2008 ASPO-USA Peak Oil Conference Proceedings

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Petroleum 101

Ken Verosub
Geology Dept.
UC Davis
The Good Old Days
Making Oil

Source rock

Reservoir rock

Cap rock

Trap
The oil window.

- Not too hot.
- Just right.
- Not too cold.
Ventura anticline.

1,200,000-year-old volcanic ash layer
Oil is trapped in traps.

Stratigraphic and structural...
Anatomy of a Salt Dome
Avery Island, Louisiana
Gravity over a Salt Dome
Reflection Seismology
Thumper Truck

Geophone Array
Seismic Reflection at Sea
3-D Seismic Profile
TAKE HOME MESSAGE

Oil forms under special conditions.

It takes time to form.

There’s only so much of it.

It isn’t easy to find.

All the “easy oil” has been found.
Drilling for Oil
History of an individual well.
Signal Hill Oil Field, Los Angeles
History of an oil field.
The man who put it all together.

M. King Hubbert
1903 -- 1989
Father of the Hubbert Curve
Hubbert Curve of oil production
Hubbert’s Prediction for US Oil Production
Discovery and production
Houston, we have a problem.
Running a deficit
Newt Gingrich: Petroleum Geologist
Join your fellow Americans who are making their voice heard!

"As gas prices continue to increase, Congress continues to blame others while ignoring practical steps to stop the pain Americans are feeling at the pump. To lower gasoline prices and reduce our dependence on foreign oil, we need real solutions to our energy challenges.

We, therefore, are petitioning the U.S. Congress to act immediately to lower gasoline prices (and diesel and other fuel prices) by authorizing the exploration of proven energy reserves to reduce our dependence on foreign energy sources from unstable countries." -Newt Gingrich
$19.95 + S & H

(That's less than 5 gallons of Gas!)

- Drill Here Drill Now Shirts
- T-Shirts are made of 100% cotton
- All T-Shirts are preshrunk
- Please allow 3-7 business days for shipping
And even if he is right....
Finding oil won’t be easy or cheap.
Finding big fields is unlikely.
Bringing them on-stream will take time.
Total U.S. Oil Reserves
20.9 billion barrels
-that’s all there is, there ain’t no more.

Total U.S. Daily Consumption
20.7 million barrels per day (in 2005)
of which we import
11.7 million barrels per day

How much time do WE have left??
U.S. Domestic Daily Consumption
9.0 million barrels per day.

U.S. Domestic Annual Consumption
3.0 billion barrels per year.

\[
\frac{20.9 \text{ billion barrels total}}{3.0 \text{ billion barrels per year}} = 7 \text{ years}
\]
2015 ± 2

It’s crunch time.
Is this the future of US oil?
What will really happen
At some point people change their behavior and new technologies become attractive.

**Sticker Shock**
It costs less to fill up in the U.S. than in most other countries. The cost to fill a 17-gallon tank in select countries, in U.S. dollars:

<table>
<thead>
<tr>
<th>Country</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITED KINGDOM</td>
<td>$152.32</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>$68.10</td>
</tr>
<tr>
<td>SAUDI ARABIA</td>
<td>$7.99</td>
</tr>
<tr>
<td>VENEZUELA</td>
<td>$2.04</td>
</tr>
</tbody>
</table>
The U.S. was once the largest producer of oil in the world. Its production peaked in 1970, and it now ranks as the third-largest producer. Demand for oil has increased, forcing the U.S. to import 75 percent of the oil it needs.

In the meantime, we just import more oil.
But we are not alone.
Global Hydrocarbon Production
32 billion barrels per year

35 billion barrels per year
365 days per year

or

~100 million barrels per day

Maximum global oil production
2015 ± 2

It’s crunch time.
World Oil Production (History + Projections)
(Barrels/day)
Peaks 2010-2035

World consumed ~960 Billion barrels: 1930-2004
~0.95, 1.45, 2.06, 2.95 trillion barrels remaining
Transition: 2% growth curve to 5% decay curve

Historical Production

Future Production?

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Alternate realities
And there’s one more problem.
Projected world oil consumption
Growth of Chinese oil consumption.
Because everyone wants to drive an SUV!!
Change in oil consumption (1965-2006)
Projected world oil consumption
TAKE HOME MESSAGE

In about 7 years, demand for oil will exceed maximum total oil production.

Then what happens????
Are you ready to make the “ultimate sacrifice”?

And cut your oil consumption by half?
We would still be using 3.5x as much oil.
Is everybody happy, now?
Have a nice day!!