years Of Declining Oil Production
(million barrels/day)

Peak: July 2015, fell 669,000 bbl/d
Still Down 532,000 bbl./d

DOE/EIA, Seasonally adjusted by IRF
Thinking About Recovery
In the Oil Patch
Drilling Has Definitively Turned Up from Historic Lows

Weekly Count of Working Rigs

488 Rig Count was previous all-time low

2008-2009

2014-2017

Weeks after peak in drilling activity
As Oil Prices Rose This Spring, Optimism Returned To The Oil Market

- The big three oil service companies all declared a bottom was in place for drilling in their 2016 earnings reports.
- The rig count has more than doubled from the March 2016 low of 404.
- Oil service and machinery stocks quickly rose 30% in February and March as the OPEC agreement fell into place. BUT then fell back in March and April with lower oil prices.
- But did producers get ahead of themselves? Again trying to drive equity gains instead of profit over the oil-price cycle?
If Oil Producers Are Chasing Equity Gains ... It Isn’t Working

S&P Exploration and Production Index

OPEC Agreement →

-19.7%
What We Really Need?: Drilling Recovery Means Oil Near $65/bbl.

Long-Run Marginal Cost of Global Oil Production

$/bbl.

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Production (million bbl./d)

This is chart is stylized and illustrative

1. Onshore Middle East
2. Offshore Shelf
3. Heavy Oil
4. Onshore Russia
5. Onshore Rest of World
6. Deep Water
7. Ultra-Deep Water
8. U.S. Shale
9. Oil Sands
10. Arctic
Price Of WTI Oil As Implied by Valuation Of The Stock of 40 Oil Producers

$/bbl.

Goldman Sachs Research, at first week of each quarter
All OPEC’s Efforts to Drive Higher Oil Prices Seem to Be Lost

WTI Futures $/bbl.

Before OPEC Pact

After OPEC Pact

May 3


$60/bbl.
Recovery In Rig Count After Oil Prices Definitively Move Up
(working rigs by quarter after oil prices begin to rise, s.a.)

Baker Hughes, calculations of IRF
Drilling Costs Fall by Over a Third Since 2014

Producers Retreat to Low-Cost Prospects

No Recent Experience Relating $60-$80 Oil to Oil Rig Count
Building Scenarios For Recovery In Oil

• When will oil prices hit bottom?
• When will the rig count turn up?
• When do energy jobs begin to come back?
• How high will the rig count go in this recovery?
• How long before the rig count reaches these highs?
Three Scenarios for a Drilling Recovery

• **Rig Count?**
  - High Scenario: Strong recovery like 2008-09 continues to unfold
  - Medium Scenario: Slows in 2017Q2/Q3 but moderate recovery continues
  - Low Scenario falls back in 2017 Q2, remains low and slow trough 2018

• **Rig Count Max After Recovery?**
  - High Scenario: 1650
  - Medium Scenario: 1500
  - Low Scenario: 1300

• **Return of Drilling Jobs in Houston**
  - High Scenario: 2017Q1
  - Medium Scenario: 2017Q3
  - Low Scenario: 2018Q4

High scenario requires a quick rebound in oil prices to $55, and continued move to $60-$65 range; moderate requires a return to $55 or better; low scenario triggered by continued oil price near $45, and staying at that level through 2017 and into 2018.
Rig Count Scenarios and the Return Of Oil Employment In Houston

Rig Count

Oil-Related Jobs in Houston (000)
U.S. Economy Continues to Work for Houston
U.S. Economy Continues To Grow Strongly And Create Jobs

- Assume in all scenarios that the U.S. economy has put the Great Recession behind it
- Consumer has deleveraged; state and local governments are collecting revenues at a healthy rate and spending; the housing market has returned to close to normal
- U.S. job growth is at 1.7 percent or about 200,000 jobs per month throughout the forecast horizon
- We see the export sector, especially manufacturing struggling with the strong dollar, but domestic growth is robust
Last Year a Split Emerged Between Growth In Production And Jobs

GDP Growth Has Slowed Sharply in Recent Quarters

While U.S. Job Growth Remains Quite Strong

% Change at Annual Rates

000 New Jobs Per Quarter

Trend holds near 200,000 jobs per month
Strong Dollar Hurts Goods-Related Exports

Dollar at Asian Financial Crisis Highs

Dollar Strength Hurts Goods Production

Industrial Production in Manufacturing
Recent Results Are Consistent With Robust Domestic Growth And Weak Exports

Productivity Growth Is Slow

Weak Export Sector

% Change in Productivity
12 Quarter Average

% Change Annual Rates
Modest Recovery Continues

Percent Chance of Recession About One Percent Today

Consensus Forecast Says Not Too Hot, Not Too Cold

## Fed Funds Rate: What the Futures Market Says

<table>
<thead>
<tr>
<th>Meeting Date</th>
<th>Range b.p.</th>
<th>Prob. of Increase</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>75-100</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3-May</td>
<td>75-100</td>
<td>5.3%</td>
<td>--</td>
</tr>
<tr>
<td><strong>14-Jun</strong></td>
<td><strong>100-125</strong></td>
<td><strong>78.5%</strong></td>
<td>+</td>
</tr>
<tr>
<td>15-Jul</td>
<td>125-150</td>
<td>5.8%</td>
<td>--</td>
</tr>
<tr>
<td>20-Sep</td>
<td>125-150</td>
<td>36.2%</td>
<td>--</td>
</tr>
<tr>
<td>1-Nov</td>
<td>125-150</td>
<td>32.2%</td>
<td>--</td>
</tr>
<tr>
<td><strong>13-Dec</strong></td>
<td><strong>125-150</strong></td>
<td><strong>54.4%</strong></td>
<td>+</td>
</tr>
<tr>
<td>31-Jan</td>
<td>125-150</td>
<td>16.6%</td>
<td>--</td>
</tr>
</tbody>
</table>

CME Group, May 7. Table assumes as soon as probability of a rate increase passes 50% an increase is triggered of 25 basis points.
Downstream Petrochemical Boom Is Over for Now
Hockey Stick Surge In Natural Gas Production Brings Collapse in Price

Marketed Production
Tcf/month, seas. Adj.

Natural Gas Prices Collapse
($/Mcf)

DOE/EIA
$179 Billion U.S. Construction Boom Is Based On Cheap Energy

- This $179 billion total includes many industries and the TX and LA Gulf Coast are the major beneficiaries.

- **Petrochemicals**: New ethylene crackers, more ethylene-related expansion in PE, PVC and other derivative plants

- **LNG export terminals**: To sell surplus natural gas into global markets

- **Refiners**: Have joined in with additional expansions

Note: The $179 billion figure is based on all U.S. shale-related expansion, estimated by the American Chemistry Council in March 2017
Natural Gas Energy Content Now Equivalent $16 per Barrel For Oil

Huge Feedstock Advantages for Oil Over Natural Gas

Margins Narrow for Ethylene With Collapse in Oil Price ($/lb)

DOE/EIA and calculations of the author
Projects Begin To Wind Down Rapidly After 2017
(Value of Projects Completed, $ million)

2016: $8,319
2017: $22,706
2018: $4,980
2019: $4,000
2020: $3,000
2021: $2,000
# The Gulf Coast Petrochemical Boom Winds Down

## Ethylene Finishes Up

<table>
<thead>
<tr>
<th>Company</th>
<th>Where</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Houston area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChevronPhillips</td>
<td>Baytown</td>
<td>mid-2017</td>
</tr>
<tr>
<td>Dow</td>
<td>Freeport</td>
<td>Complete</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Baytown</td>
<td>mid-2017</td>
</tr>
<tr>
<td>Ineos</td>
<td>Chocolate Bayou</td>
<td>Complete</td>
</tr>
<tr>
<td><strong>Other Gulf Coast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formosa Plastic</td>
<td>Point Comfort</td>
<td>2017-2018</td>
</tr>
<tr>
<td>OxyChem/MexiChem</td>
<td>Ingleside</td>
<td>Complete</td>
</tr>
<tr>
<td>LyondellBassell</td>
<td>Corpus Christi</td>
<td>Complete</td>
</tr>
<tr>
<td>Ineos/Sasol</td>
<td>Lake Charles, La.</td>
<td>2018</td>
</tr>
</tbody>
</table>

## Polyethylene Is Right Behind

<table>
<thead>
<tr>
<th>Company</th>
<th>Where</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Houston area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChevronPhillips</td>
<td>Sweeny</td>
<td>2017Q3</td>
</tr>
<tr>
<td>Dow</td>
<td>Freeport</td>
<td>2017Q3</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Mont Belvieu</td>
<td>2017Q3</td>
</tr>
<tr>
<td>Ineos/Sasol</td>
<td>LaPorte</td>
<td>2017Q2</td>
</tr>
<tr>
<td>LyondellBassell</td>
<td>LaPorte</td>
<td>2019</td>
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<tr>
<td><strong>Other Texas Gulf Coast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formosa Plastic</td>
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<td>2018</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Ingleside</td>
<td>Complete</td>
</tr>
<tr>
<td>Exxon/SABIC</td>
<td>Corpus Christi</td>
<td>2020's</td>
</tr>
</tbody>
</table>

## Recent Announcements

- Total: Port Arthur, 2020's
- Exxon/SABIC: Corpus Christi, 2020's

## Next Wave?

- ???, 2024-26
Pull It All Together?

• Three oil scenarios: high, medium, or low. High sees solid recovery now underway in drilling; medium sees strength delayed until early 2017; low until late 2018

• Continued U.S. expansion at moderate rates

• A drag from the end of the petrochemical construction on the East Side

• All forward momentum from the fracking boom is gone

• Data revisions that point to possible mild local recession in early 2016.
# Forecast Job Growth In Houston: A Likely Slow Start

**(000 New Jobs, Q4/Q4)**

<table>
<thead>
<tr>
<th>Year</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>25/60/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>112.7</td>
<td>112.7</td>
<td>112.7</td>
<td>112.7</td>
</tr>
<tr>
<td>2015</td>
<td>11.0</td>
<td>11.0</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>2016</td>
<td>10.8</td>
<td>10.8</td>
<td>10.8</td>
<td>10.8</td>
</tr>
<tr>
<td>2017</td>
<td>54.3</td>
<td>35.2</td>
<td>21.2</td>
<td>37.9</td>
</tr>
<tr>
<td>2018</td>
<td>79.6</td>
<td>52.6</td>
<td>22.8</td>
<td>54.9</td>
</tr>
<tr>
<td>2019</td>
<td>91.4</td>
<td>68.0</td>
<td>42.8</td>
<td>70.1</td>
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<tr>
<td>2020</td>
<td>89.6</td>
<td>74.1</td>
<td>56.8</td>
<td>75.4</td>
</tr>
<tr>
<td>2021</td>
<td>91.6</td>
<td>78.8</td>
<td>67.7</td>
<td>80.4</td>
</tr>
</tbody>
</table>

Calculations of IRF, based on drilling scenarios above. Figures are Q4/Q4. The 2016 calculations include benchmark revisions of March 2017.
Net Migration Follows Job Growth in Houston

• When population grows, net migration gives the biggest economic stimulus

• As job growth rises, net migration begins to rise a year later

• In recovery, net migration falls a year behind

• Data at right matches 25/60/15 weighted employment forecast, sees a 2018/19 trough with about 30,000 net migrants
Houston Single-Family Housing: A Long, Strange Journey Ends Well
The Fracking Boom Brought Lot Shortages … Then the Oil Bust Did the Same

• The sub-prime Implosion in 2006 left Houston with 50,000 small and scattered lots – and not much other inventory

• By 2012, the Fracking Boom generated strong demand for large homes for high-end engineers/executives
  • Existing home supply was quickly exhausted, and there were no lots on the ground to build large homes. Pressure grew on existing homes
  • Low inventories and sharply rising home prices slowly squeezed 100,000+ families out of the housing market

• By 2015, the large lot supply caught up – in time for the drilling bust to abruptly end the demand for upscale housing

• The last two years have been spent on lot development for low- to moderately-priced homes with 45-60 foot frontages. The traditional, moderately-priced heart of the Houston housing market is finally back in business
A Strong Existing Home Continues On Despite the Oil Bust
(sales, s.a.)

- Flat since 2012? First, sales flat due to a lack of existing and new home supply. There was nothing left to sell.
- But oil bust drives changes beneath the surface, as existing home market moved downscale in price and home size.
- Starter homes and price levels cited above did fine, while expensive and close-in properties faltered.

Source: Texas A&M Real Estate Center
Oil Boom and Lot Shortages from 2012-2014 Distorted Single-Family Housing Market

Source: Texas A&M Real Estate Center, seasonal adjustment by IRF
Ship Channel Cities
Baytown, Channelview, Pasadena

Sales and Home Prices Rising

Inventory only 2.5 months

Source: Texas A&M Real Estate Center, calculations of IRF
South Houston
South Belt, Clear Lake, League City

Sales flat, prices rising

Not much left to sell with two months inventory

Source: Texas A&M Real Estate Center, calculations of IRF
Close-In and Upscale
Rice Military, Heights, Galleria

Sales and Prices Sag in 2015-16

Inventory falling again as oil prices rise?

Source: Texas A&M Real Estate Center, calculations of IRF
Prices hold up, sales recover on better oil price?

Inventory falls as sales pick up

Source: Texas A&M Real Estate Center, calculations of IRF
The Woodlands Cools Off

Sales down, Price trying to recover

Inventories stabilizing near 5.0 months

Source: Texas A&M Real Estate Center, calculations of IRF
Other Distant Suburbs
Pearland, Sugar Land, Kingwood, Katy

Sales flat & price increases slow

Inventories remain very low,
Not much to sell

Source: Texas A&M Real Estate Center, calculations of IRF
Shouldn’t Houston Be Better Than Just Average Affordability?

Affordability Index:
Percentage of Houston homes for sale within in reach of median income family

Largest 10 U.S. Metros and Affordability

- New York 35.4%
- Los Angeles 12.5%
- Chicago 61.1%
- Dallas-Fort Worth
  - Dallas 50.1%
  - Fort Worth 64.2%
- Houston 61.8%
- Washington, D.C. 64.1%
- Philadelphia 70.1%
- Miami 33.2%
- Atlanta 69.9%
- Boston 51.2%

Wells Fargo Housing Opportunity Index
Houston’s Homebuilders Rediscover Houston’s Traditional Moderate-Income Market
New Home Market Shifts To Moderate Priced Homes On Smaller Lots

2016 Closings by Price Range $000

2016 Starts By Size of Lots

MetroStudy
Lot Supply Is Finally Finding an Equilibrium in Houston

Current Lot Inventory
Number and Months Supply

Lots Under Development

Frontage in Feet

MetroStudy
Single-Family Permits Softer in 2016 But May Have Room to Grow in 2017

(monthly permits at annual rates, s.a.)

Texas A&M Real Estate Center
Apartment Market Keeps on Building
Class A Apartment Market Suffers From Self-inflicted Wounds

- Damage is felt first in the rest of Class A, in similar product
- Class A is struggling with rent under pressure from widespread concessions and falling occupancy rates
- There are 27,000 units in lease-up with only 27.4% occupancy, another 15,000 units still in the construction pipeline

### Class A Rents and Occupancy Under Growing Pressure

<table>
<thead>
<tr>
<th></th>
<th>Stable</th>
<th>In Lease Up</th>
<th>All Class A</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Units</td>
<td>114,963</td>
<td>26,886</td>
<td>141,849</td>
</tr>
<tr>
<td>Monthly Rent</td>
<td>$1,416</td>
<td>$1,501</td>
<td>$1,432</td>
</tr>
<tr>
<td>Occupancy</td>
<td>89.7%</td>
<td>27.4%</td>
<td>77.9%</td>
</tr>
</tbody>
</table>

Apartment Data Services through February
-- Metro-wide Class A apartment construction continues at a high pace in 2017

-- We thought it peaked last year? Surprise!

-- By 2018, the local Class A apartment market will have expanded by 30.8% since 2014, when oil bust began

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Units</th>
<th>Percent of 2018 Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 existing</td>
<td>120,390</td>
<td>69.2</td>
</tr>
<tr>
<td>2015 delivery</td>
<td>18,300</td>
<td>10.5</td>
</tr>
<tr>
<td>2016 delivery</td>
<td>17,500</td>
<td>10.1</td>
</tr>
<tr>
<td>2017 delivery</td>
<td>&gt;17,700</td>
<td>10.2</td>
</tr>
<tr>
<td>2018 existing</td>
<td>173,890+</td>
<td>100.0</td>
</tr>
</tbody>
</table>

CoStar
New Product Puts Class A Under Pressure, But Damage Spreading

Class A Rents Under Pressure, but Occupancy Up in Recent Months

Occupancy (%) now falling in Class B & C

Apartment Data Services
Entire Market Suffers as Class A Continues to Build

- No job growth, and population growth is falling rapidly
- Where are the new Class A tenants? Living in Class B, of course
- Widespread incentives cut the effective rents in Class A to compete with B,C product
Multifamily Permits Finally Slip Under Long-Run Trends

Monthly permits, 6-month average

TAMU Real Estate Center
Where Rental Rates Are Under Pressure
(12-mo. changes, all classes)

Largest 12-Month Declines
• Medical Center  -7.8%
• Woodlands      -6.4%
• Upper Kirby    -5.9%
• Galleria       -5.5%
• Montrose       -4.9%
• Lake Hou/KW    -3.5%
• Jersey V/Cypress -3.5%

Other Notables
• Energy Corridor -3.0%
• Westchase      -3.0%
• Heights        -2.9%
• Downtown       -1.2%
• Memorial/Spr Br -0.7%
• Baytown        +0.5
• I-10 East      +4.7

Note: These are 12-month changes; many of these areas improved substantially in 17Q1
Apartment Data Services
Damage Also Spreads Geographically From Complex To Complex

• Look at all Class A apartment complexes in metro area at end of 2016
• Look at all the other Class A complexes in circle of radius of 2 miles
• Compute the resulting vacancy rate in its market area after new units completed in 2017
• Each dot an A apartment, the darker the spot, the higher the vacancy rate in its market area

CoStar, IRF
Delivered or In Pipeline for 2017
These Multi-Family Vacancy Rates Approach Worst of Modern Times

Percent Vacancy All Classes By Forecast

Medium Forecast Peaks at 11.4% Vacancy in 2018; Double-digits to 2020 in all forecasts
Where Class A Vacancy Rates Are Above 20 Percent By Year End
Ugly As The Office Market Is Today, This Is Not The 1980’s

Cumulative square footage delivered after 1977 or 2009
In Million Sq Ft

<table>
<thead>
<tr>
<th>Year</th>
<th>Cumulative Sq Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982-84</td>
<td>46.9 million</td>
</tr>
<tr>
<td>2014-16</td>
<td>14.9 million</td>
</tr>
</tbody>
</table>

Cumulative square footage delivered after 1977 or 2009
In Million Sq Ft

<table>
<thead>
<tr>
<th>Year</th>
<th>Cumulative Sq Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980s</td>
<td>13.9</td>
</tr>
<tr>
<td>2010s</td>
<td>10.6</td>
</tr>
</tbody>
</table>

46.9 million 1982 – 84
14.9 million 2014-16
Sure, There Is an Oil Bust, But Vacancy Mostly a Product of Deliveries

--- Annual Deliveries vs Change in Vacancy Rate ---
Class A Office Market: Feeling a Lot of Pain Right Now?

Class A Vacancy Rates Nearly Double, Head for Modern Highs

Class A Rent Premiums Approach 2010 Lows

Vacancy Rates

Class A

B & Below

Class A Base Rent Premium

Class A Rent Premiums

Approach 2010 Lows
Across All Classes of Buildings: Office Vacancy Rate Nears A Peak

Average = 13.2%

High

Medium = 16.4%

Average = 13.2%
Damage Spreads Geographically From Building To Building

• Look at all buildings in metro area at end of 2016
• Look at all the other buildings in circle of radius of 2 miles
• Compute the resulting vacancy rate in its market area with new deliveries
• Each dot a building. The darker the spot, the higher the vacancy rate in its market area

CoStar, IRF
Local Office Markets With Vacancy Rate Headed Above 20 Percent in 2017

CoStar, IRF
Industrial and Retail?
No Real Excitement Here!
East versus West: Houston’s Economy Split by Energy
Industrial East And West Vacancy: East Side Boom Fading?
Industrial Construction Slows In East And West Houston
(million square feet)
Retail: Still Waiting for Better Times

• Retail missed the boom of recent years after delivering 16 million square feet in 2006-07, leaving a glut of space that lasted to 2014

• Local growth caught up with retail space needs in 2013-14, and vacancy rates show tightness, and rents are quite healthy

• Retail is still primarily relegated to following the grocery store anchored shopping centers, chasing new home construction around the Grand Parkway

• The current construction pipeline is no threat to the market, growing more slowly than population.

• But be careful – consumer purchases of retail, food service, entertainment and other services have been flat or falling for two years
Retail Rent And Vacancy Began to Tighten In 2014

Vacancy Rate (%)

Rent $/ft^2

Source: CoStar
Retail Pipeline Is Okay – Despite a No-Growth Retail Market

Taxable Sales for Retail, Food and Drink, Entertainment, Services ($/Q)

Growth Rate of Population and Retail Space: In-Line So Far
Retail Construction Is Still Mostly Chasing Rooftops In The Far Suburbs
Close-In and West See Single-Family Sales Sag, Inventories Rise, Prices Flat

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Monthly Sales</th>
<th>Median Price(000)</th>
<th>Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-in*</td>
<td>7298</td>
<td>7112</td>
<td>200.9</td>
</tr>
<tr>
<td>Rice Mil/WashAve.</td>
<td>272</td>
<td>216</td>
<td>402.1</td>
</tr>
<tr>
<td>Heights</td>
<td>67</td>
<td>45</td>
<td>453.3</td>
</tr>
<tr>
<td>Galleria</td>
<td>147</td>
<td>120</td>
<td>445.2</td>
</tr>
<tr>
<td>South of I-10*</td>
<td>66</td>
<td>51</td>
<td>312.1</td>
</tr>
<tr>
<td>Energy Corridor</td>
<td>148</td>
<td>132</td>
<td>384.8</td>
</tr>
<tr>
<td>Memorial West</td>
<td>103</td>
<td>111</td>
<td>320.8</td>
</tr>
<tr>
<td>Spring Branch</td>
<td>229</td>
<td>167</td>
<td>355.8</td>
</tr>
<tr>
<td>Woodlands</td>
<td>87</td>
<td>83</td>
<td>123.7</td>
</tr>
<tr>
<td>Alief</td>
<td>(*) denotes the sum of the sub-categories; all data seasonally adjusted and may not add to totals; sales and price are 3-month moving averages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rest of Metro Single Family: Little Left to Sell, Prices Still Rise

<table>
<thead>
<tr>
<th>Monthly Sales</th>
<th>Median Price</th>
<th>Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Area</td>
<td>7298</td>
<td>7112</td>
</tr>
<tr>
<td>Ship Channel*</td>
<td>233</td>
<td>264</td>
</tr>
<tr>
<td>Baytown</td>
<td>85</td>
<td>86</td>
</tr>
<tr>
<td>Pasadena</td>
<td>77</td>
<td>78</td>
</tr>
<tr>
<td>North Channel</td>
<td>78</td>
<td>99</td>
</tr>
<tr>
<td>South Houston*</td>
<td>458</td>
<td>393</td>
</tr>
<tr>
<td>Friendswood</td>
<td>74</td>
<td>62</td>
</tr>
<tr>
<td>Clear Lake</td>
<td>131</td>
<td>125</td>
</tr>
<tr>
<td>League City</td>
<td>190</td>
<td>171</td>
</tr>
<tr>
<td>South Belt</td>
<td>75</td>
<td>59</td>
</tr>
<tr>
<td>Suburbs*</td>
<td>1,311</td>
<td>1,163</td>
</tr>
<tr>
<td>Kingwood</td>
<td>124</td>
<td>95</td>
</tr>
<tr>
<td>Katy</td>
<td>510</td>
<td>425</td>
</tr>
<tr>
<td>Cypress</td>
<td>300</td>
<td>296</td>
</tr>
<tr>
<td>Pearland</td>
<td>214</td>
<td>195</td>
</tr>
<tr>
<td>Sugarland</td>
<td>178</td>
<td>153</td>
</tr>
</tbody>
</table>

(*) denotes the sum of the sub-categories; all data seasonally adjusted and may not add to totals; sales and price are 3-month moving averages.
Where Class A Vacancy Rates Are Above 30 Percent By Year End
Vacancy Rate For Class A and B Climb From Low Levels

Source: CoStar
Thank you for attending

Our Fall 2017 Symposium is scheduled for Monday, November 6, 2017