

“Peak Oil”

Some Knowns & Unknowns

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“Peak Oil” is only one of a number of current or impending disasters.



Problem: “Peak Oil” is not now obvious, & people tend to take action on “now” problems.

Another Problem: Different People See “Oil” in Different Ways.

- Oil Industry Folk
- Classical Economists
- Resource Economists
- Climate Advocates
- Clean Energy Folk
- Lay Public
- Politicians
- Journalists
- World Planners



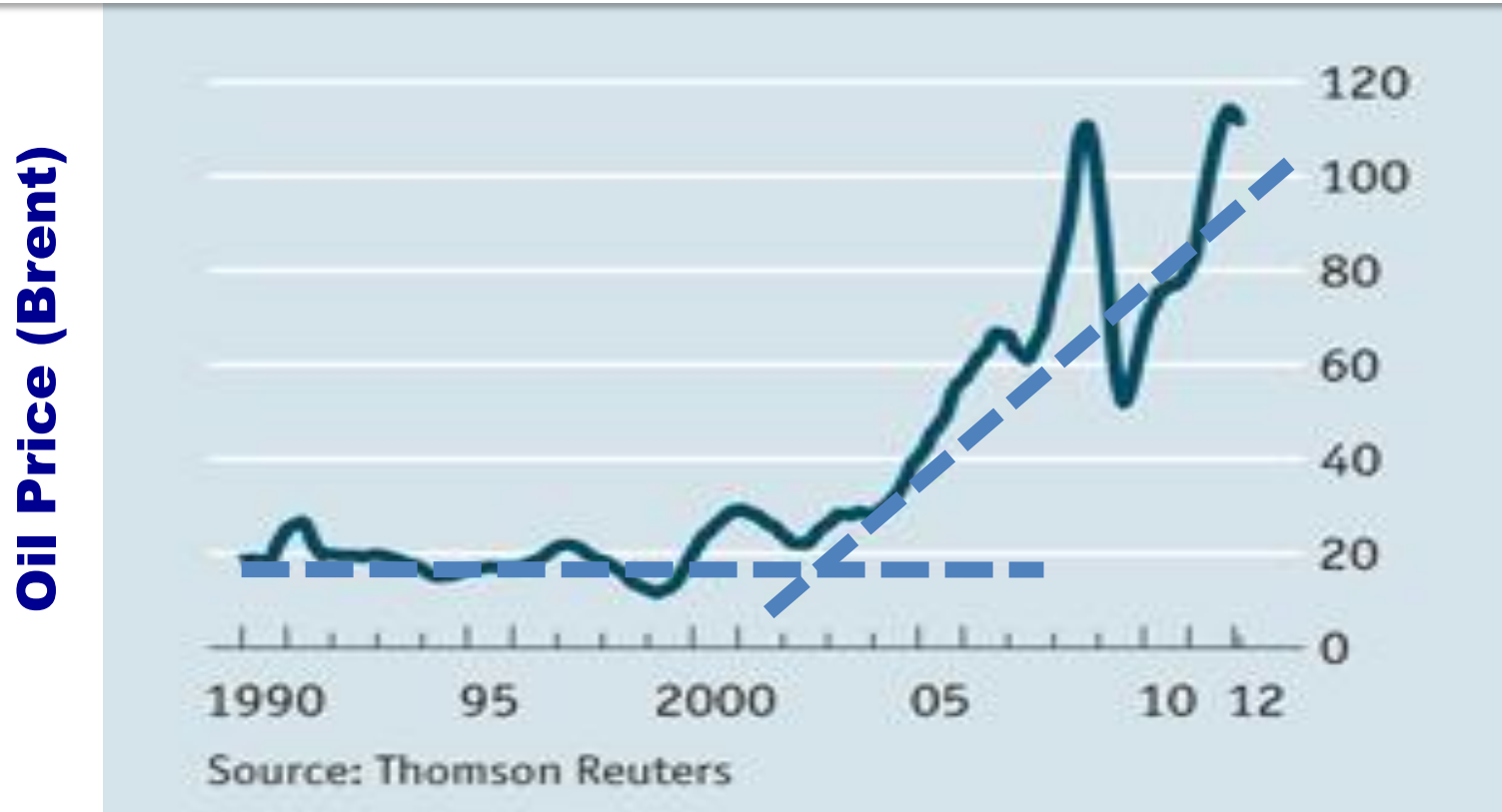
- “Peak Oilers”
- Financial Folk
- Pragmatic Energy Folk
- Etc.

Known: Things Most Experts Agree On

- Oil is essential to modern economies.
- Oil is a finite resource.
- Production from oil fields rises to a maximum & then declines.
- Many countries have passed the maximum of their oil production – Their production has “peaked.”
- Important world oil reserves data is uncertain, secret, & not verified.
- World conventional oil production will begin to decline sometime.
- The “Easy Oil” has been produced.



World Oil Prices



The era of easy oil is past.

“Peak oil” is not yet impacting daily / weekly oil prices. Factors that now impact:

Supply & demand

- Economic outlook
- Cost of the marginal barrel
- Inventories
- Speculation
- Value of the dollar
- Stock markets
- Middle East situation
- Politics
- Weather
- Etc.

PO Price signal not likely until the last minute.

Public Lack of Knowledge, Confusion & Misunderstanding

- How critically important oil is
- World oil realities
- Whether the oil companies are part of the problem or part of the solution
- The meaning & credibility of “Peak Oil”
- The chances for North American energy independence
- How long it takes to make meaningful changes in domestic energy usage
- What can renewables do
- **Differentiation between oil & energy**



OIL is liquid energy,

but

ENERGY can be solid, liquid & gas.

(Coal, wood, oil, gas, solar, nuclear, hydro, etc.)

- Machinery built to operate on liquid fuels cannot operate on other energy forms. We either have to retrofit or build new.
- Worldwide machinery operating on oil is valued at \$50 -100 trillion.
(Automobiles, airplanes, tractors, trucks, ships, buses, etc.)
 - Retrofit or new equipment will be extremely expensive & time-consuming.

Some Areas of Expert Uncertainty

- Definitions of oil & “peak oil”
- How much oil remains
- When world oil production will begin to decline
- How fast world oil production will decline
- Size of OPEC reserves
- Can & will OPEC expand production to meet world needs?
- How much oil from shale
- Impact of world oil decline on economies
- How fast we can mitigate “peak oil”
- Role of government in mitigation
- How fast renewables can impact”
- Importance of EROI
- Climate change vs “peak oil” mitigation

An Alternate Definition of “Oil”

Common Oil Definitions :

- Total H/C Liquids – Includes fractions going to chemicals, lubes, waxes, coke, asphalt, etc.
- Conventional Crude Oil: Misses heavy oil, biofuels, refinery gains, etc.
- Total volume ignores the varying energy contents of constituents.
- **Is there a better measure?**

Consider:

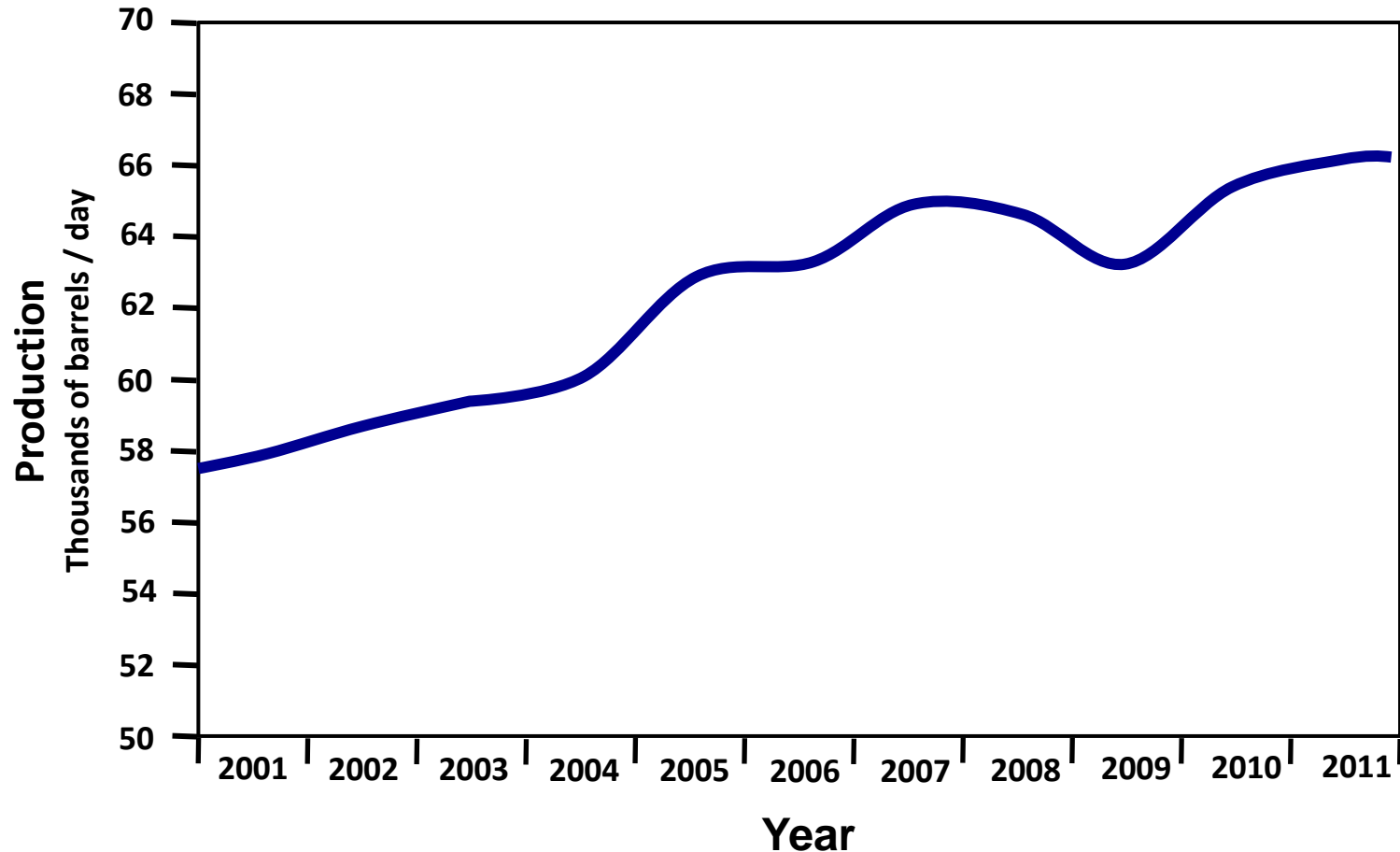
- Many believe that the looming disaster will be shortages & high priced transportation fuels.
- A more meaningful “oil” definition might be

World Transportation Fuels

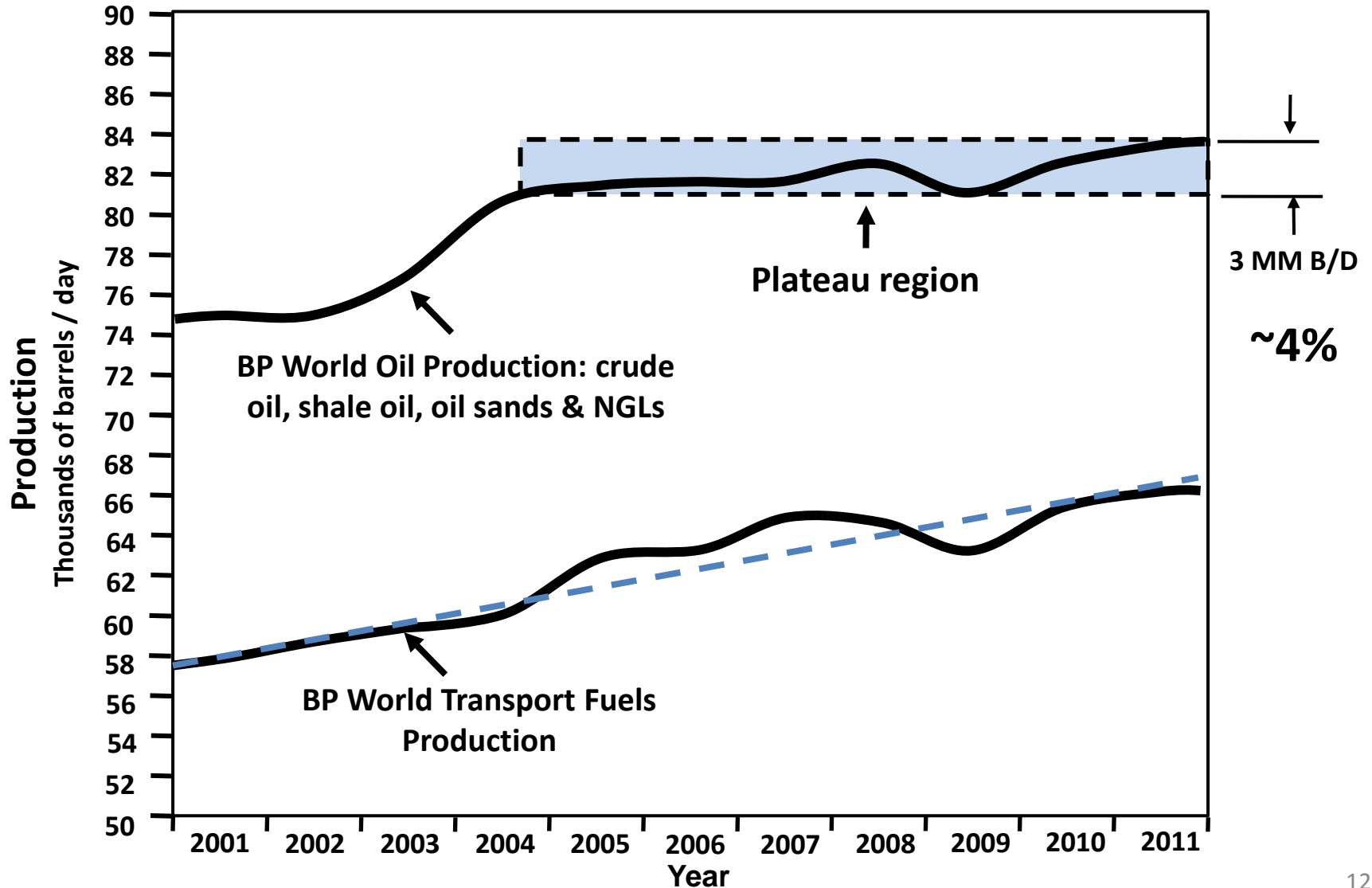
- As a rough estimate, consider data from the BP Statistical Review.

Estimated World Transportation Fuel Production

Refinery outputs of Light & Middle Distillates & Fuel Oil per The BP Statistical Review



Comparison of Estimated World Transportation Fuel Production & “Total Oil Production”



Notes

- Isn't transport fuels the major concern?
- This approach provides a useful focus & insights.
- To a degree refineries can alter product slates to produce most valuable products & they appear to have done so.
- The so-called "production plateau" starting in 2004-2005 is obvious in "Total Oil Production," while transport fuel production shows a gentle linear increase 2001 - 2011.
- A more detailed analysis over a longer period of time might be useful. More detailed data is available from the IEA, elsewhere?
- Thanks to Kjell Aleklett & Chris Skebrowski

Definition of “Peak Oil”

- Past peak is supposed to be disaster.
- The 2006 tiny peak was not a disaster!
- Do we still think we are on a production plateau?
- Isn't the onset of decline in world transportation fuels the disaster?
- What about “Economic Peak Oil”?
- **Clarity needed.**

World
production will
peak or
plateau &
decline.





How Much Oil Remains to be Produced?

- Various estimates exist, but experts differ.
- Certainty would require independent third party verification around the world.
- OPEC, IOCs, others are unlikely to open up.
 - Enough professionals to do the job?
 - Just focus on some countries?
 - “The impossible dream”?
- Would verified numbers be enough to move policy?
- **We have no choice but to use “best estimates,” so there will always be differences of opinion!**

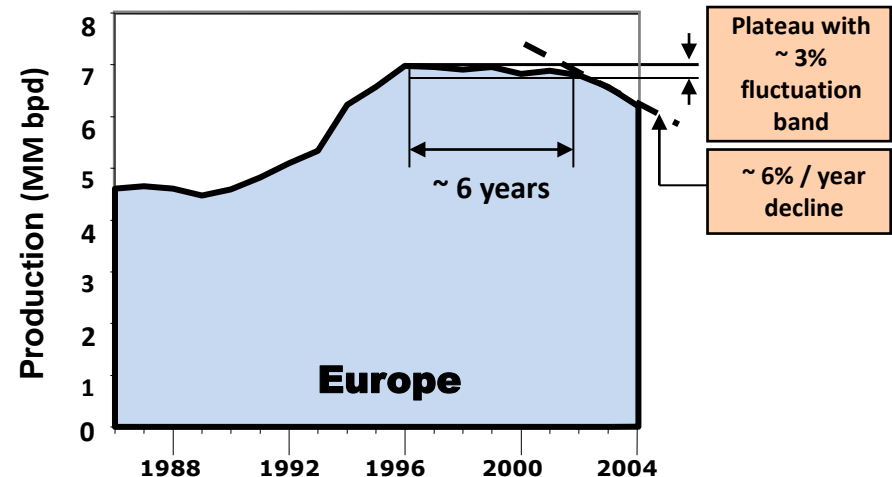
When will world oil production begin to decline?

The \$64 trillion question!

- ASPO / others believe soon.
- Industry, OPEC, EIA, others: “Not to worry.”

How Fast Will World Oil Production Decline?

- Will world production look like Europe?
- **A good estimate by cooperating experts might be possible.**



How fast is existing production declining?

- 4.5% CERA
- 4-6% ExxonMobil
- 8% Schlumberger
- 8% T. Boone Pickens
- 5.8-6.7% IEA
- 5.5-6.5% Höök, Hirsch & Aleklett

Höök, Hirsch & Aleklett. Giant oil field decline rates and their influence on world oil production, Energy Policy, June 2009.

These require annual additions of 4-7 Mbpd of new production just to stay level.

The Size of OPEC / Other Reserves?

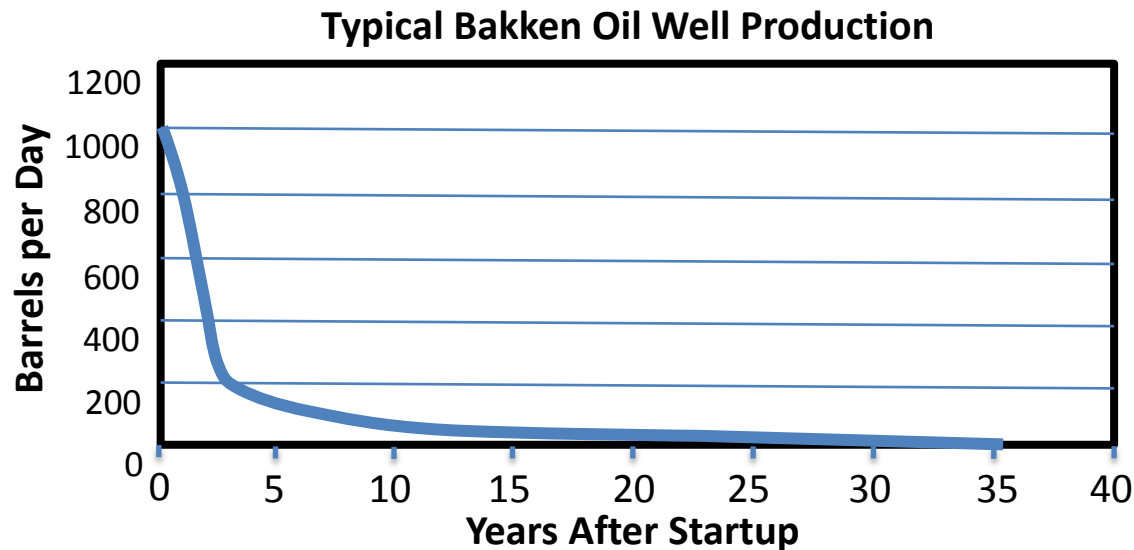
- Various estimates exist.
- Mid-late 1980s OPEC sudden changes indicate mischief.
- **No consensus / knowable?**

Will OPEC Expand Production to Meet World Needs?

- Why should they?
- Withholding means greater income.
- Saudi already said “save for the future.”
- **No consensus / knowable?**

How much oil can be produced from shale?

- Some say “extremely large.”
- Montana data raises questions.
- Some independent geologists: “Not so much.”
- **No consensus**



How big an economic impact will the decline in world oil production have?

- It depends on the **decline rate**.
- **Public reaction** will have a major impact.
- Government actions / words will make things better or worse.
- While economies are different now, we are still human & we react to major uncertainty. Remember 1973 & 1979.....

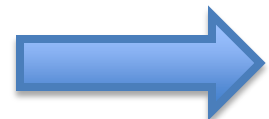


Impacts of the Brief Oil Shocks of 1973 and 1979

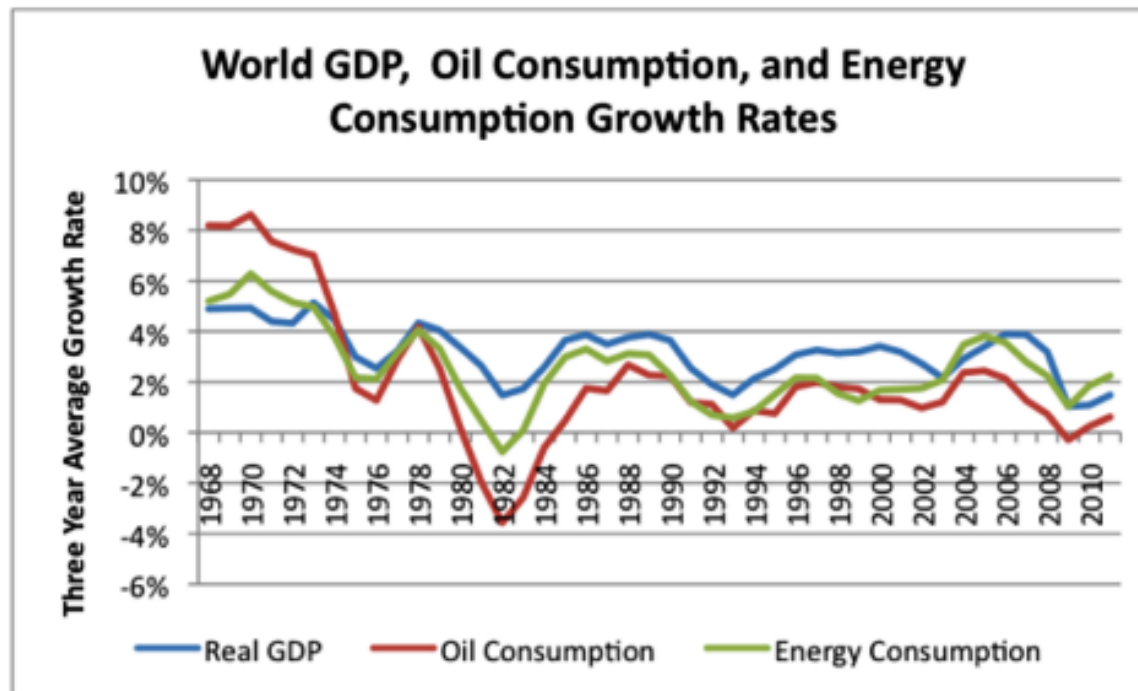
- Public shock & panic
- Oil shortages & gas lines
- Declining stock markets
- Rising unemployment
- Increasing interest rates
- Inflation & recession



What's ahead will not be brief.



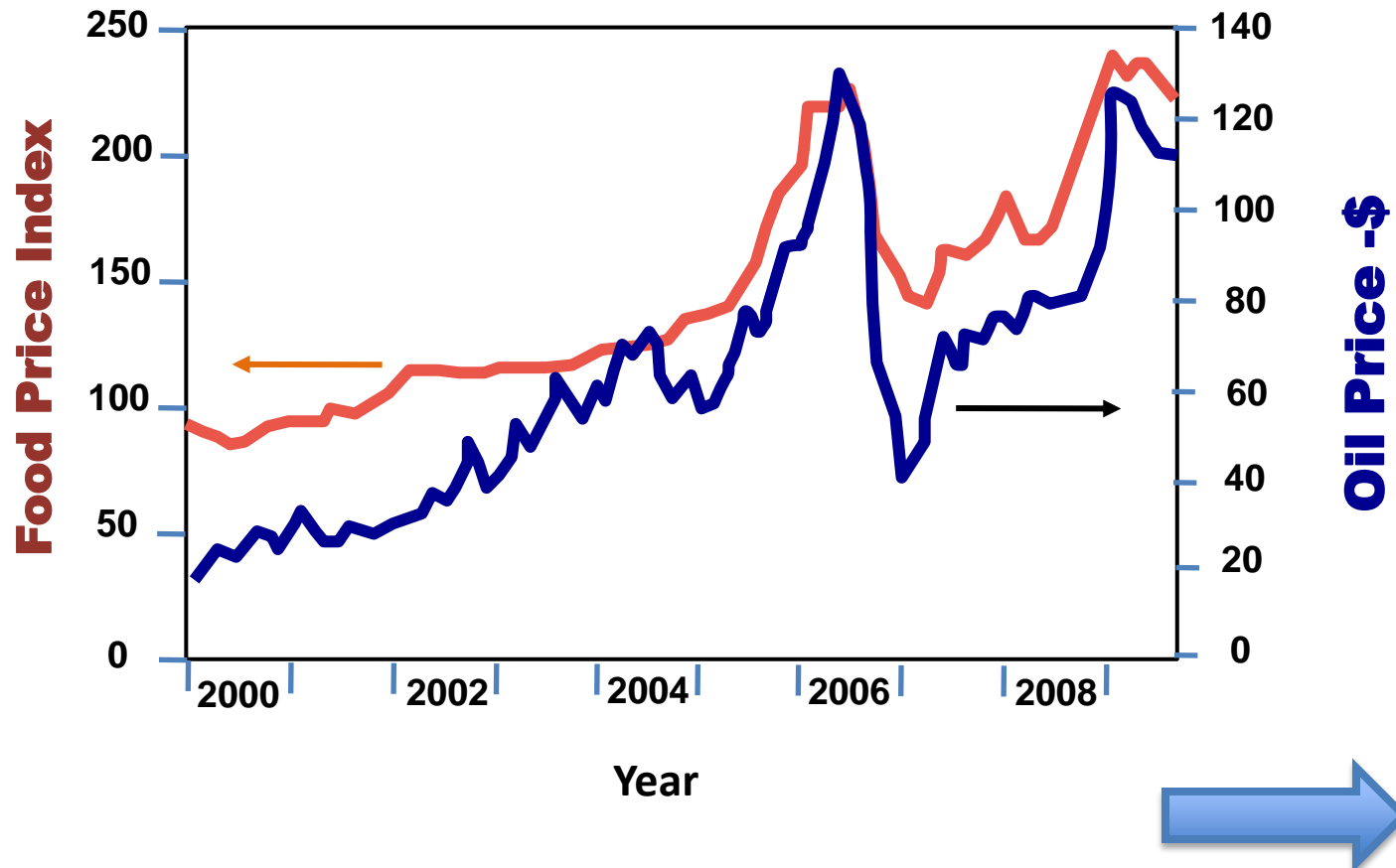
An Impact: World GDP, oil consumption and energy consumption growth rates



Tverberg, Gail. Peak Oil and the Challenging Years Ahead. Oilprice.com. Oct. 25, 2012

Correlation cannot be denied!

An Impact:
Agriculture is highly dependent on oil so when
oil prices go up, so do food prices
→ Inflation.



How Fast Can The World Mitigate “Peak Oil”?

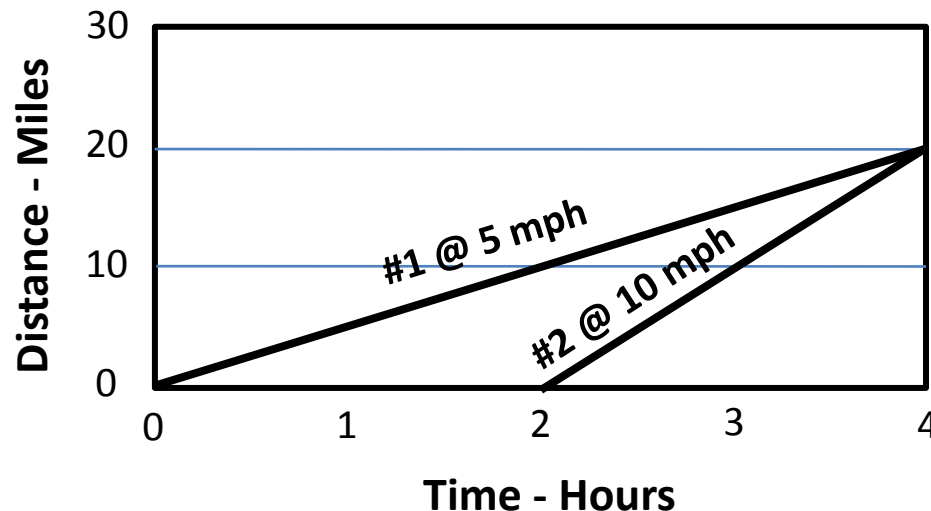
- Hirsch, Bezdek & Wendling: a **crash program upper estimate**.
- HBW is an underestimate, because **political gridlock will cause delays**, maybe long ones.
- Aleklett et al raised **maximum upper limit questions** on options.
- **Knowable? Huge unknowns & uncertainties!**
- Why will it take so long to mitigate?
 - The task is enormous!
 - R & D is critical for the long term, but **short term, deployment of existing technologies is a must.**
 - Oil decline will have had a head start.



Why will a worldwide crash program to mitigate oil production decline take so long?

A: It's a "rates race," analogous to a fast runner (crash mitigation) running after a slower runner with a big head start (oil production decline); it takes time to catch up.

Consider Runner #1 running at 5 mph starting two hours ahead of Runner #2 running at 10 mph:



The Role of Government in PO Mitigation

- **Recognize the reality & enormity of the problem, including the time & money required**
- **Effectively communicate to all**
- **Decide to manage themselves or let industry manage**
- **Organize & clear the way for rapid action**
 - **Limit or eliminate permitting & regulation.**
 - **Expedite procurements**
- **Impose effective rationing**
- **Care for the needy**
- **Stimulate R & D**

How Fast Can Renewables Mitigate “Peak Oil”?

- **It's a liquid fuel problem, not energy!**
- Wind & solar can't help soon
- Biomass may have some potential
 - Competition with food production.
 - Environmental impacts can be large
 - Some options have low EROI.
- How long before facts & analysis impact true believers?

Importance of EROI?

- Professionals understand the concept; the public does not.
- To provide early relief, low EROI options will be needed.
- EROI considerations are critical longer term.

Is Climate Change Mitigation More Important Than “Peak Oil” Mitigation?

- Before shortages / high prices occur, there will be significant disagreements.
- After pain & devastation, disarguments will fade.

The “Peak Oil” Public Relations War

IEA: “U.S. will overtake Saudi Arabia as the world's largest oil producer by 2020.”

**P.R. War:
We're here.**

In Conclusion

- **The problem is both simple & very complicated.**
- **Many have made wonderful contributions. More are needed.**
- **Challenges require sound thinking & analysis & effective communication.**
- **Rapid mitigation will be essential and a huge challenge.**

The Arrow: We will get through the impending oil shortage problem & be stronger afterward.