THE UNPRECEDENTED UPSURGE OF OIL PRODUCTION CAPACITY AND WHAT IT MEANS FOR THE WORLD

Leonardo Maugeri
UNDERESTIMATION OF SUPPLY

★ “Peak-Oil” production mantra, in spite of ever-growing supply
★ Price, Technology, and Oil Industry Behaviour not considered
★ Supply still calculated as a function of demand, even if its investment-cycles are asynchronous with respect to demand
★ Few analyses based on bottom-up, field-by-field supply
★ General underestimation of huge unconventional oil potential: the case of U.S. shale/tight oil

The market is still convinced that oil supply capacity will remain structurally tight, but it now admits that short-term weakness of demand may provoke a temporary decline of oil prices

IT’S NOT LIKE THIS
THERE’S PLENTY OF OIL UNDERGROUND
World known recoverable oil resources (Trillion barrels)

2010 World oil consumption = 32.3 billions barrel

Recoverable resources
1.3
70% in the U.S., Canada and Venezuela

World cumulative consumption
1

World remaining proven reserves
1.2

70% in the Middle East

OIL IN PLACE unconventional *
7-9

OIL IN PLACE conventional *
7-8

Leonardo Maugeri, Harvard Kennedy School
WHY IS IT SO DIFFICULT TO ASSESS OIL RESOURCES?

**Geology Hard Reality**
No great underground oil lakes of caves, but only solid rocks.

No current technology may ensure an exact answer to the question “how much oil lies beneath?” Drilling is always necessary to assess, and even drilling may be deceitful.

**Limited Exploration**
Only 1/3 of world’s sedimentary basins has been explored.

65% of world’s exploration wells (new wildcats) drilled in the U.S. alone in the last 30 years.
PRICE AND TECHNOLOGY ARE THE MOST CRITICAL FACTORS IN DETERMINING RESERVE AND PRODUCTION GROWTH

TECHNOLOGY
On average, less than 35% of already known oil is extracted today using current business-as-usual technologies.

More expensive tech may dramatically increase oil recovery.

PRICE - COST
Oil companies make their investment decisions assuming a conservative (much lower) oil price in the long term (20 years).

Only 20% of already recoverable resources are not profitable (double digit IRR) with an oil price (Brent) lower than $70 per barrel (at current costs).
AN EXPLORATION&DEVELOPMENT BOOM IS UNDERWAY
A huge investment cycle started in 2003, and boomed from 2010 on

2010-2012 BOOM: around $1.5 trillions invested for oil&gas E&P

EXPLORATION&DEVELOPMENT RECORD
more than $550 billion in 2011

EXPLORATION SPENDING RECORD
about $90 billions in 2011

2012: AN ALL-TIME RECORD?
Preliminary estimates shows that the pace of E&P investments is set to overcome $600 billions

The outcome of this boom - e.g. new production - will be asynchronous to demand
A Note on Methodology

Global field-by-field analysis =
Oil investments underway based on proprietary database

Additional unrestricted production =
targeted production of each investment, no risk-factor associated

Additional adjusted production =
actual possible production after cutting targeted production to take risk-factors into account

Risk-factors =
calculated on the basis of personal experience and assessment, and disclosed for each country

Depletion and Reserve Growth =
natural decline of already producing oilfields plus possible increase of their producible reserves, due to the discovery of new satellites or use of advanced technologies to recover more oil
WHERE WILL THE NEW PRODUCTION COME FROM? -1
(field-by-field estimates)

A “mosaic” of new oil production capacity is growing worldwide, implying an “unrestricted” (no risk-adjusted), additional output of a little less than 50 million barrels per day by 2020.
ADDING NEW PRODUCTION TO OLD ONE  
(preliminary field-by-field estimates)

★ New oil production will integrate current world’s production capacity

★ World’s oilfields DEEPLETION rates appear to be overestimated, due to an underestimation of technological advance and RESERVE GROWTH

★ To 2020, the biggest oil producers tend to maintain a relatively stable production from older oilfields

★ Only four big producers (Norway, UK, Mexico, and Iran) may face a net decrease of their current production capacity

As a result, current world’s oil capacity of about 93 mbd (end of 2011) will decline more slowly, probably at a 2-3 percent rate
WHAT COULD THE OUTCOME BE?
World liquids production capacity excluding biofuels (Million b/d)

The biggest increase since the 1980s

ECONOMIC PREREQUISITE
An oil price (Brent) higher than $70 bl to 2020
Country-by-country evolution of oil production capacity to 2020
(Million b/d)
U.S. SHALE-TIGHT OIL: A NEW PERSIAN GULF OR A HYPE?
1 - The case of Bakken Shale

PRICE (1999) BAKKEN’S POTENTIAL ASSESSMENT

271-503 billion barrels of original oil in place
Mean of 413 billion barrels
206 billion barrels of recoverable oil
Preliminary evidence suggests that Price’s analysis was right.
### Additional production from U.S. shale/tight oil plays by 2020
(million barrels per day)

<table>
<thead>
<tr>
<th>Shale Play</th>
<th>Additional unrestricted production</th>
<th>Additional adjusted production</th>
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</thead>
<tbody>
<tr>
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<tr>
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<td>Niobrara/Codell</td>
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<tr>
<td>Others</td>
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<td>0.3</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>6.6</strong></td>
<td><strong>4.17</strong></td>
</tr>
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</table>
The obstacles/1: the inadequate U.S. oil transportation system, and the structure of the refining complex

The real obstacles/2: the fear of Hydraulic Fracturing

But...

The U.S. shale revolution is the biggest oil revolution since decades

It will allow the U.S. to produce 65 percent of the oil it consumes (or about 90 percent considering Canada’s oil imports)

It will likely represent the single, most important factor of economic growth and job creation in the next few years
OVERESTIMATION OF DEMAND?

★ Hype about China and Emerging Countries’ oil “bulimia”

★ Underestimation of “Peak-demand” in OECD countries: it’s not economy alone

★ Incapacity to assess the impact of ageing population, energy efficiency spurred by new legislations, technological innovation, consumers attitude

★ Long-term predictions of Emerging Countries demand extrapolated from past/present consumption trends

UNLESS OIL DEMAND WERE TO GROWTH AT A SUSTAINED YEARLY RATE OF 1.6% TO 2020 (CURRENT RATE= LESS THAN 1%),

A COLLAPSE OF OIL PRICES IS ALWAYS POSSIBLE
MAJOR GEOPOLITICAL IMPLICATIONS

★ The Western hemishpere could become virtually independent from the rest of the world, and the major source of oil production growth over the next decades

★ However, the U.S. won’t be insulated from the global oil market, and whatever happens in the Middle East will always influence the oil market

★ Middle East’s oil will be only one pillar - not the Center of Gravity - of the world’s oil market

★ Asia to become the key market for Middle Eastern Oil, and China a U.S. political competitor in the region, as well as in Africa

★ China will try to extend its grip on Venezuela and Canada too (fields, pipelines, etc.)

★ Opec strained by Iraqi oil resurgence and global production growth
Back-up
## World’s Oil Production Capacity to 2020 (MBD) - 1/2

<table>
<thead>
<tr>
<th>Country</th>
<th>Production Capacity 2011 - end</th>
<th>Additional Unrestricted Production</th>
<th>Additional Adjusted Production</th>
<th>Net production additions or losses*</th>
<th>Production Capacity 2020</th>
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</table>

| Sub-Total | 75.3                         | 47.54                             | 27.4                           | 18.6                                | 93.9                     |

| Others    | 17.7                         | 2                                 | 1.2                            | -1                                  | 16.7                     |

**WORLD TOTAL** | 93                          | 49.54                             | 28.6                           | 17.6                                | 110.6                    |

*Of which:*

| Crude Oil | 78 | 86 |
| NGLs      | 15 | 24.6 |
How hydraulic fracturing works

- Sand keeps fissures open
- Natural gas flows from fissures into well
- Mixture of water, sand and chemical agents
- The shale is fractured by the pressure inside the well.

Adapted from: Al Granberg/ProPublica