A Peak Oil Overview

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For

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Outline

- What is Peak Oil?
- What is the Problem?
- The Era of Easy Oil is Over
- The Current Global Oil Picture
- Biomass to the Rescue?
- Delusions over Brazil
  - Why Brazil can't be a model for the world
  - Brazil versus U.S. energy statistics
- Rise of the Snake Oil Salesmen
  - The TDP Story: A cautionary tale
- Energy Policy Mistakes
  - Solutions that would make a difference

Peak Oil

- Peak oil is the point at which oil production rates begin an irreversible decline
- Peak oil is NOT a theory
- Peak oil does not mean we are running out of oil
- Peak oil dates for various countries
  - Germany – 1966
  - USA – 1970 (peaked at 9.6 million bpd; currently at 5)
  - UK - 1999
  - Norway – 2000
  - Mexico – 2004
- The global peak?
  - Maybe last year, maybe in 5 years, but without a doubt a problem that the world must soon contend with

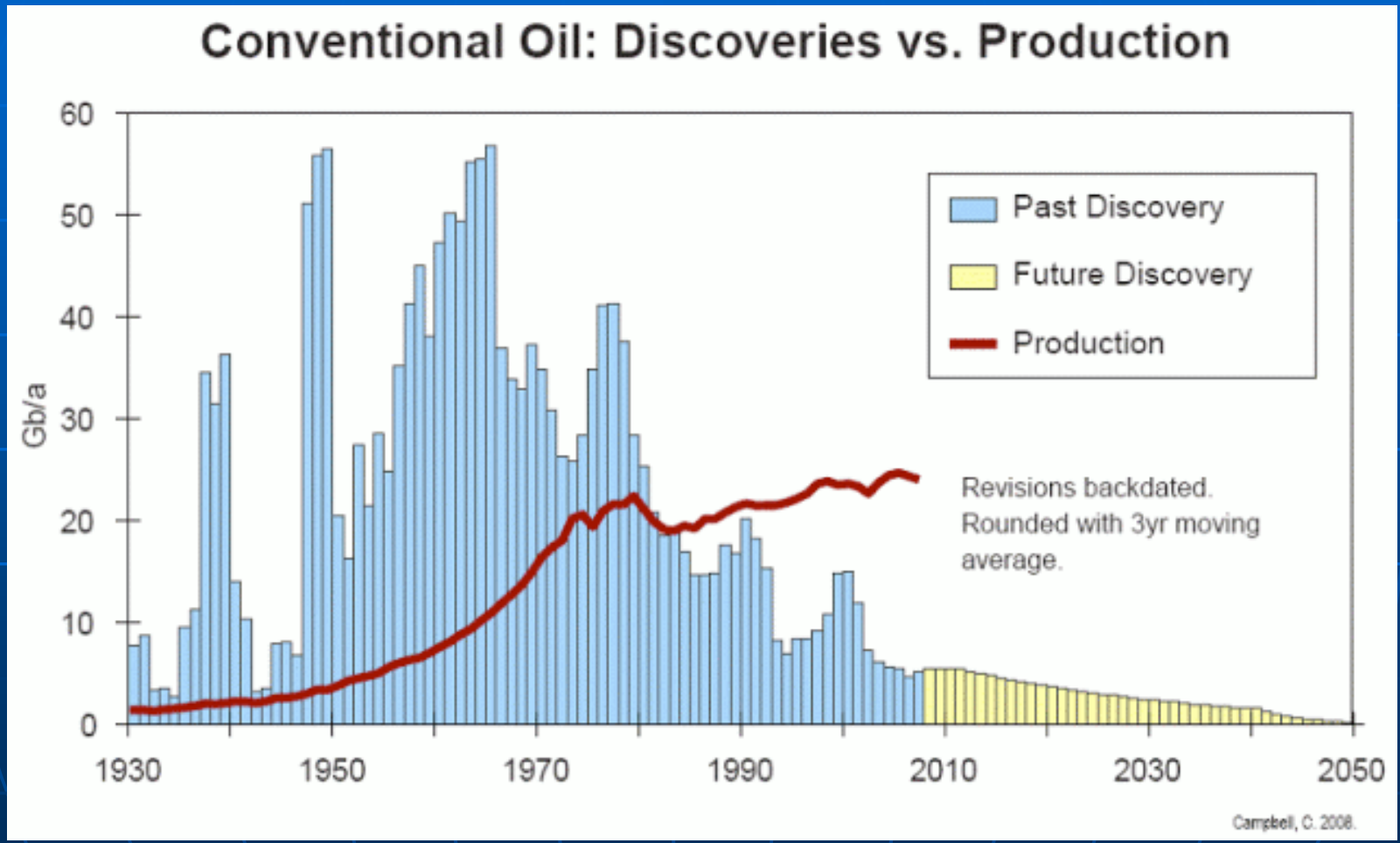
The Threat from Peak Oil

- Oil is presently the lifeblood of the global economy
- The global transportation system – and thus global trade – is utterly dependent upon cheap oil
- Industrial agriculture is enabled by cheap fossil fuels
- Modern militaries can't function without oil
- Modern society that has been arisen over the past 100 years has done so on the back of cheap oil
- Societies deprived of cheap oil will struggle – North Korea, Japan, Cuba
- *Globalization makes it impossible for societies to collapse in isolation* – Jared Diamond

Notable Viewpoints

- Domestic demand in Saudi Arabia is forecast to rise by 250% by 2030 - Khalid A. Al-Falih, Saudi Aramco President and CEO
- By 2012, surplus oil production capacity could entirely disappear, and as early as 2015, the shortfall in output could reach nearly 10 million barrels per day - US Joint Forces Command
- Non-OPEC production peaked in 2006; global production to peak in 2014 - Department of Petroleum Engineering, Kuwait University

The Easy Oil is Gone



Graphic Source: Colin Campbell

Global Oil Picture

- Global oil production – 85.4 million bpd*
  - On a plateau since 2005
  - Some spare capacity, but…
    - Projects are being delayed – setting up price surges
    - The “incident” in the Gulf of Mexico will hasten the decline
- The good news
  - U.S. oil demand down 1.2 million bpd from 2004-2008
- The bad news
  - Largely induced by crippling prices and recession
  - Demand from China and India up by 1.9 million bpd
  - Oil at $70-$80/bbl the new norm
- How does the recession end if oil prices remain at recession-inducing levels?

Biomass

Biomass as a Solution?

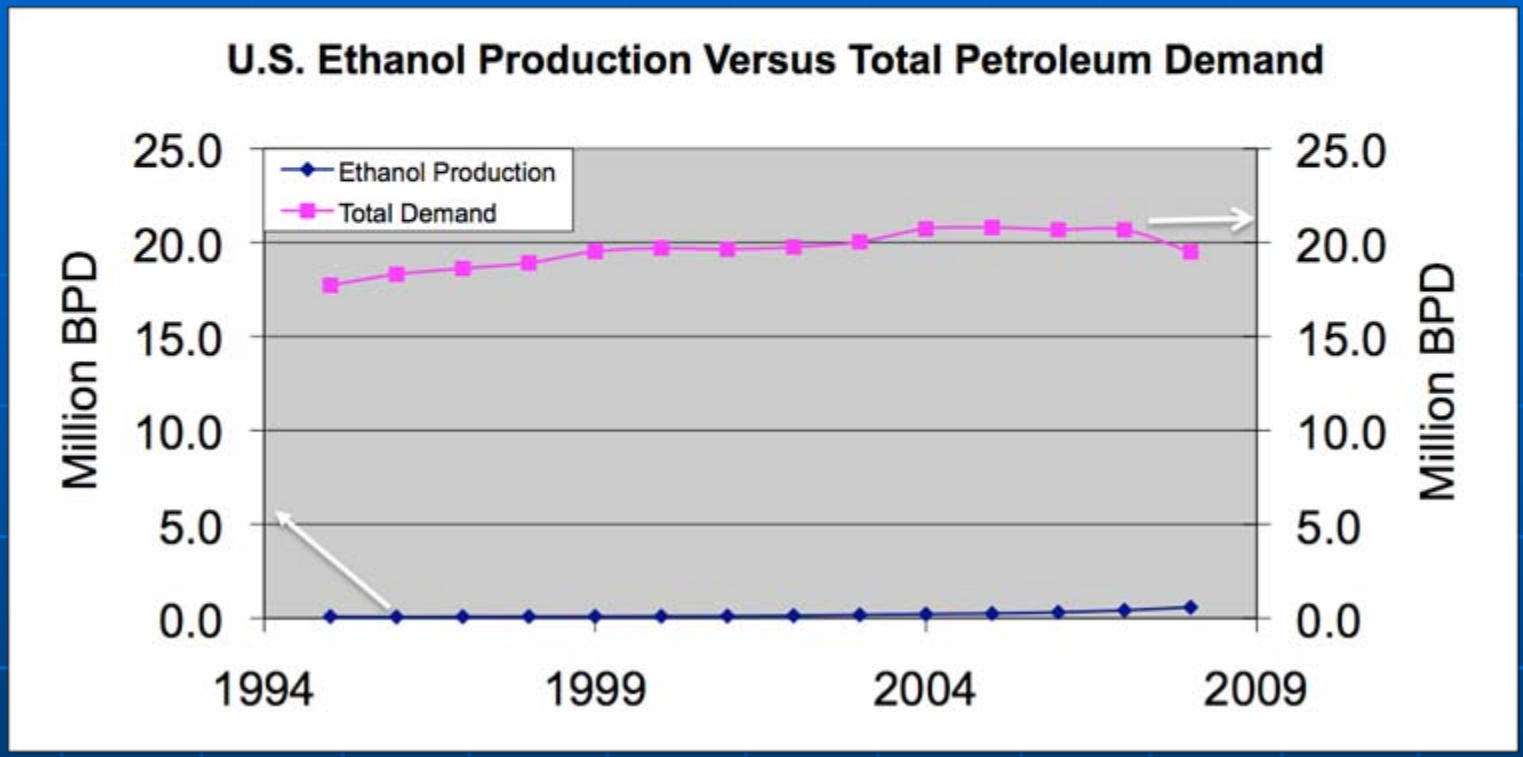
- Replacing current consumption of fossil fuels with biomass IS NOT POSSIBLE
  - Photosynthetic efficiency is too low
  - Each year we burn >400 years of ancient biomass*
  - That biomass was processed with heat and pressure courtesy of Mother Nature in fossil fuels
- “Renewable” energy is often heavily dependent on fossil fuels
- Two examples of presently energy intensive processes in the renewable energy world
  - Cellulosic ethanol
  - Algal biofuel

*Burning Buried Sunshine: Human Consumption of Ancient Solar Energy

Pseudo-Renewable Energy

- Is the renewable fuel renewable?
- The energy balance matters
  - How many units of fossil fuel to produce a unit of renewable energy?
  - How many BTUs to transport renewable energy (1/3rd of the energy density of oil)
- If production costs are high because energy inputs are high, you have a receding horizon problem
  - Cost position may worsen as oil prices increase
- The problem of receding horizons
  - "Oil Shale Development Imminent" – headline circa 1900
  - When oil was $20/bbl, oil shale needed $40/bbl
  - At $80/bbl, oil shale still not economical

Understanding Scale



- While the U.S. has been successful at rapidly ramping up corn ethanol, it barely registers on the scale of our petroleum demand

Brazil

Can the World Emulate Brazil?

- *"As a result [of ethanol], Brazil has virtually stopped importing expensive foreign oil."* – Dan Rather in The Ethanol Solution
- *"If Brazil can do it, so can we."* – Bill Clinton, promoting California's Prop 87
- *"As Brazil's 'energy independence miracle' proves, an aggressive strategy of investing in petroleum substitutes like ethanol can end dependence on imported oil."* – Vinod Khosla and Tom Daschle in Miles per Cob (a New York Times editorial)
- *"I'm driving a Chevrolet in the middle of Brazil on ethanol, pure ethanol, not a drop of oil, imported oil in this tank. And here is the stuff grown all around us that is the fuel. So I'm thinking, why can't I do this in America? Why aren't we doing it?"* – Frank Sesno in CNN's We Were Warned

Energy Policy in Brazil

- Sugarcane ethanol has long been a cornerstone of Brazil's energy policy
- Can be produced from byproduct molasses – food and fuel
- The key to the process is bagasse
  - A readily available energy source for fueling boilers
  - Minimal fossil fuel inputs relative to corn ethanol

Reality Check

- Annual ethanol usage in Brazil: 0.33 barrels* per person
- Annual oil usage in Brazil: 4.4 barrels per person
- Oil still supplies more than 90% of Brazil's transportation needs
- Brazil celebrated energy independence in 2006
  - Brazilian President Luiz da Silva made the announcement on the P-50 oil rig in the Albacora Leste field in the Atlantic Ocean

* Barrels of oil equivalent (BOE)

Reality Check – It Gets Worse

- Annual oil usage in US: **23.4 bbl/person***
- Annual oil usage in Brazil: **4.4 bbl/person**
- Annual oil production in US: **8.1 bbl/person**
- Annual oil production in Brazil: **3.5 bbl/person**
- U.S. supply imbalance: **15.3 bbl/person**
- Brazil's supply imbalance: **0.9 bbl/person**
- Consumption and production are:
  - Grossly unbalanced in the US
  - Fairly balanced in Brazil
- So, how can the US emulate Brazil?
  - By cutting oil consumption by 2/3^{rds}
  - Or by tripling oil production

* Consumption and production figures are from 2008

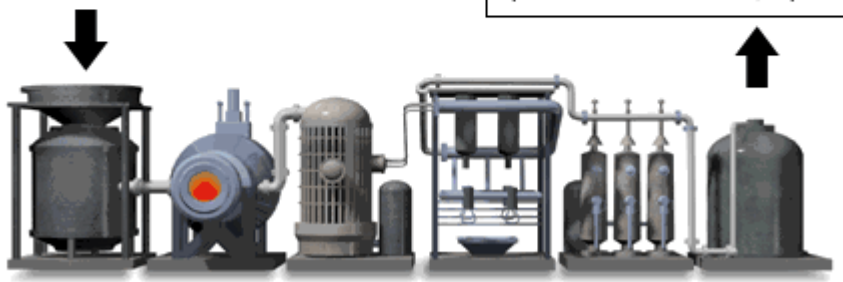
Rise of the Pretenders

Anything into Oil: The TDP Story

"Technological savvy could turn 600 million tons of turkey guts and other waste into 4 billion barrels of light Texas crude each year" – Discover Magazine, May 2003

The thermal depolymerization process can convert a wide range of waste materials into oil and other useful by-products, in proportions that vary according to the specific type of feedstock run through the works:

100 POUNDS OF:	
PLASTIC BOTTLES: Clear (polyethylene terephthalate) and translucent (high-density polyethylene)	PLASTIC BOTTLES: 70 pounds oil, 16 pounds gas, 6 pounds carbon solids, 8 pounds water
MUNICIPAL LIQUID WASTE: 75 percent sewage sludge, 25 percent grease-trap refuse	MUNICIPAL LIQUID WASTE: 26 pounds oil, 9 pounds gas, 8 pounds carbon and mineral solids, 57 pounds water
TIRES: All kinds, including standard rubber and steel-belted radials	TIRES: 44 pounds oil, 10 pounds gas, 42 pounds carbon and metal solids, 4 pounds water
HEAVY OIL: Refinery residues, heavy crudes, and tar sands	HEAVY OIL: 74 pounds oil, 17 pounds gas, 9 pounds carbon solids
MEDICAL WASTE: Transfusion bags, needles and razor blades, and wet human waste	MEDICAL WASTE: 65 pounds oil, 10 pounds gas, 5 pounds carbon and metal solids, 20 pounds water



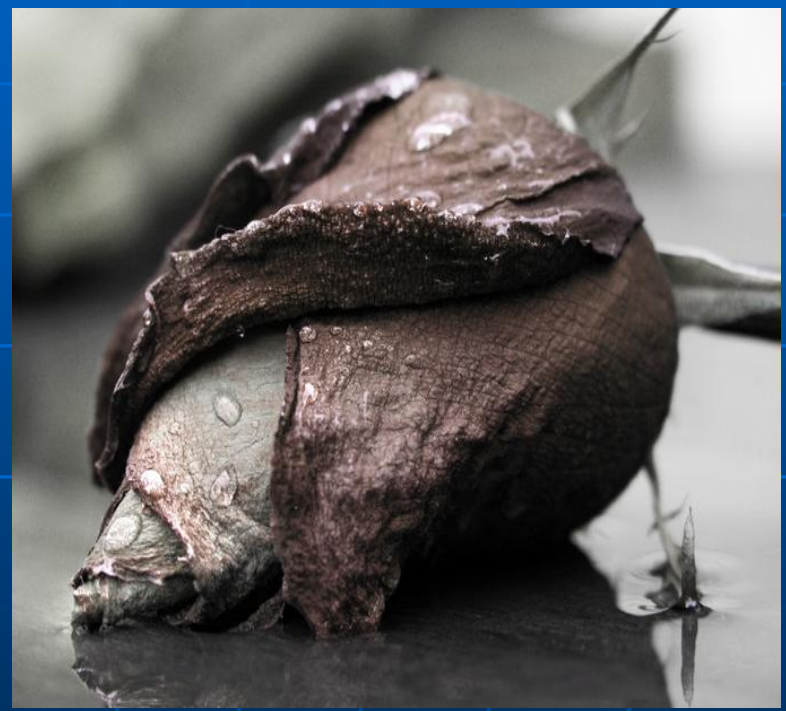
GRAPHIC BY DON FOLEY

Everything's Coming Up Roses

- From May 2003 Discover Magazine
  - The price is right
    - "We will be able to make oil for $8 to $12 a barrel"
  - The technology sounds futuristic
    - "thermal depolymerization process"
  - The cast is interesting
    - "a tall, affable entrepreneur"
    - "a team of scientists, former government leaders, and deep-pocketed investors"
- The awards and accolades rained down…

The Bloom Comes Off

- Discover Update, April 2006
  - “We were too aggressive in our earlier projections”
  - “Production costs turned out to be $80 per barrel” (as crude oil was trading at $40/bbl)
  - “Construction problems”
  - “Odor problems”



- Complete failure to deliver
- Company now bankrupt

Lessons Learned (or not)

- It is easy to fool people with ‘new technology’
- The potential problems of scaling up a process tend to be underestimated
- Small problems in the lab are big problems at scale
- Technical vetting and critical analyses are often lacking
- Failure to understand the idea that:

Killing cancer cells in the lab is not the same as curing cancer

So What to Do?

Solutions

- Cease the delusions of ‘cheap gas for everyone’
  - Cheap gas encourages fossil fuel consumption
- Trade off fossil fuel taxes for income taxes
  - Rebate income taxes to make it revenue neutral
  - Encourages energy conservation
  - Encourages alternatives
  - Encourages mass transit
- Encourage behaviors that reduce energy consumption
  - Rebates for solar water heaters, fuel efficient cars

Key Questions for Alternatives

- Is the process enabled by fossil fuels?
- Does the process impact food supplies?
- Can the process operate without straining water supplies?
- Does the process lower the soil quality?
- Does the process impact local biodiversity?
- What are the emissions from the process?

Conclusions

- The world is collectively asleep at the wheel
- The future will arrive regardless of whether you plan for it
- None of us expect our houses to burn down
  - But if it does, the consequences are great
  - Thus, we carry insurance
- The consequences of peak oil are far greater, yet we have no insurance policy
- The good news is that there is enough solar energy falling on the earth to sustain a good quality of life – if we ever resolve the technical challenges of efficiently storing and later using the energy

Recommended Reading

- Crude World by Peter Maass – to help put into perspective the price of our oil dependency
- The Long Emergency by Jim Kunstler – to scare you into action
- The Hirsch Report by Robert Hirsch – to convince you that delaying action will be far more problematic than facing the problem now
- The Oil Depletion Protocol by Richard Heinberg – to see one possible course of action

Thank You