Struggling to Find Balance

February 2016
The North American Gas Market: Will demand ever catch up?
Searching for demand to balance supply

Market balance turns toward lower prices

El Nino Winter

Lower oil prices?

Demand surge

Higher natural gas prices

$5.00

$4.00

$3.00

Lower natural gas prices

Continued upside supply surprises

New Marcellus infrastructure

Superfracking

50502-S4
Source: IHS Energy

© 2015 IHS
N Am Gas Resource Chart: Reserves and Cost

- ~ 850 Tcf at $3.00
- ~ 1350 Tcf at $4.00
Key takeaways—Big picture

• IHS Energy’s new supply forecasting methodology is showing a massive resource base that could potentially continue getting bigger with improving well EURs and a Utica play that still hasn’t been proven up.

• Well costs and breakeven prices continue to fall and now look to stay below $4/MMBtu in real terms through 2040.

• Upstream transition from exploration to manufacturing type operation means we can drill it up faster than we can grow demand or build infrastructure.

• Power generation demand growth is real but the industry still hasn’t adequately dealt with how to pay for firm supply for lower load factor generation, necessary for grid reliability.

• Massive pullback in rig activity is causing well costs to fall. Slower long term demand growth argues against much pricing pressure in the future.

• The gas market was somewhat in balance in summer 2015 but fall Marcellus/Utica supply surge drove storage balances to record levels and into injection constraints.

• North America and global energy markets (oil, coal, LNG, NG) expected to be demand-constrained with excess capacity pressuring utilization levels.

• The North American market is looking at long-term gas-on-coal and gas-on-gas competition.
US lower-48 gas production growth

US lower 48 dry gas production growth

Several years of production at around 50 Bcf/d

Barnett, Fayetteville, Woodford shales dominate growth

Haynesville, Marcellus shale plays drive growth

December 2014
73.7 Bcf/d, up over 24 Bcf/d from January 2007

Shift to wet gas and oil drilling

Outlook

January 2007
49.7 Bcf/d

Hurricane Ike

57% fall in rig count drives 3% reduction in production

September 2009
54 Bcf/d

Hurricanes Katrina, Rita

Notes: Bcf/d = billion cubic feet
Source: EIA and IHS Energy

© 2016 IHS
North American production growth centers on the Marcellus/Utica

Projected supply growth in the US Lower 48 and Canada (from Jan 2014 levels)

Source: EIA, Canadian pipeline data scrapes, IHS Energy

© 2016 IHS
IHS Energy has implemented a quintiles-based North American gas supply forecast model

Performance Evaluator categorization of Marcellus wells by quintile per peak production in barrel oil equivalent
New US lower-48 supply outlook focuses more production growth in Appalachia

October 2015 lower-48 natural gas productive capacity outlook


© 2015 IHS

September 2015 lower-48 natural gas productive capacity outlook


© 2015 IHS
Sustained lower prices and increasing focus on capital discipline keeping a lid on near-term production growth

- The Marcellus and Utica shales are the primary drivers of production growth through the forecast period. Marcellus and Utica productivity gains outstrip infrastructure growth in the near-term, keeping the regional basis depressed. Weather could also play a role as forecasts indicate the possibility of a warm winter.

- IHS projections for two quarters of sub-$45 WTI oil prices is a major component of the outlook for associated gas.

- Increased focus on capital discipline in 2016 in both oil and gas directed drilling will be a key factor affecting development plans and rig counts.
Full US gas production with associated gas

- Using play-level production data, IHS estimates associated gas at ~25% of total Lower-48 production. Near-term, associated gas contributions are projected to fall due to an oil drilling decline driven by low oil prices.

- A rebound in associated gas volumes is forecast to begin in late-2016/early-2017.

- Increasing activity in the Eagle Ford and Permian Unconventionals are the key drivers of associated gas through the forecast period.
North American gas demand will surpass 140 Bcf/d by 2040

North American natural gas demand

Source: IHS Energy, EIA and Statistics Canada

© 2016 IHS
Components of North American gas demand growth—A longer-term slowdown

North American gas demand growth over 2010 levels

<table>
<thead>
<tr>
<th>Year</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Power</th>
<th>Vehicles</th>
<th>Other</th>
<th>LNG Exports</th>
<th>MX Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td>3.4 Bcf/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2023</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2027</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2029</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2031</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2033</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2037</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2039</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bcf/d

Source: IHS Energy, EIA and Statistics Canada
Future pipeline expansion

Future natural gas infrastructure

<table>
<thead>
<tr>
<th>Pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sasabe – Guaymas</td>
</tr>
<tr>
<td>2 Guaymas – El Oro</td>
</tr>
<tr>
<td>3 El Oro – Mazatlan</td>
</tr>
<tr>
<td>4 Ojinaga – El Encino</td>
</tr>
<tr>
<td>5 El Encino – La Laguna</td>
</tr>
<tr>
<td>6 <strong>Waha – Presidio</strong></td>
</tr>
<tr>
<td>7 <strong>Waha – San Elizario</strong></td>
</tr>
<tr>
<td>8 San Isidro-Samalayuca</td>
</tr>
<tr>
<td>9 Samalayuca – Sásabe</td>
</tr>
<tr>
<td>10 Tuxpan – Tula</td>
</tr>
<tr>
<td>11 Supply to BCS</td>
</tr>
<tr>
<td>12 <strong>Colombia – Escobedo</strong></td>
</tr>
<tr>
<td>13 Tula-Villa de Reyes</td>
</tr>
<tr>
<td>14 Villa de Reyes – Guadalajara</td>
</tr>
<tr>
<td>15 <strong>Texas – Tuxpan</strong></td>
</tr>
<tr>
<td>16 <strong>Nueces – Brownsville</strong></td>
</tr>
<tr>
<td>17 Laguna – Aguascalientes</td>
</tr>
<tr>
<td>18 Los Ramones I</td>
</tr>
<tr>
<td>19 Ramones II – North</td>
</tr>
</tbody>
</table>

Note: UC = Under construction.
Source: IHS Energy, CFE, CRE

© 2015 IHS
Pipeline exports to Mexico will reach 5.6 Bcf/d by 2025, double the 2015 levels

Source: IHS Energy, EIA
North American LNG projects in the current outlook

North American regasification facilities and advanced liquefaction projects

[Map showing potential export sites, existing regas and potential export sites, and under-construction export sites.]

Source: IHS Energy

© 2016 IHS
North American LNG exports in the current outlook signs point to a potentially looser market

<table>
<thead>
<tr>
<th>Year</th>
<th>Canada Capacity</th>
<th>Canada Volumes</th>
<th>US Lower-48 Capacity</th>
<th>US Lower-48 Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>1 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>2 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>3 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>4 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>5 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>6 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2022</td>
<td>7 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2023</td>
<td>8 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2024</td>
<td>9 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td>10 Bcf/d</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: IHS Energy
Rapid demand growth leads to higher natural gas prices, but they remain under $4 per MMBtu until late 2021

January 2016 Henry Hub history and forecast

$/MMBtu

Marginal cost range 2

IHS forecast, January 2016

Henry Hub

NYMEX, 11 January 2016

Notes: MMBtu = million Btu.
Source: IHS, CME, Intelligence Press

© 2016 IHS
Crude Oil Markets – Closer to Rebalancing
Current low oil prices are reducing upstream investment – eventually oil supply will drop to meet demand.
Balance will (eventually) be reached and the price will rise materially

- The low oil prices are being met with banks and other analysts revising down their near-term price forecasts (which IHS has also done) along with extending their views of the depth and breadth of the price decline (which IHS is not doing at this time).

- These are the key data points we are watching to help inform us if we need to adjust our base case to an extended low price track rather than a recovery year:

  - **US production declines**: Relatively slow shale slowdown has been offset with higher Gulf of Mexico production. These declines are expected to continue in our current base case.

  - **Iran’s return**: We expect another ~400,000 b/d from Iran by mid-year. We are watching for signs of stronger and sustained production increases as well as the potential to trigger an active market share battle with Saudi Arabia which causes them to increase production even further.

  - **Non-OPEC/non-US**: We forecast no significant growth in this supply source and potentially declines, expecting an end to the production growth caused as some projects have come on slightly faster and field maintenance was shortened.

  - **Demand**: Despite stronger headline economic growth, we do expect slower demand growth this year, but at 1.2 MMb/d, it is still sufficient to tighten the market at this level when combined with lower production.

  - **Stocks**: One of the key assumptions in some analysts earlier low price predictions was “running out of storage space” which would indicate a very high contango, pushing the prompt price downward. While stocks are up, there is still an indication of available storage capacity.

- Longer term, to move to a lower price track, costs will need to fall even further, allowing investment to continue.
Benchmark crude price outlook
Brent will lower to $46.46/bbl in 2016, rising to $55.71/bbl by 2017

Assumptions
Low prices continue to put pressure on US production

OPEC maintains production and incremental Iranian barrels begin entering the market. Additional 400,000 b/d by mid-2016.

Demand growth slows relative to 2015’s strong growth but remains well above 1 MMb/d.

Price forecast risks
Upside: Iranian barrels do not enter the market in large quantities. Conventional production begins to slow more rapidly than expected. Financial short squeeze pushes price up in near term.

Downside: Continued bearish news without a break, balance does not occur until 2017 as production remains too high from US, non OPEC, non US.

Brent and other benchmark crude oil price outlook to 2017
Quarterly average price per barrel

Source: IHS; Argus Media Limited
Notes: LLS = Louisiana Light Sweet. WTI = West Texas Intermediate.

© 2016 IHS
Despite the oversupply of crude oil we see right now, future barrels are going to be more expensive to find and produce.
US tight oil production will likely peak in the late 2020s
Thin OPEC spare capacity will become a serious issue in late-2016

OPEC spare crude oil production capacity

Source: IHS

© 2016 IHS
The call on OPEC production will increase as non-OPEC supply sources are unable to keep pace with demand

### OPEC

- **Saudi**: only OPEC country intentionally not operating at capacity, but higher production than in recent years
- **Iran**: Recent lifting of sanctions may increase production above this forecast
- **Iraq**: Sectarian tensions will delay crude production
- **Venezuela**: economic mismanagement deferring needed investments
- **Nigeria**: hard to find capital for deepwater projects
- **Libya**: failed state - expect production below capacity

### Non-OPEC

- **Canadian** oil sands development growth is reduced but not reversed
- **Brazil**'s production will be delayed due to high upstream costs, project delays, currency devaluation, reduced oil prices and ongoing corruption scandal
- **Kazakh** supply growth depends on successful restart of the Kashagan field, likely post 2025
- **Mexico**'s energy reform may stabilize production in the next decade but declines will continue medium term
- **Low prices** will exacerbate the **North Sea** production decline
- **Russian** crude oil output will decline slowly due to sanctions and oil prices
- **Chinese** output expected to remain stable

**Source:** IHS

### OPEC & Non-OPEC Crude Production (Ex. Seg. Condensates)

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-OPEC</th>
<th>OPEC</th>
<th>% OPEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Million barrels per day

© 2015 IHS
The base case for Brent crude oil included an oversupply mini-cycle following a recovery period.
Risks to the crude oil forecast

• **Saudi crude oil output could be above our projected 10 million barrels per day**, thus lowering global spare capacity below 2.5 million barrels per day and exposing global markets to potentially very high prices in the case of a market disruption.

• IHS assumes that **North American tight oil production crests next decade** and that the scale of its success is not replicated elsewhere.

• IHS assumes that **key OPEC countries will be able to overcome their critical aboveground issues**; these include Venezuela, Iraq, Iran and Libya.

• We expect **crude oil growth to be lighter through 2025** driven by North American tight oil; longer term the light sweet crude growth will subside and be replaced by heavier oil; an extension of the North American tight oil production would impact our assumptions around light heavy spreads and the call on OPEC.

• The Rivalry (Base Case) scenario assumes **competition among primary energy sources, with natural gas and renewables gaining share among transportation fuels**. Failure of natural gas and renewables to achieve that higher share will likely increase the call on crude oil.