THE PEAK OIL DEBATE
As The EIA Turns 30

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By:
Matthew R. Simmons, Chairman
Simmons & Company International
Should We Debate “Peak Oil”

- Oil seems non-renewable.
- High percentage comes from “mature fields.”
- High percentage of new fields are offshore with sharp peaks.
- Oil supply will peak, someday.
- Timing is only debate.
- Fog of non-transparency creates the debate.
- With precise supply data, the debate would end.
Can The EIA Give The World A 30th Birthday Present?

- Like the IEA, EIA was created to collect timely, accurate energy data.
- Its oil supply model still relies on 3rd party input or guesses.
- The 3rd party models claim solid field-by-field data.
- But, OPEC, Russia and many other producers keep this data as “state or corporate secrets.”

Is it important to have real data? Can anyone forecast future supply without it?
Fuzzy Terms Create Great Confusion

Some fuzzy terms:

- Decline rates: Does this mean depletion?
- Depletion: Does this mean oil is gone?
- Resource endowment: Amount of original oil that might be in place ("OOIP")
- Recoverable resource: Amount of OOIP that might be recoverable
- Flow rate: The physical oil volume coming out of a well
- Peak flow rate: The highest oil volume a well will produce
- Water cut/gas coning: Why the flows decline (crowding out)

These terms get intermingled too often.
**Conventional Vs. Non-Conventional Oil**

- Another confusion is intermingling “conventional” oil with family of “non-conventional oils.”
- Conventional is also not precise term.
- Highest quality conventional is extra light crude flowing at high volumes from pressurized reservoirs.
- Conventional heavy oil: Tar melted into heavy oil by steam.
- Non-conventional oil: All sources worse than heavy oil:
  - Low flows
  - Low quality oil
  - High water content and energy intensive to produce
Stark Difference Between High Quality Crude And Oil Sands

- Arab Light/Extra Light used to come from North Ghawar, Abqaiq and Berri at 40,000 to 60,000 B/D per well (these high flow rate wells are now depleted).

- Shell Oil’s Athabasca Oil Sands Project wants to expand volume of flow by 100,000 B/D (from 155,000 B/D now):
  - Latest cost estimates: $20 billion (est.)
  - Time to create: 5 – 7 years (perhaps)

There is no comparability between high flow light oil and Canadian oil sands, tar is even worse.
Non-Conventional Issues Worsen When Expanded To Orinoco Oil Belt And Oil Shale

- Estimated volumes of both Orinoco Oil Belt and oil shale are vast.

- No technology has yet created a non-energy intense way to turn either into high flows of usable oil.

- Whether the water usage is worse than energy expended to create energy should be “debated.”
Over the years, believers in Abiotic Oil arise to refute “Hubbert’s Peak.”

Abiotic Oil is being constantly created from migrations of magma gasses.

Newest Theory:
- Jupiter’s Titan
- Atlantic Trench

No one, thus far, has figured how to produce Abiotic Oil.
“Remaining Reserve Estimates” Also Fuzzy

- Remaining proven reserves are non-scientific guesses on remaining OOIP and amount that can be recovered.

- Recent slurry of technical papers question ability to guess these parameters. What is needed:
  - Well-by-well flow rates (not gathered at GOSPs)
  - Water cut by well
  - Numerous well logs throughout heterogeneous fields
  - Core samples throughout any carbonate fields

- Without all four inputs, reservoir simulation models are simply educated guesses without sufficient information.

This is fuzzy logic².
Data Scarcity Rampant Throughout Middle East

- Only small numbers of super giant Middle East fields have metering at the wells of oil and water:
  - Too many aggregated by GOSP gathering systems

- Small number of cores from producing rocks hinder all future modeling:
  - This complex exercise was too risky and costly when it seemed Middle East Oil was everywhere
Many Deepwater Fields Face Same Data Problems

- The expense to core and flow test deeper water fields was very high.
- If rocks were also in need of fracturing, costs grew even higher.
- Too many offshore “failures” came through drilling minimal amount of appraisal wells and rarely flow testing for any length or cutting a core sample.
It is factual that many OPEC producing countries arbitrarily doubled or tripled reported “proven reserves” in 1982 – 1988 era.

Then, the data stayed stagnant for next two decades.

This created illusion that the numbers were extremely conservative.

“At least 300 billion of reported global reserves were imagined.” - Retired Senior Officer of an NOC
High Flow Rate Wells Do Decline

- Some drain every layer of reservoir oil ASAP.
- This is necessary to create sufficient IRR.
- But, it led to “monster decline rates”:
- See pictures of 24 “typical” fields:
  - Real production rates of 20,000 to 100,000 B/D
  - A few super giant fields peak at 1.5 to 2.2 MMB/D
  - A few in between 100,000 B/D and 1.5 MMB/D
How Fast Do Oil Fields Decline?
(GOM Deepwater Field Production – Part I)

- Vacuum of solid decline data is alarming.
- But digging into data does reveal shocking pictures.
- “A picture is worth a 1,000 words”:

Source: Minerals Management Services
How Fast Do Oil Fields Decline?
(GOM Deepwater Field Production – Part II)

Source: Minerals Management Services
How Fast Do Oil Fields Decline? (North Sea – Part III)

Source: Saga Petroleum Report
Cantarell Is A Classic Decline Curve Study

Source: Pemex
Prudhoe Bay Decline

Source: Government Sources
Yibal, Oman

Oil Production Yibal Oman
1969 - 2003

1994: start of production with horizontal wells
Oil demand was thought to peak in 1988 – 1994 at 66 – 68 MMB/D. Instead, it grew to over 88 MMB/D by early 2008. This unplanned growth used up 99% of world’s spare capacity. Demand growth came despite ten fold rise in oil prices.

China and India are on the march to prosperity. Their 2.4 billion people want to drive cars:
- China is now buying 6 – 8 million vehicles a year
- India’s current rate (average motorbike) is only 1.8 million/year
Oil Demand Headed Towards 100 MMB/D

- Unless global economies collapse, this should be planned to happen (on all current trends).

- Betting on hard landings in India and China a dangerous bet.

- Once 100 million mark is reached, system feeds on itself to further this growth:
  - Prosperity in many resource nations creating fast internal growth
  - $100+ oil is creating prosperity in Middle East
Global Crude Oil Had Peak In May 2005

- This record (EIA data) 74.3 MMB/D is now almost 3 years old.
- 32 added monthly supply estimates have failed to breach this record.
- Climbing to 75 – 77 MMB/D quickly becoming far-fetched dream.
- The gap to supply 88 MMB/D is spread thin and not sustainable:
  - NGL’s
  - Refinery processing gains
  - Sliver of biofuels

Source: EIA Monthly Energy Report
Demand does not slow down when supply slows.

Draining usable inventories is last great supply frontier.

We have no gauge when usable “stocks” dwindle from ¼ full to “empty.”

Empty creates shortage that morphs into a giant “run on the energy bank.”
Two Added “Above Ground” Supply Risks Add Urgency To The Crisis

- **Rust:** Most of the oil and gas infrastructure is built of steel and beyond original design life:
  - High percentage is un-inspectable until leaks happen
  - “Rust” never sleeps
  - We need to rebuild 80% of current infrastructure

- **Maturity of workforce:** High percentage of global energy work force is too old and retiring:
  - The ex-pats around the world are “coming back home”
  - Talent wars and poaching are getting fierce

*Alaskan Pipeline*
“For Lack Of A Nail, The War Was Lost”

- Does it matter how the 1871 Great Chicago Fire started? (i.e. whose lantern the cow kicked over)
- Above ground risks will hamper supply but can ultimately be fixed (in decades).
- Below ground risks are the age of reservoirs, declining quality of heavier tainted oil and deteriorating quality of producing reservoir rocks (these cannot be fixed).
Peak Oil Is Extremely Real
And Extremely Risky

- There is nothing fuzzy when oil demand outstrips faltering supply.
- It creates a clash between energy haves and have nots.
- It can lead to social chaos and war.
- Ignoring the risk or hiding behind secret undisclosed supply data could be a colossal mistake.
The Path Through A Mine Field
(Or “Decision Making Under Uncertainty”)

2008

88 MMB/D

2009

2010

2011

2012

2013

2014

2015

7 year horizon

Odds

1.5% per annum (97 MMB/D)

1.0% per annum (94 MMB/D)

0.4% per annum (90 MMB/D)

FLAT

2.0% decline per annum (76 MM/BD)

4.0% decline per annum (66 MMB/D)

Demand

Supply
Summation Of Odds

- Flat demand and flat supply = “best case?”
- 1% demand growth + 2% production decline = “most likely?”
- 1.5% demand growth + 4% decline = “shortages ahead?”
- None represent “worst case.”

THIS ISSUE IS THE MOST SERIOUS RISK TO SUSTAINING THE 21ST CENTURY.
Energy production needs to be close to where energy is used.

In USA, 54% of population and homes are located in counties on our coasts:

<table>
<thead>
<tr>
<th>Coastal Counties</th>
<th>People (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta</td>
<td>69</td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>20</td>
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<tr>
<td>Great Lakes</td>
<td>28</td>
</tr>
<tr>
<td>Pacific</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>157</strong></td>
</tr>
</tbody>
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Around the rest of the world has the same demographics.
History’s Great Lessons

It is said that there are only three great lessons to be learned from history:

1. “Who the Gods wish to destroy, they first make mad.”
   
   Euripides (Greek Philosopher (406-480 BC))

2. “Though the mills of God grind slowly, yet they grind exceedingly small.”
   
   Sextus Empiricus (ancient Greek Philosopher)

3. “History repeats itself. That’s one of the things wrong with history.”
   
   Clarence Darrow (US defense lawyer (1857-1938))