

Peak Oil by the Numbers

Data Visualization for Global Energy Trends

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Mazama Science



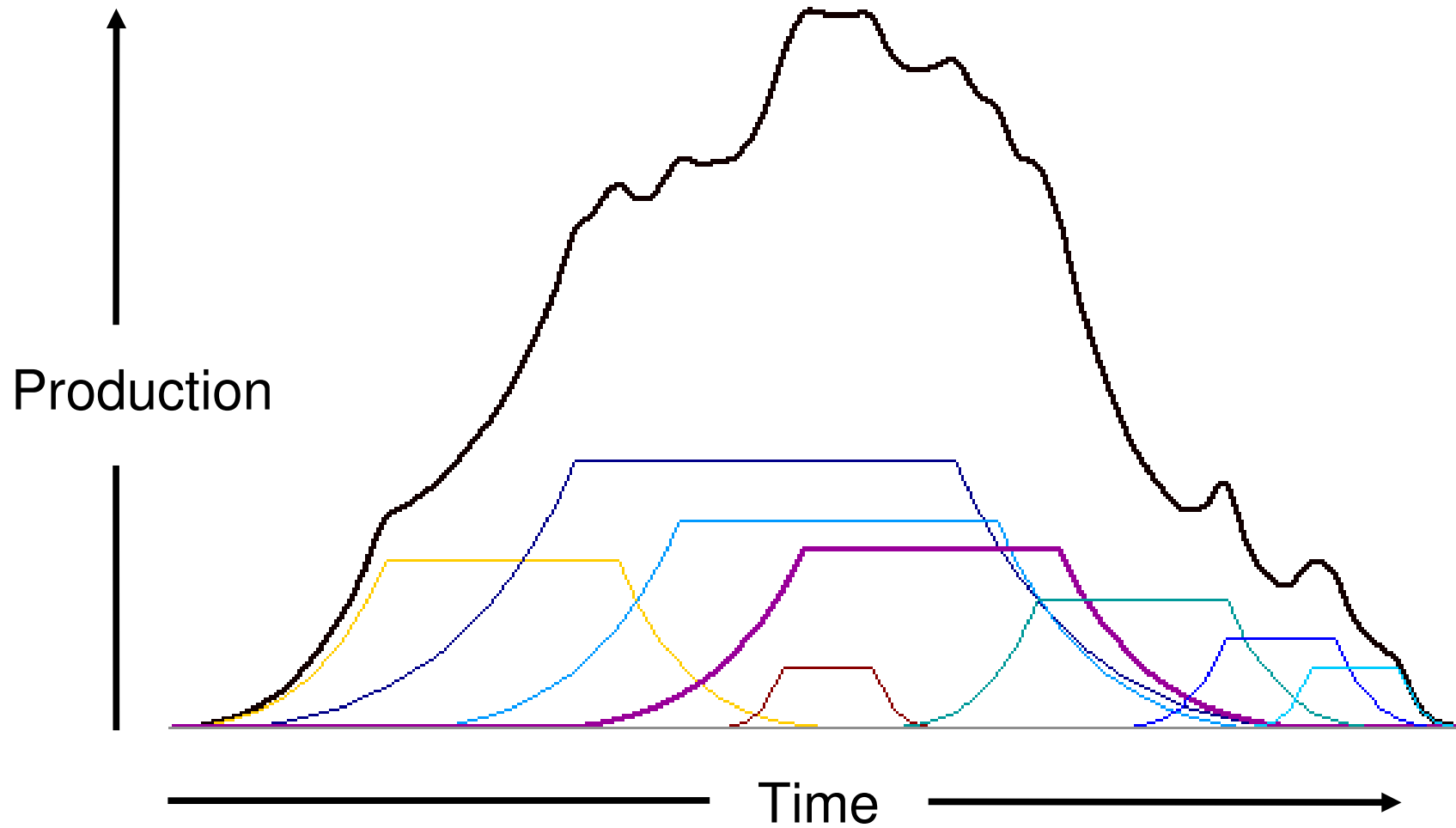
What is Peak Oil?

- Oil collects in certain geological formations.
- Oil companies drill and then pump out the oil.
- The rate of oil production rises to a maximum and then declines.

'Peak Oil' is defined as the maximum rate of production.



Why a peak?



Individual wells contribute to an overall peak.

Global peak?

- Every well in a field will reach a production peak.
- Every field will reach a peak.
- Every producing region will reach a peak.
- The world will reach a peak.

The only question is: When?



Peak Oil is a phenomenon, not a theory.

Why do we care?

- Americans love to drive, shop and fly.
- Scarce oil means expensive liquid fuels.
- That money leaves our economy.

\$4 gasoline occurred before the banking crisis.



Cheap energy underpins everything we do.



Shi[o]pping depends upon cheap oil.

Cheap energy underpins everything we do.



Agriculture depends upon cheap oil.

Cheap energy underpins everything we do.



Transportation depends upon cheap oil.

Cheap energy underpins everything we do.



Work depends upon cheap oil.

When will Peak Oil arrive?

Here's what we know:

- 1) Oil production at every scale goes through: rise – peak – fall.
- 2) Cheap oil is super important to our economy and lifestyle.

Here's what we should be asking:

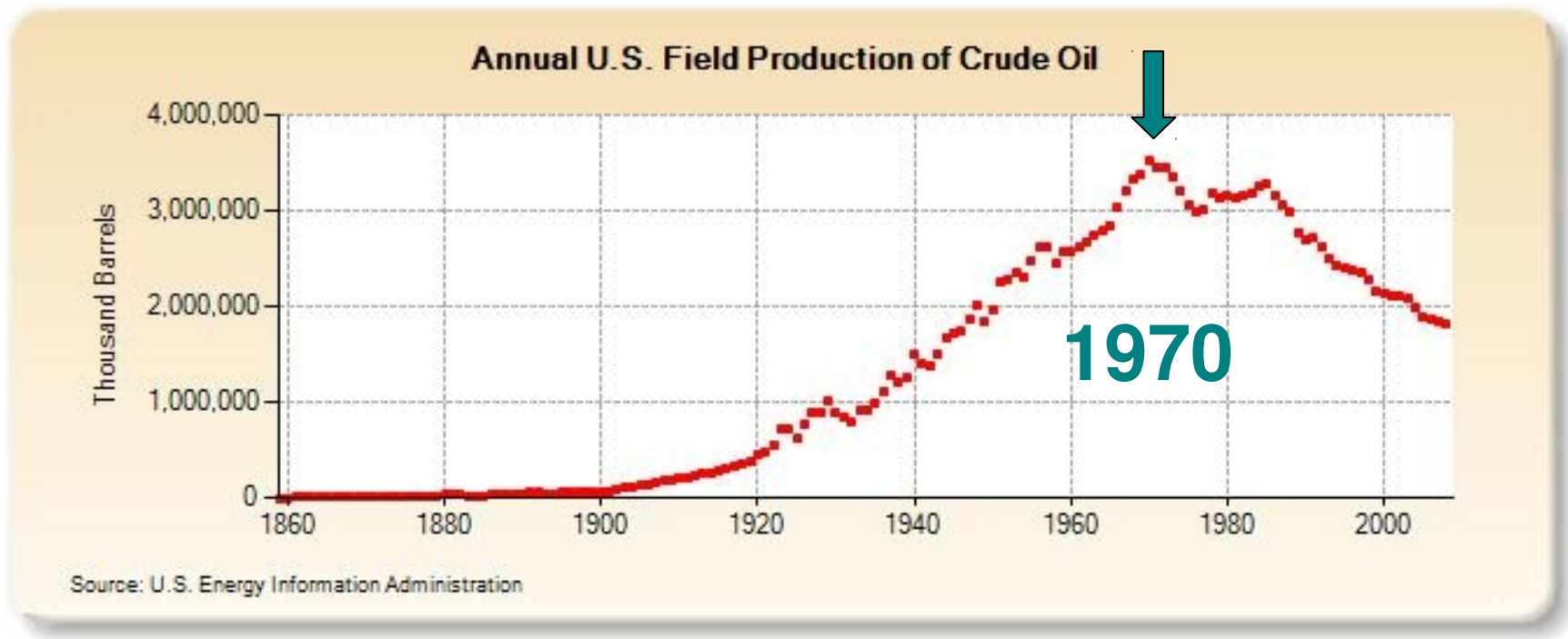
- 1) When will the US peak?
- 2) How much do we produce and consume?
- 3) When will the world peak?

When will US Peak Oil arrive?

Any guesses?

- 1950
- 1970
- 1990
- 2010
- 2030
- 2050

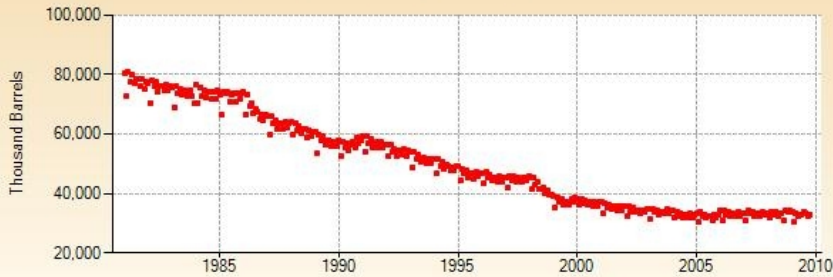
When will US Peak Oil arrive?



Looks just like we'd expect.

US top six oil producing regions in 2009: TX, AK, CA, offshore, ND, LA

Monthly Texas Field Production of Crude Oil



Monthly U.S. --State Offshore Field Production of Crude Oil



Monthly Alaska Field Production of Crude Oil



Monthly North Dakota Field Production of Crude Oil



Monthly California Field Production of Crude Oil

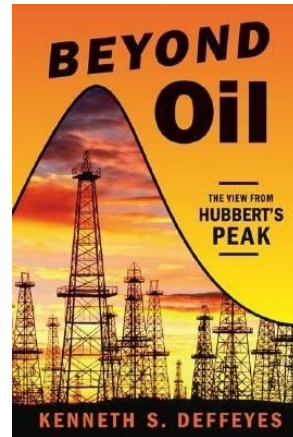
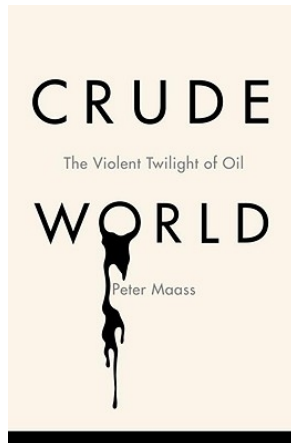
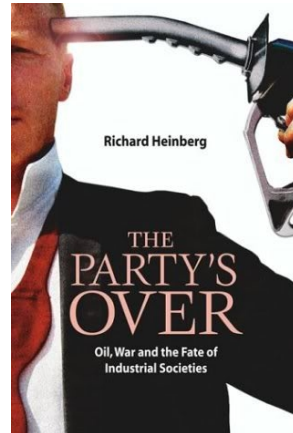
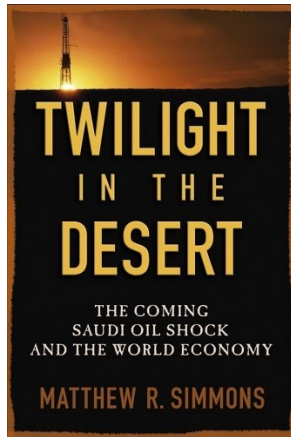


Monthly Louisiana Field Production of Crude Oil

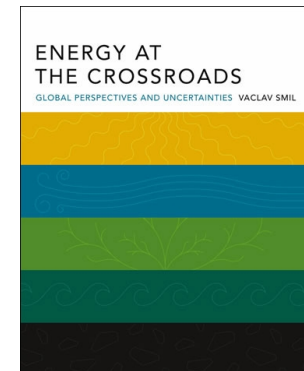
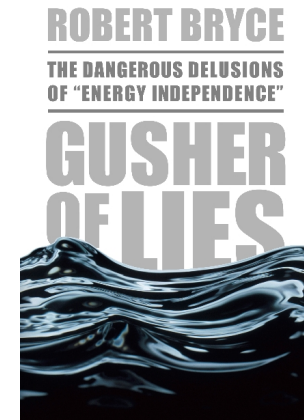
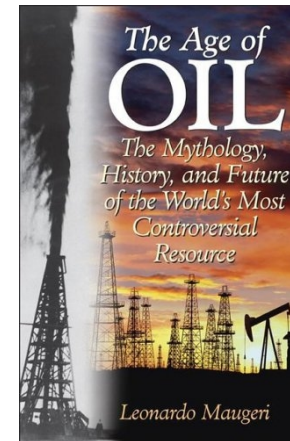


When will World Peak Oil arrive?

Sooner



Later

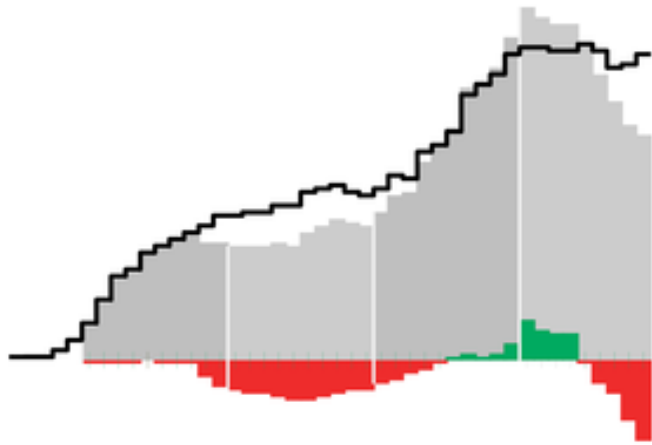


Forget the 'experts'. Look at the data!

- Energy Information Administration (US EIA)
- International Energy Agency (IEA)
- British Petroleum (BP)
- Joint Oil Data Initiative (JODI)
- Organization of Petroleum Exporting Countries (OPEC)
- national statistical agencies

Best single source is the BP Statistical Review.

But first, there's another story to tell.



**Number Crunchers
Pattern Recognizers
& Story Tellers**

Number Crunchers

- Fast
- Accurate
- Consistent
- > 50 years of evolution



Very good at what they do!

Pattern Recognizers

- Fast!
- Accurate ~
- Creative!!
- > 50K years of evolution



Awesome at what we do!

Pattern Recognition

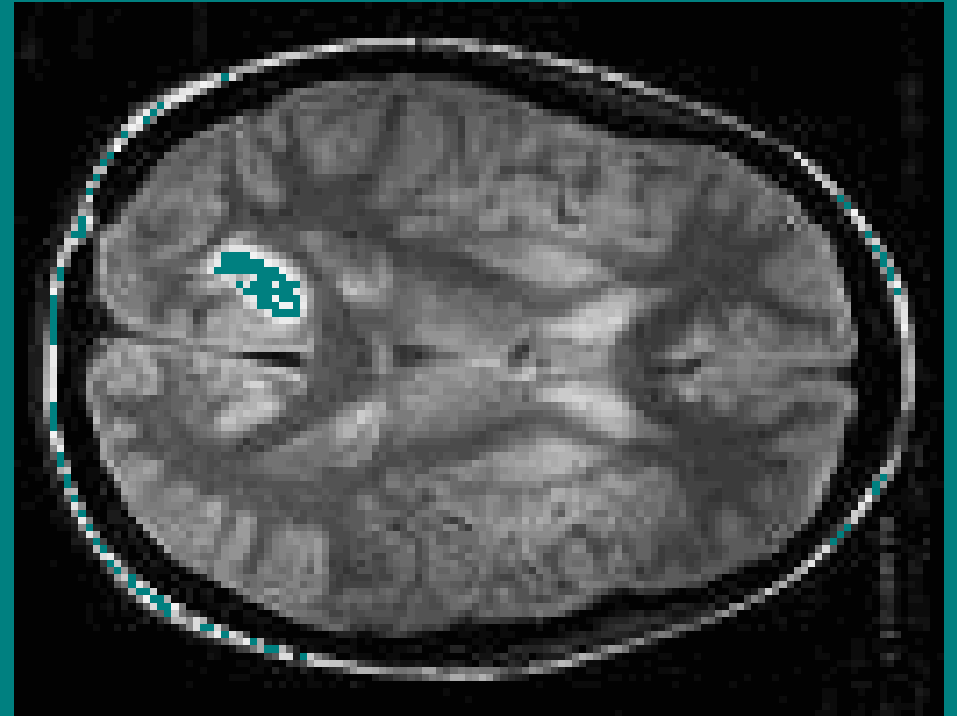
Humans are better than computers are recognizing patterns.



Pattern Recognition

Sensors can generate and computers can process millions of measurements.

When presented visually, humans recognize patterns instantly.



Pattern Recognition

Even abstract concepts can be displayed visually.

Some claim to see patterns even here!

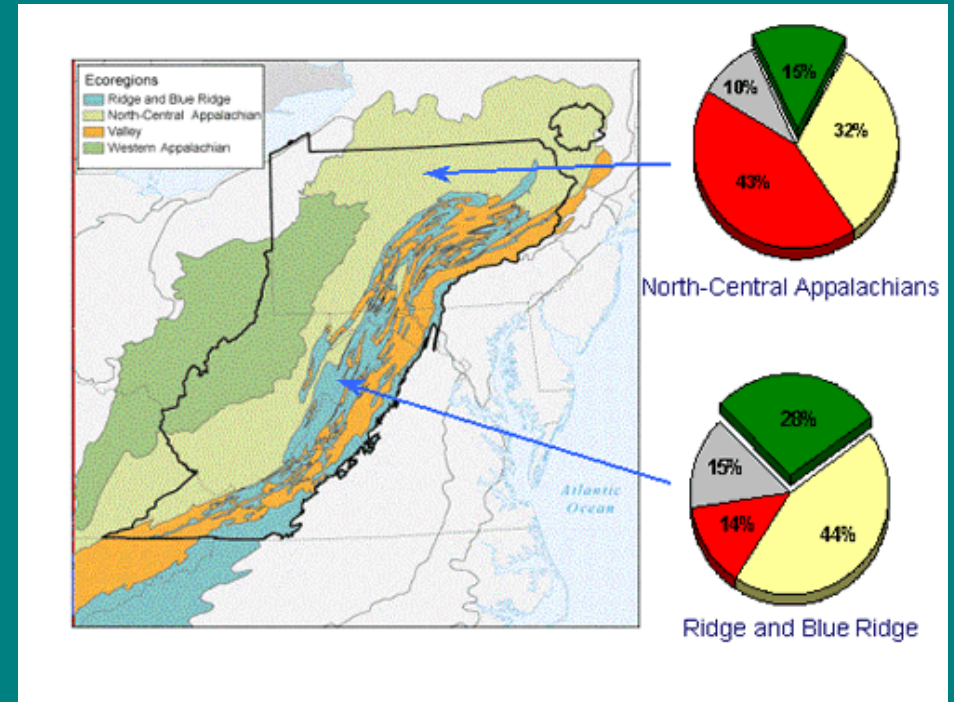


Pattern Recognition

When we want to tell stories with data we use graphics.

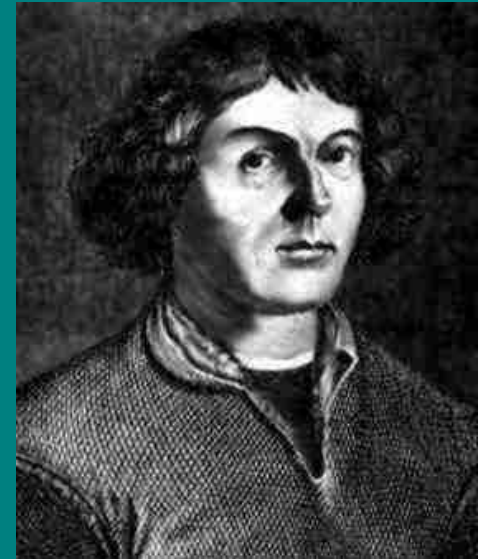
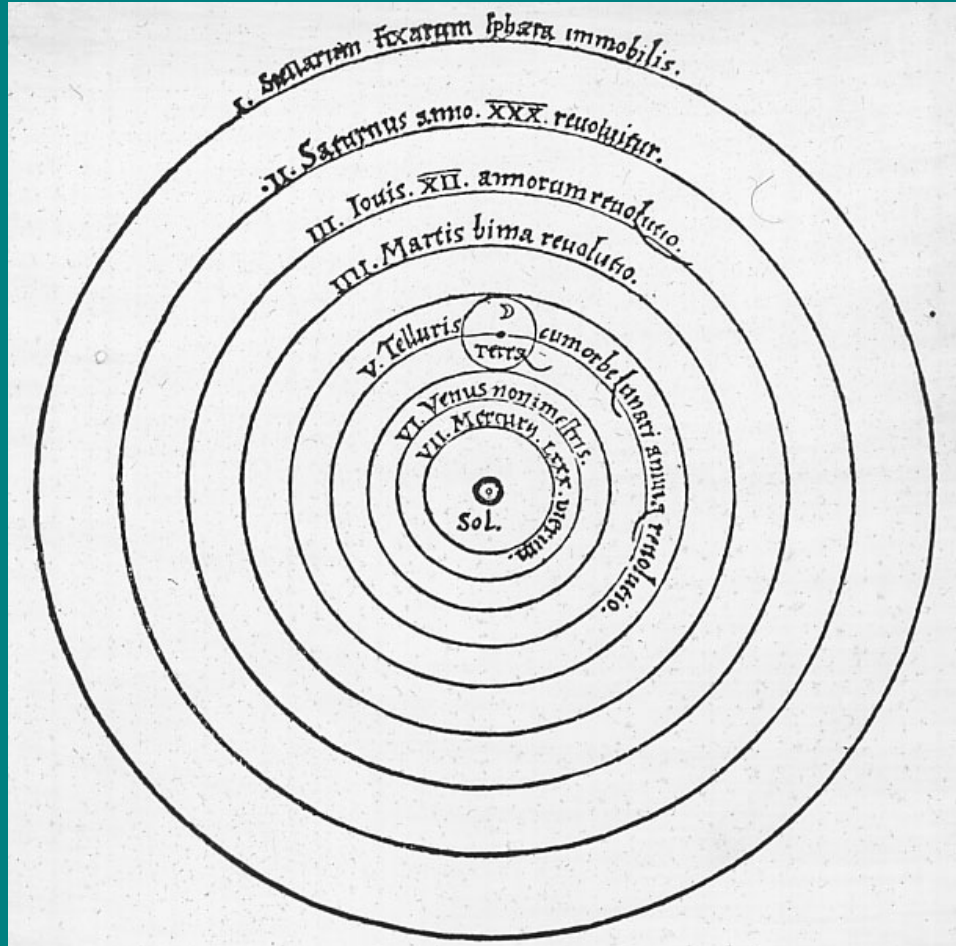
Including visualizations that map onto the real world.

And charts that are completely abstract.



Telling stories with data requires data visualization.

Story Tellers

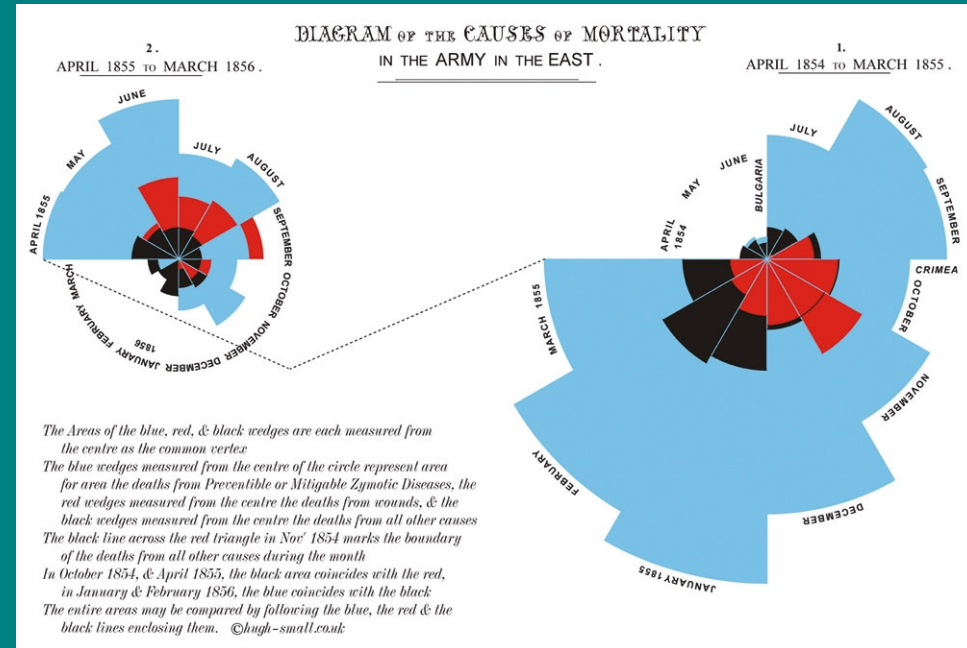


Copernicus

Story Tellers



Florence Nightingale



Story Tellers

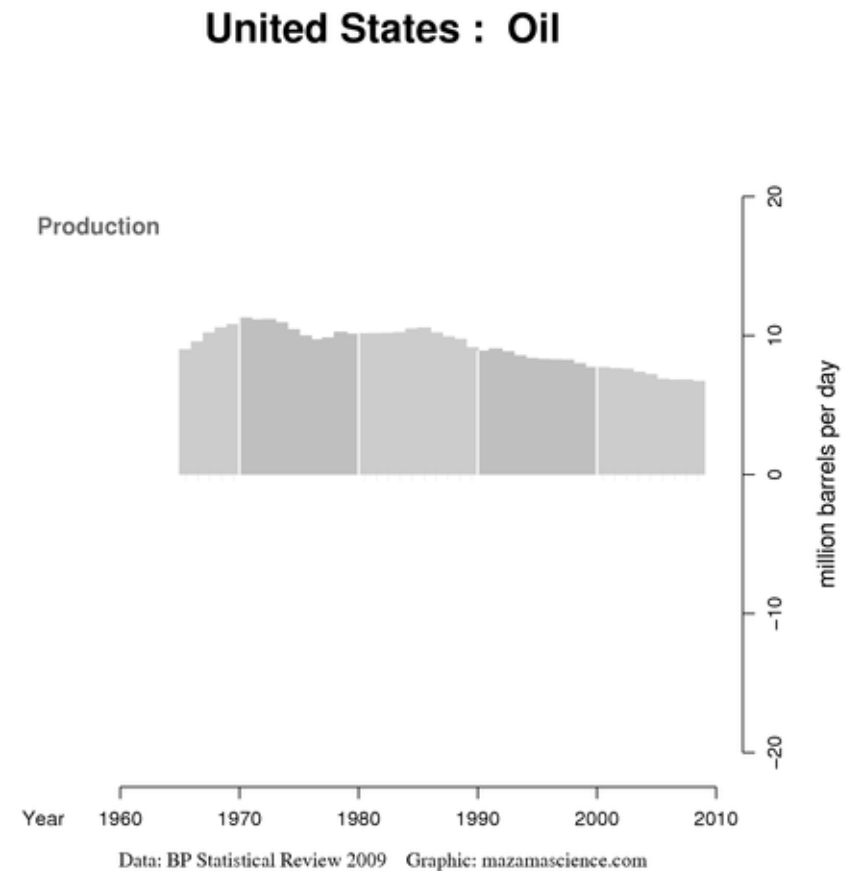


Hans Rosling

gapminder.org

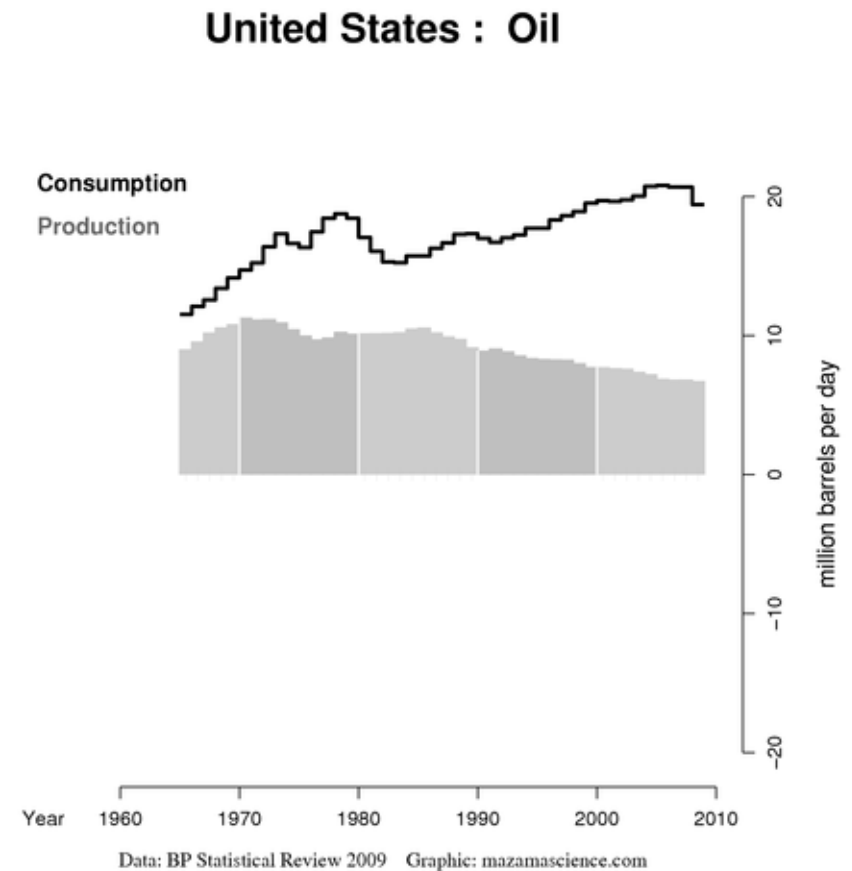
Let's tell a story with data – USA: Oil

- Oil production peaked in 1970 and has been in steady decline since 1985.



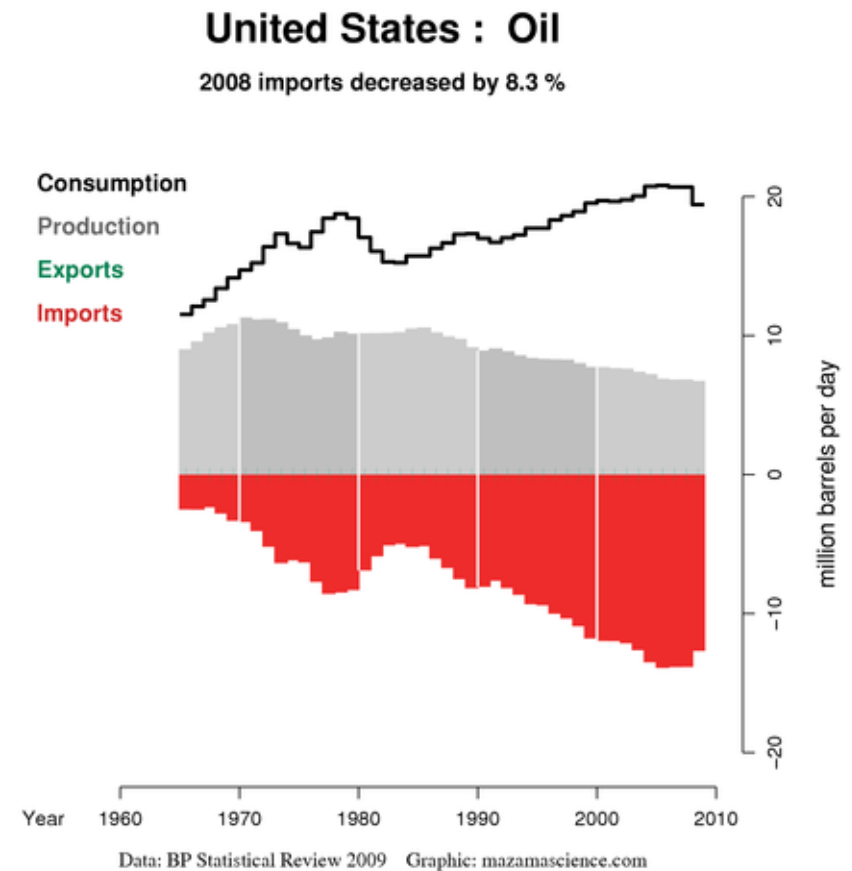
Let's tell a story with data – USA: Oil

- Oil production peaked in 1970 and has been in steady decline since 1985.
- Consumption shows growth, oil shocks and recessions.



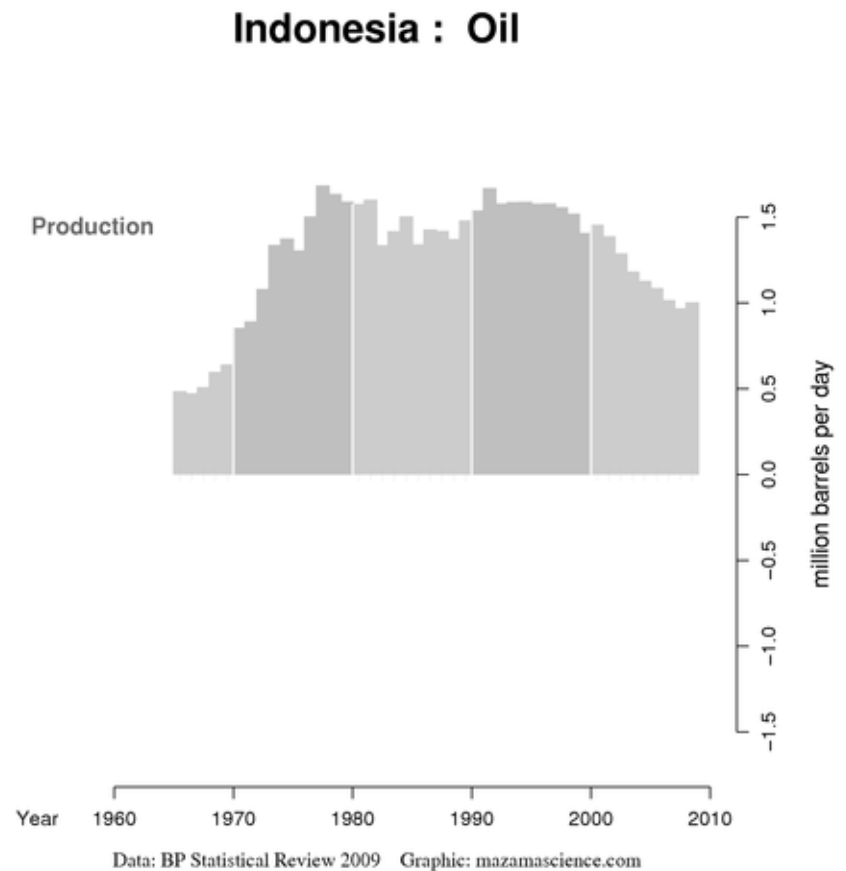
Let's tell a story with data – USA: Oil

- Oil production peaked in 1970 and has been in steady decline since 1985.
- Consumption shows growth, oil shocks and recessions.
- Subtracting consumption from production shows our growing import dependency.



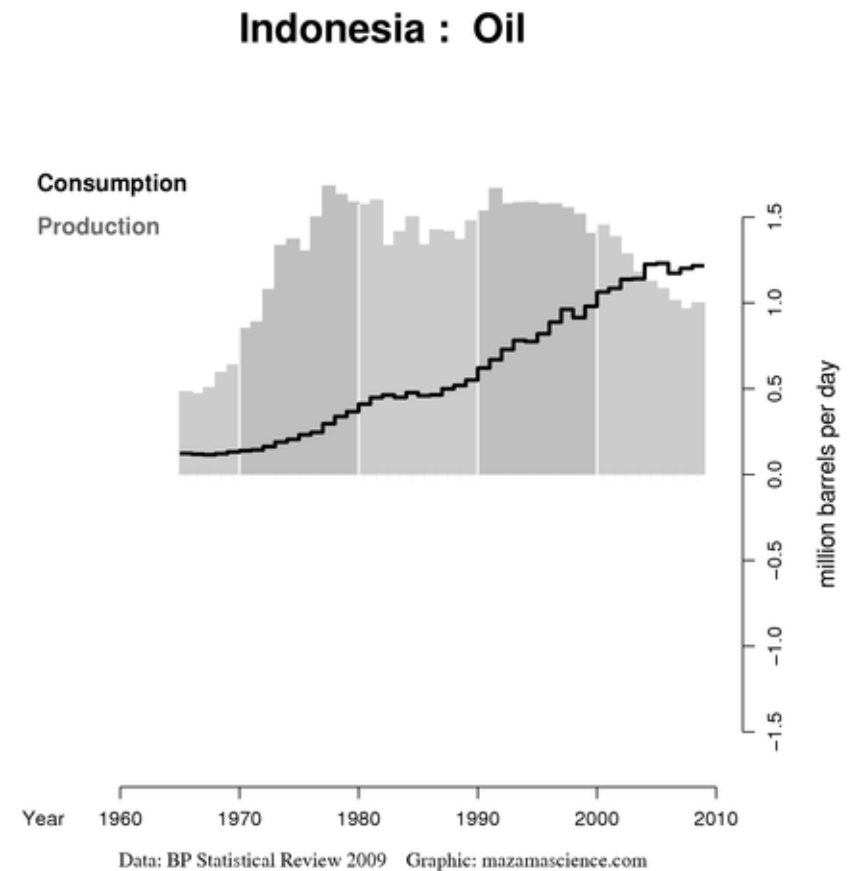
Let's tell another story – Indonesia: Oil

- Indonesia peaked in 1977 with steady decline after 1996.



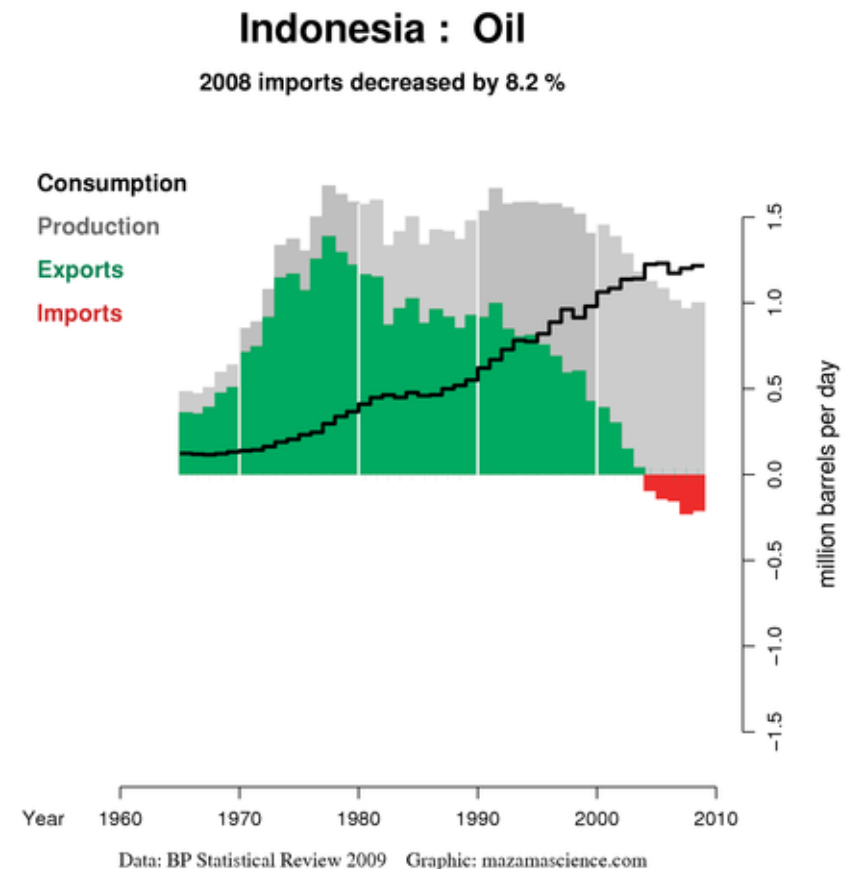
Let's tell another story – Indonesia: Oil

- Indonesia peaked in 1977 with steady decline after 1996.
- Consumption, fed by oil profits, increased steadily in this developing nation.



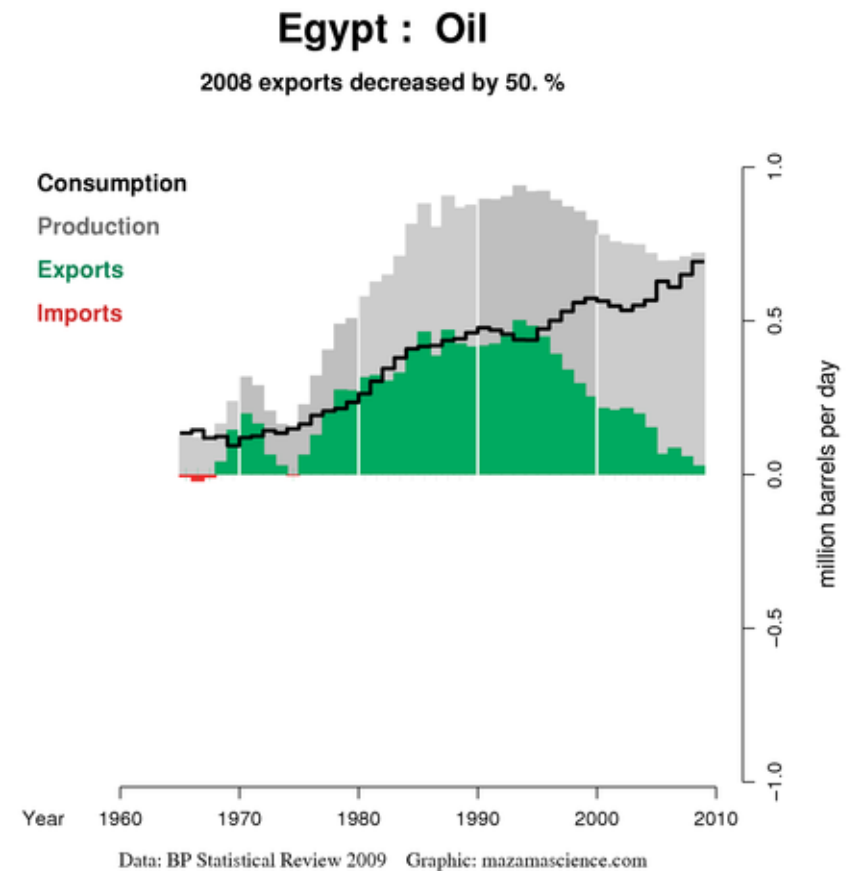
Let's tell another story – Indonesia: Oil

- Indonesia peaked in 1977 with steady decline after 1996.
- Consumption, fed by oil profits, increased steadily in this developing nation.
- Originally an OPEC member, Indonesia began importing oil in 2004.



One more for practice – Egypt: Oil

- Production peaked in 1993.
- Consumption shows a mostly steady increase.
- As of 2009, Egypt is a net importer of oil.



Interpreting Headlines

- Our news reports are concerned with today and tomorrow.
- But knowing a little history can help explain a lot.
- Energy headlines are full of estimates of 'huge reserves'.
- But we can't really measure reserves.
- All we know is what came out of the ground in the past.

Studying data gives the back story needed to interpret the news.

Headline: Falkands

Falklands Oil Reopens Old Wounds

By **UKI GONI/BUENOS AIRES** Saturday, Mar. 13, 2010

Related

Stories

- Argentina Asks U.S. Help to End Falklands Spat
- The Falklands: Two Hollow Victories at Sea

More Related

- Troubles for Argentina's New Evita



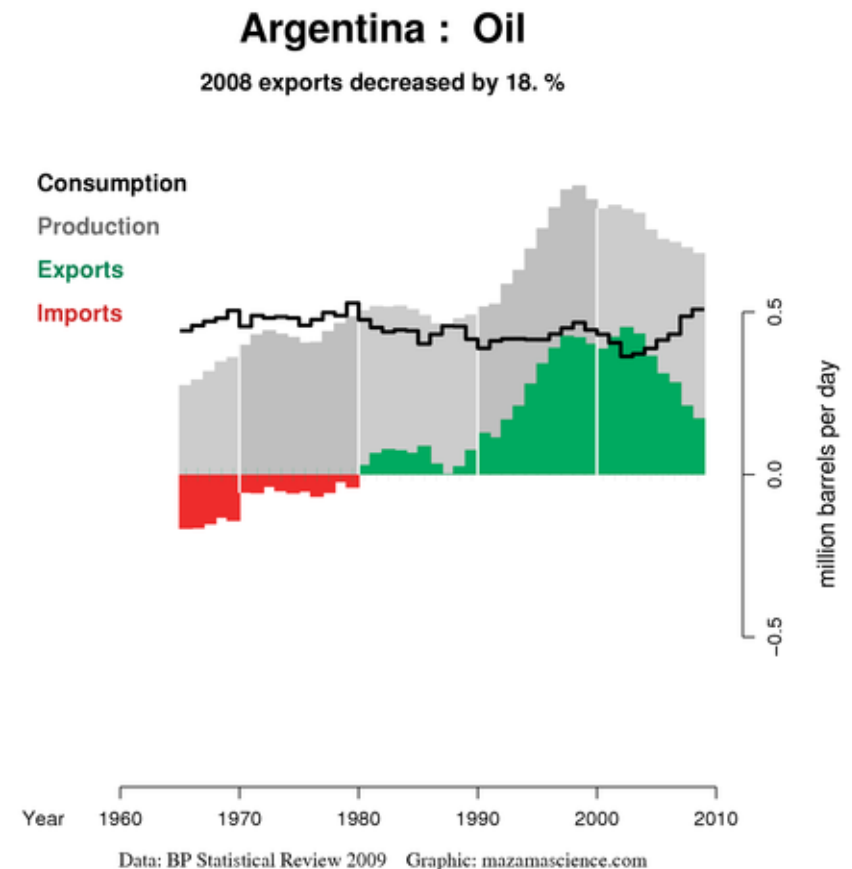
The Ocean Guardian, a semi-submersible oil drilling rig, under tow in British coastal waters.

Diamond Offshore drilling / AP

Argentina: Oil

- Production peaked in 1998 followed by a steady decline.
- Consumption has been rising steadily since 2002.
- Exports peaked in 2002 followed by rapid decline.

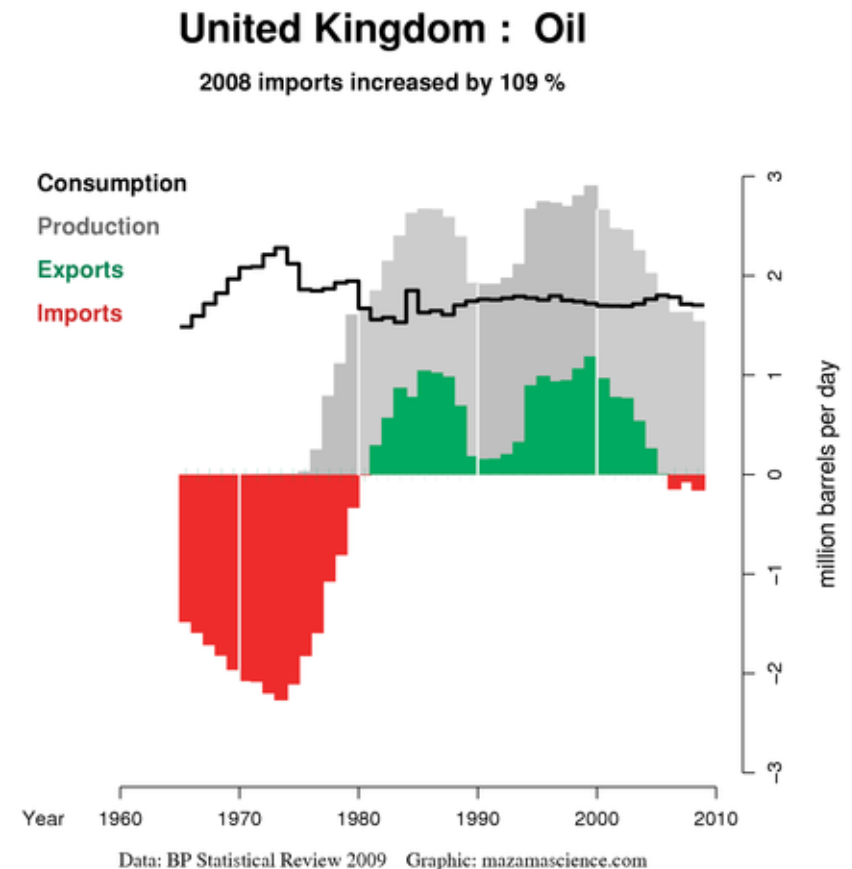
Argentina will soon be a net importer of oil.



UK: Oil

- Production peaked in 1986 and again in 1999 followed by rapid decline.
- Consumption has been steady since 1990.
- Exports peaked in 1999 followed by rapid decline.

The UK exported when oil was cheap and now must import today's expensive oil.



Headline: Brazil

Brazil Seeks More Control of Oil Beneath Its Seas



Sergio Moraes/Reuters

President Luiz Inácio Lula da Silva of Brazil, front left, and José Sergio Gabrielli, the president of Petrobras, right, on a visit to a liquefied natural gas terminal in Rio de Janeiro in March.

By ALEXEI BARRIONUEVO

Published: August 17, 2009

RIO DE JANEIRO — Faced with the world's most important oil discovery in years, the Brazilian government is seeking to step back from more than a decade of close cooperation with foreign oil companies and more directly control the extraction itself.

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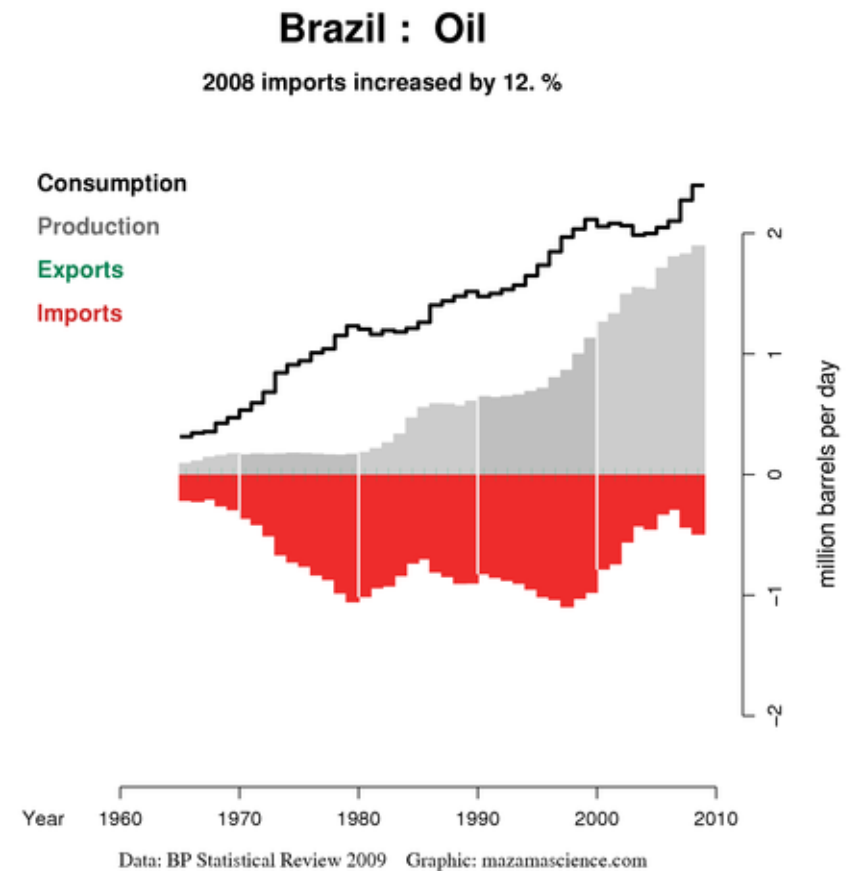
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Brazil: Oil

- Production has not yet peaked.
- Consumption is steadily increasing.

Brazil is a net importer of oil and likely to stay so.



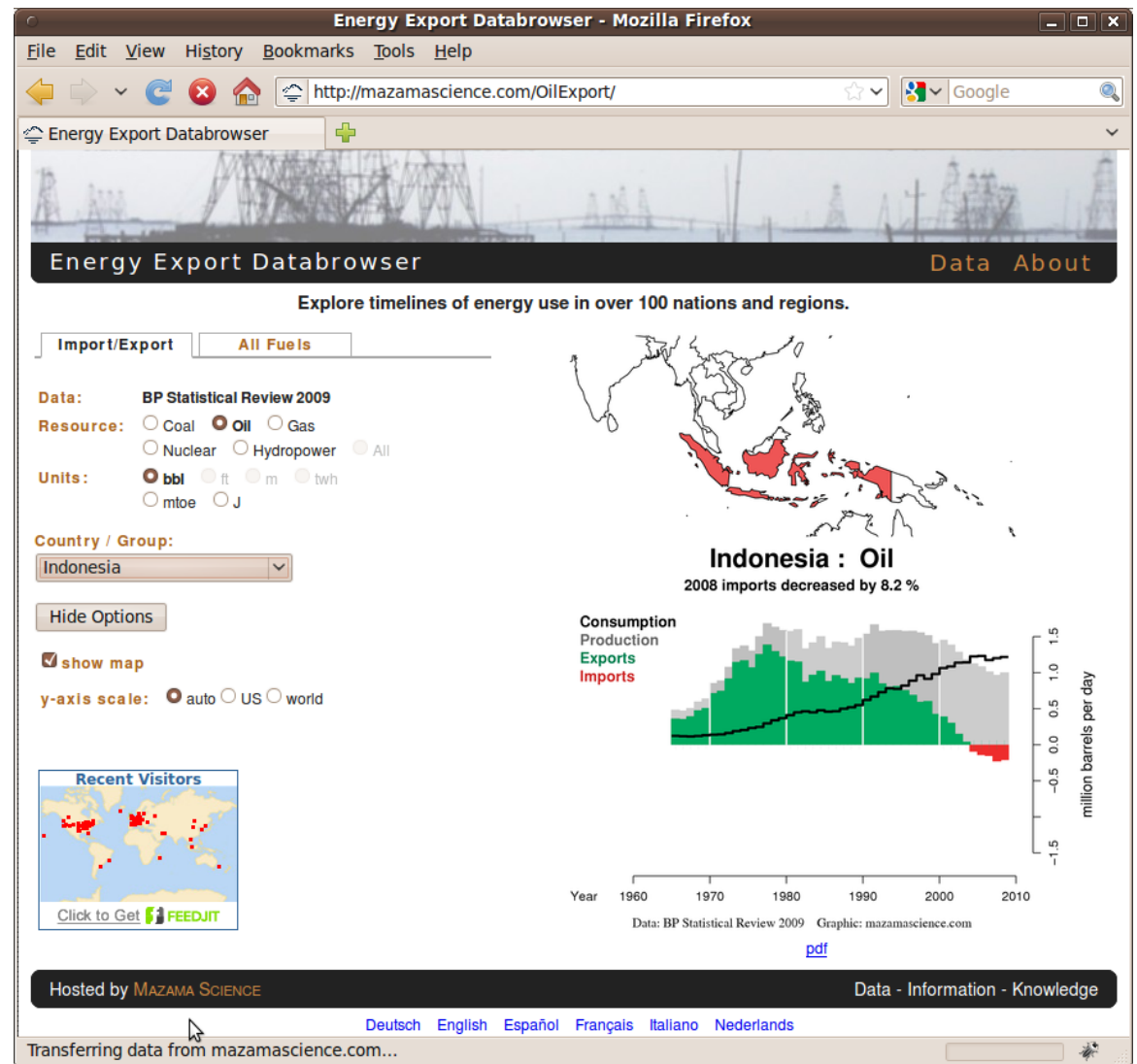
Empowering the Curious

- Wouldn't it be nice if you had access to these plots whenever you had a question about an oil headline?
- Or a headline about natural gas?
- Or one about coal?
- What if you had a question about all fossil fuels combined?
- What if you were interested in all of North America?
- Or all of OPEC?
- Or the G7?

Energy Export Databrowser

- Simple
- Intuitive
- Informative

Lets you
recognize patterns
and tell stories.



<http://mazamascience.com/OilExport>

Now You are the expert!

All you have to do is pay attention and Question Authority.

- 1) Pay attention to energy headlines.
- 2) Read the article to see which nations and which resources are involved.
- 3) Formulate some questions:
 - **Who** is making a claim?
 - **Which Fuel** are we talking about?
 - **What Production / demand Rate** is being discussed? (per month/year)
 - **When** will new production / demand come on line?
- 1) Use the Energy Export Databrowser to generate plots and harness your own *pattern recognition* and *story telling* skills.

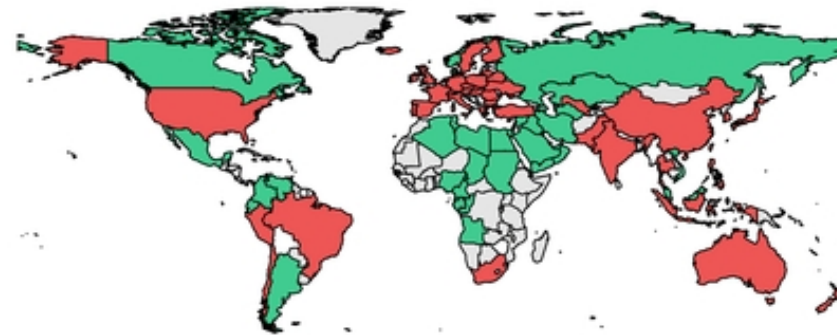
Questions to get you started:

- What about our top two providers of oil – Canada and Mexico?
- What about Saudi Arabia?
- What about the North Sea?
- What about Russia?
- What about Natural Gas?
- What about Chinese demand?
- What about Indian demand?
- What about coal?
- What about nuclear?

When will global Peak Oil arrive?

???

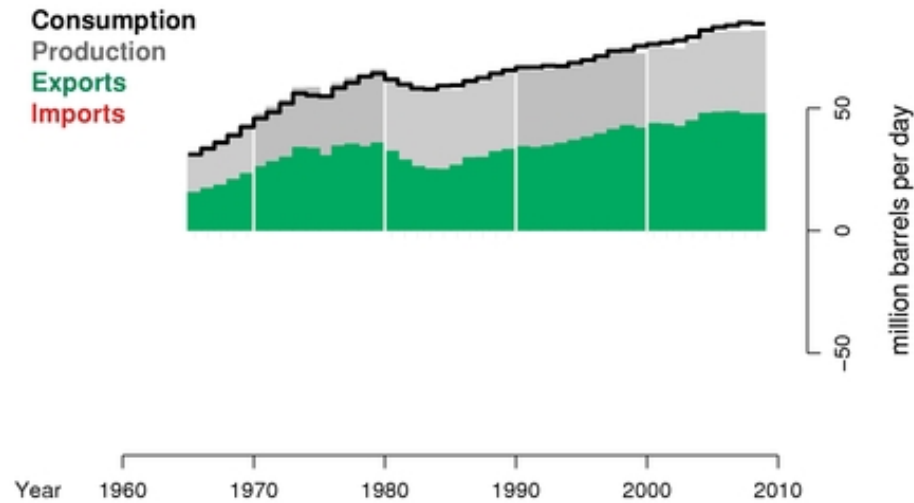
When will global Peak Oil arrive?



no data

World : Oil

2008 production increased by 0.4 %



Data: BP Statistical Review 2009 Graphic: mazamascience.com

It probably already has.

Bad News / Good News

Bad

- Expensive gasoline
- Expensive heating oil
- Expensive jet fuel
- Reduced independence
- Inflation in consumer goods
- Factory farm costs rise
- Less energy available

Bad News / Good News

Bad

- Expensive gasoline
- Expensive heating oil
- Expensive jet fuel
- Reduced independence
- Inflation in consumer goods
- Factory farm costs rise
- Less energy available

Good

- Less solo driving
- Insulation / passive solar
- More regional cohesion
- Strong communities
- Reduced consumption
- More local farms & gardens
- Less CO2 emitted

Peak Oil can be a good thing if you are informed.

Current Events – Deepwater Horizon

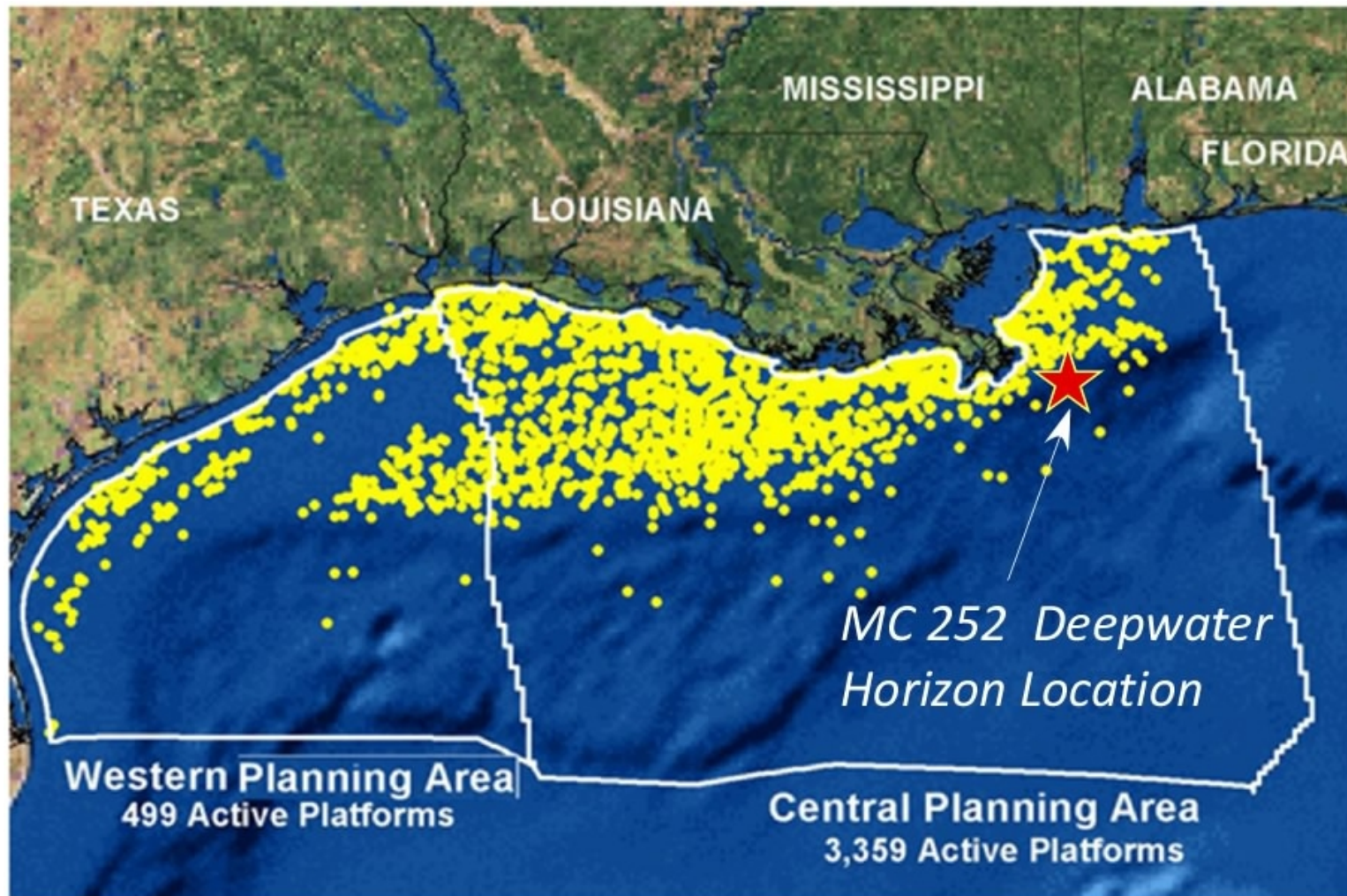


Figure 1. Mississippi Canyon Block 252 Location Map. From U.S. Minerals Management Service

Deepwater Horizon Spill by the Numbers

- Water Depth
 - 5,067 ft
 - (Gulf record = 10,011 ft)
- Well Depth
 - 13,293 ft below sea floor
 - (Gulf record > 30,000 ft)
- Reservoir Pressure
 - 13,000 psi
 - (Gulf record = 22,000 psi)
- Flow Rate
 - 5,000 – 70,000 bpd
 - (Gulf record ~ 50,000 bpd)

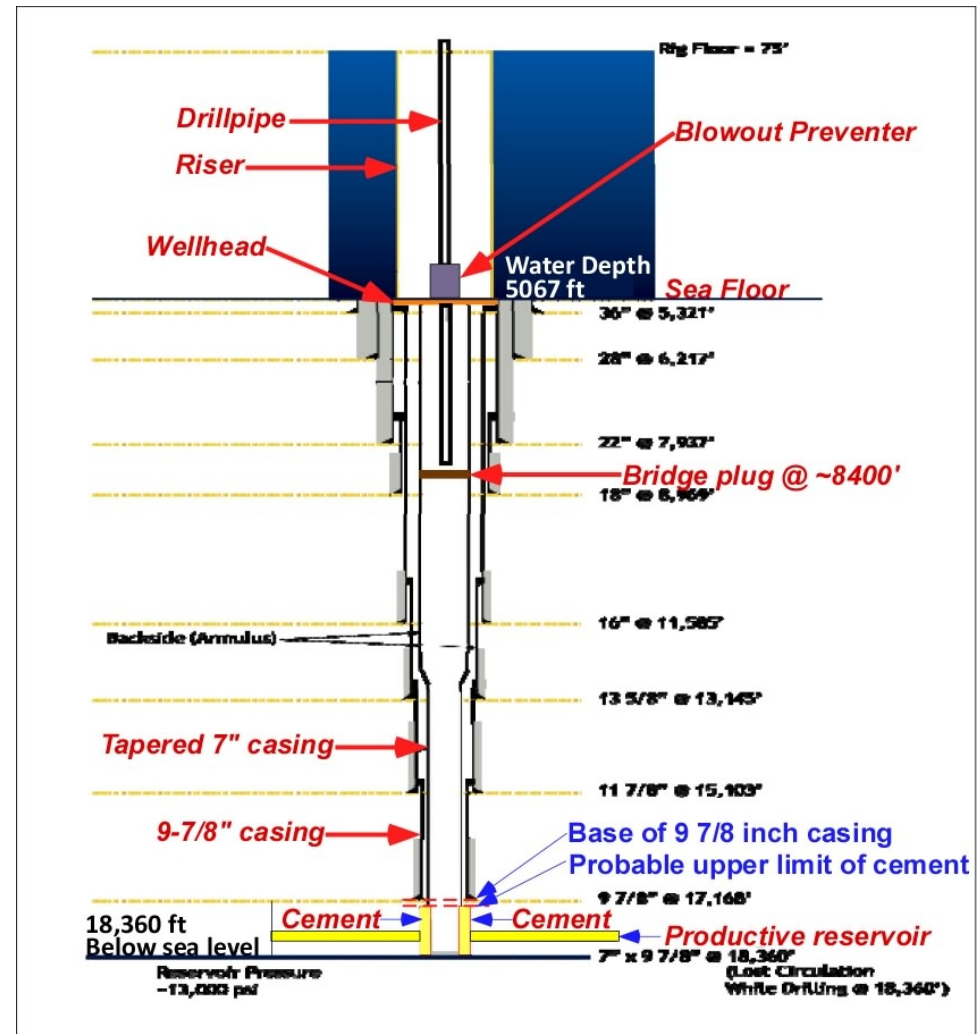


Figure 2. Mississippi Canyon Block 252 well schematic diagram (modified from www.tudorpickering.com/pdfs/tph.well.slides.pdf).

Deepwater Horizon Spill by the Numbers

Top oil spills in million barrels

- ~10.0 – 1991 Kuwait
- ~ 3.5 – 1979/80 Ixtoc, Mexico
- ~ 2.1 – 1979 Trinidad
- ~ 2.0 – 1992 Uzbekistan
- ~ 1.9 – 1983 Iran
- ~ 1.9 – 1991 Angola
- ~ 1.8 – 1983 South Africa
- ...
- ~ 1.5 – Deepwater Horizon (@ 50 kbpd)
- ...
- ~ 0.3 – Exxon Valdez

