Shale and the Future of World Oil

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U.S. Energy Landscape circa 2005

**U.S. Oil Production**
(millions of barrels per day)

**Liquefied Natural Gas Imports**
(bcf per day)

**U.S. Net Energy Imports**
(millions of BOE per day)

Source: U.S. Dept. of Energy, EIA; Oil = Oil & Condensate (NGLs excluded); LNG and Net Energy Imports predictions from EIA AEO 2005 Report; Oil = extrapolation of trend
The Unconventional Revolution Vastly Improved America’s Energy Future

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Game-Changers: U.S. Unconventional Natural Gas and Oil Production

**U.S. Natural Gas Production**
(Billions of cubic feet per day)

**U.S. Oil Production**
(Million barrels per day)

Source: U.S. Department of Energy, Energy Information Administration
America’s “Big Four” Unconventional Fields are World-Class Discoveries

Map shows wells drilled in U.S. 48 since start of 20th century; well locations from U.S. Geological Survey; resource estimates based upon publically available sources and ConocoPhillips estimates.
New Era of Abundance for U.S. Oil Supply

U.S. Crude, Condensate and Natural Gas Liquids Production

U.S. Department of Energy Forecast

Million Barrels per Day

U.S. crude production nearly doubled between 2008 and 2015 after falling by half during the previous four decades

0.7 MMBD decline since peak in March 2015

Permian tight oil production grew by 0.2 MMBD in the same time period

Lower prices caused decreasing production

Source: U.S. Department of Energy, Energy Information Administration
Productivity Improvements in U.S. Tight Oil Production

**Bakken Horizontal Oil Type Curves**
- Peak IP increased 20%
- 2010 - 2015

**Permian Horizontal Oil Type Curves**
- Peak IP increased ~300%
- 2010 - 2015

**Eagle Ford Horizontal Oil Type Curves**
- Peak IP increased 100%
- 2010 - 2015

Future Productivity Improvements
- Longer laterals
- Multi-laterals
- Increased drilling efficiency
- More perf clusters per well/stage
- More consistent proppant placement

Source: Drilling Info. Charts represent production profiles for the average of all wells drilled in that year.

Continued productivity improvements are likely
Incremental Global Oil Supply for 2020

Large portions of U.S. tight oil are in the middle to lower end of the oil supply curve

Source: ConocoPhillips, Rystad; gross production growth before declines, boxes are indicative of the types of assets on each category not a fully inclusive list
Sources of New Supplies: 2015-2020

New supply through 2020 will mainly come from OPEC & U.S. tight oil.

Higher cost supply may be needed post 2020.

Source: ConocoPhillips and Rystad for cost of supply * Includes NGL’s, bio fuels, and refinery processing gains.
Structural Change Lowering Marginal Supply Costs

- Slower industrial growth in China, which lowers the rate of oil demand growth
- Reductions in marginal cost of supply for U.S. tight oil production
- Some cost deflation maintained
- Greater share of low-cost OPEC supply in market

Source: ConocoPhillips based on Rystad
Long-Run View of Investment-Based Price Cycles

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<th>Price Collapse (months)</th>
<th>Rigs Lag (months)</th>
<th>Production Lag (months)</th>
<th>Price Recovery (months)</th>
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Source: ConocoPhillips, based on historical observation.
Lifting Export Ban Prevents Steep Discounts on U.S. Crude Prices

- With U.S. crude production in decline, domestic crude oil price discount is currently small.

- Without exports:
  - Seasonal discounts would have been possible today when U.S. refineries are in steep maintenance turnarounds.
  - The domestic crude price discount would have grown over time as the global oil price recovered and U.S. crude production growth resumed.

- Crude exports are more likely to be economic when U.S. refineries are in turnaround.

U.S. domestic crude price discount has been greatly reduced.
U.S. Crude Oil Export Destinations More Diversified Today

U.S. Exports of Crude Oil (MMBD)

Canada’s share of U.S. exports cut from 90-100% to about 50% in a few months

Source: U.S. Department of Energy, Energy Information Administration
Observations

• U.S. tight oil supply will be needed to fill any supply gap because it can be brought on the fastest and it has relatively attractive economics

• The U.S. tight oil supply response time is not as short as commonly believed

• Inventory changes are likely to become the short-term balancing mechanism

• Implies higher oil price volatility as price signals are needed to build or draw inventories and to ramp U.S. tight oil up or down