



November 27-29, 2012
Hilton Americas - Houston
Houston, Texas

Scale Creates Challenges for Chemicals from Biomass

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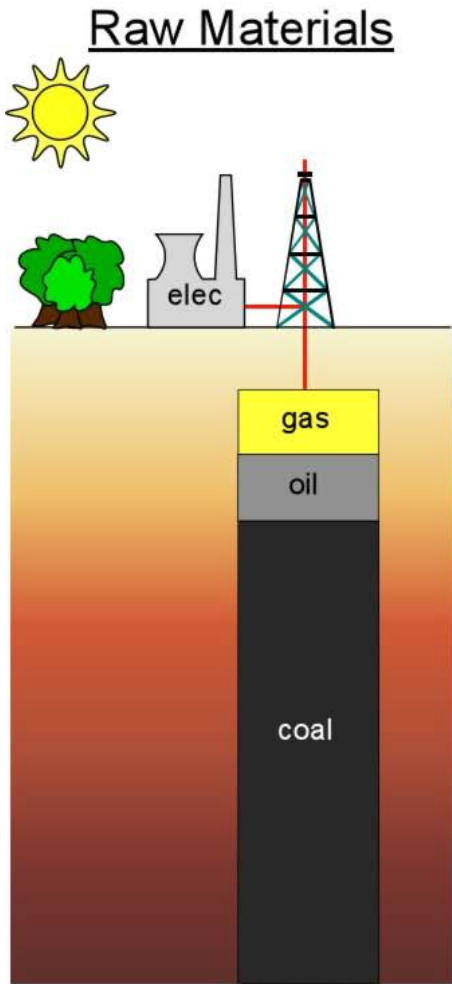
The Dow Chemical Company



DOW

®

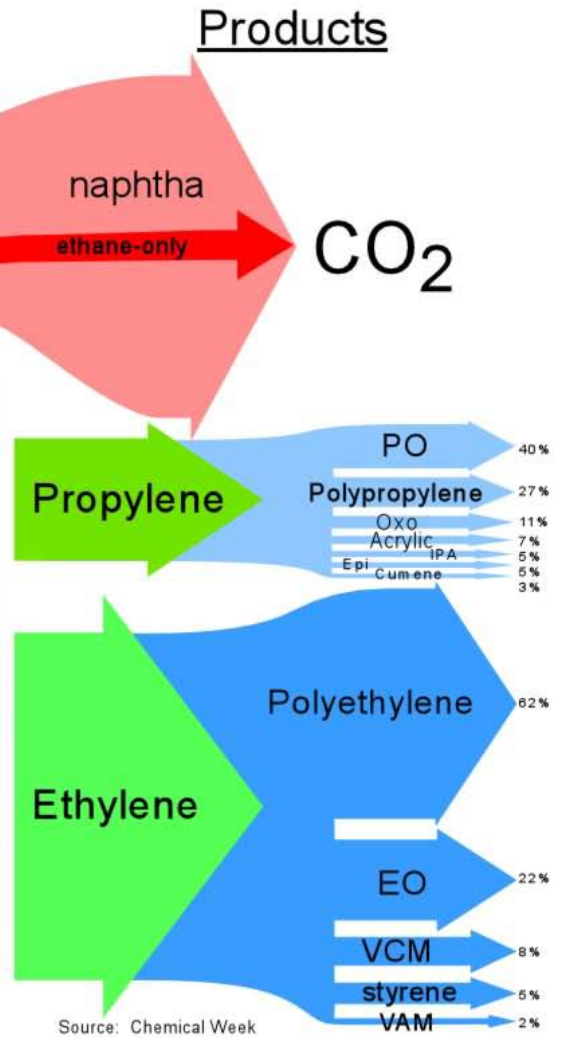
Chemical Industry



source: 2002 BP Statistical Review



source: SRI 29G



Source: Chemical Week

What Unhealthy Looks Like

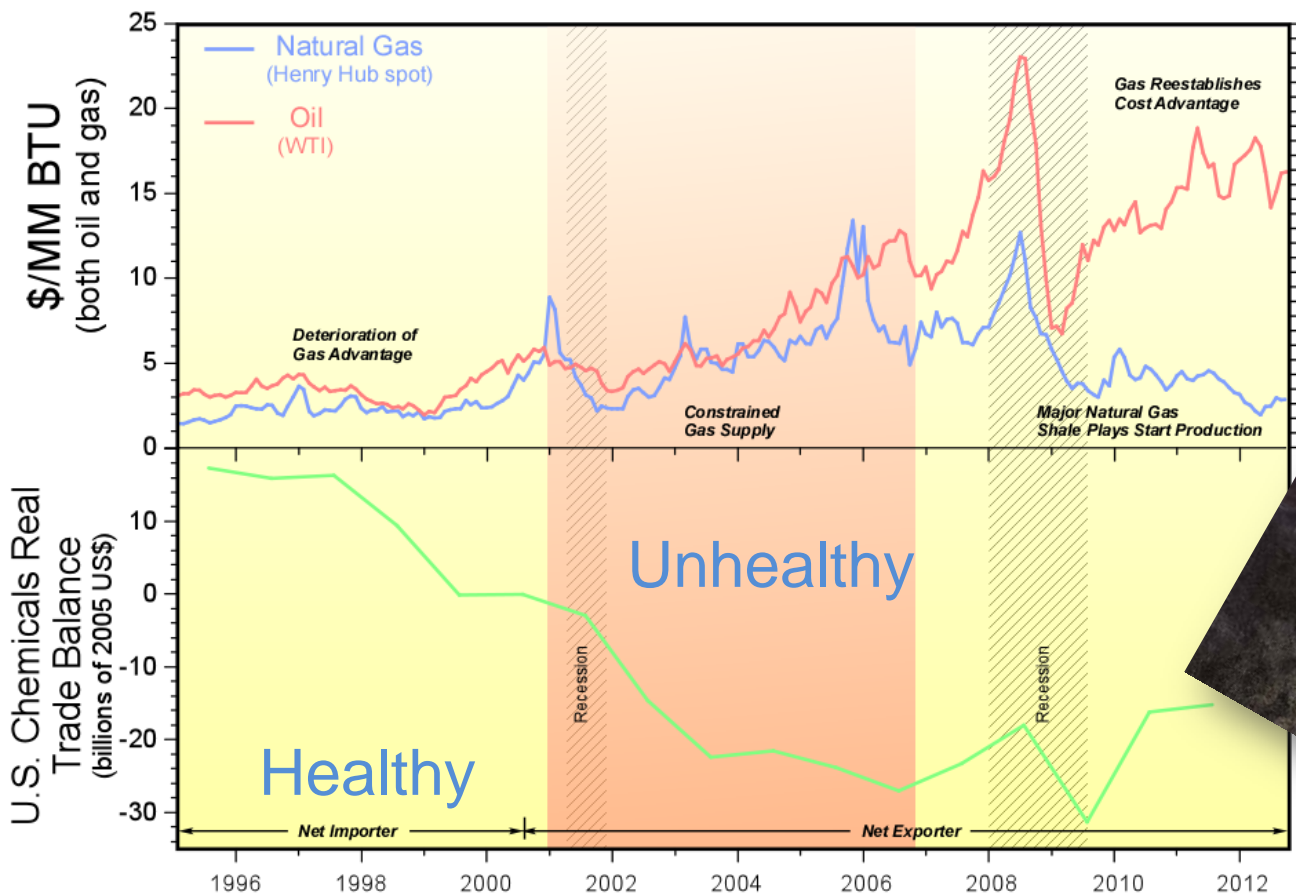
Healthy



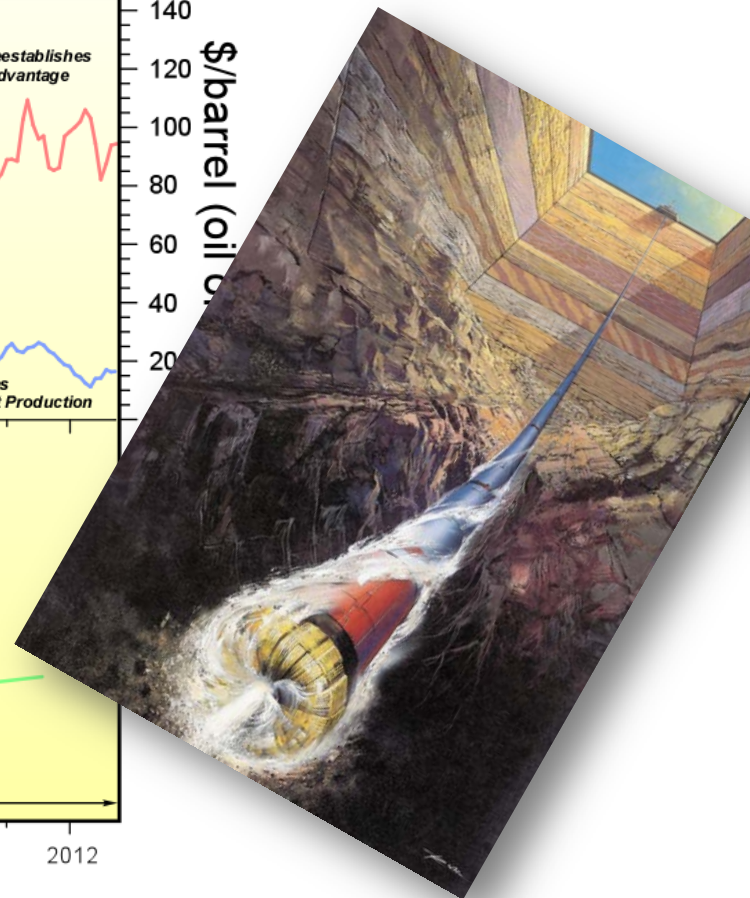
Unhealthy



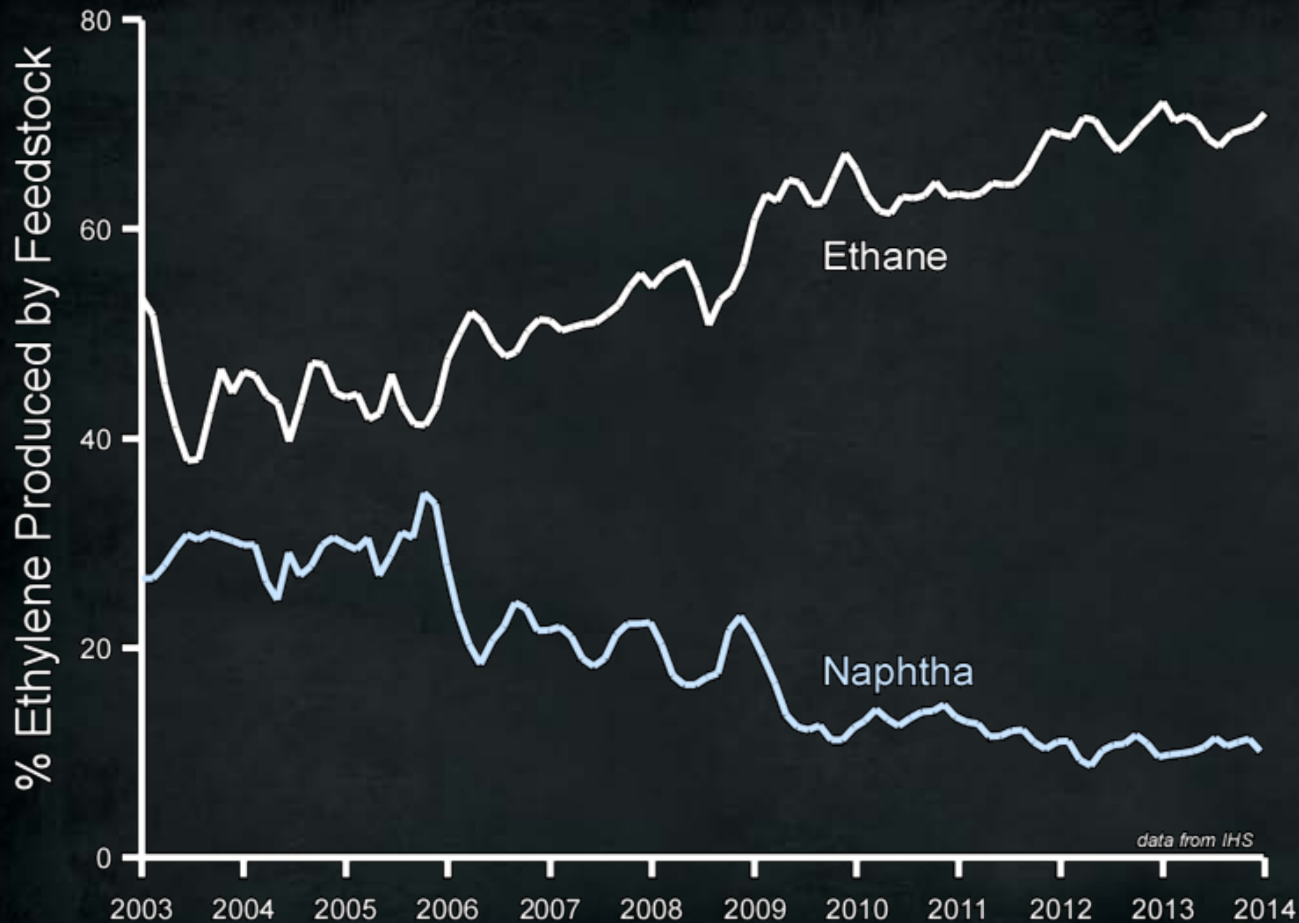
Truism 1: Chemical Industry is Returning to Health



IHS Global Insight, "The Economic and Employment Contributions of Shale Gas in the US", prepared for America's Natural Gas Alliance, December 2011.



US Trend

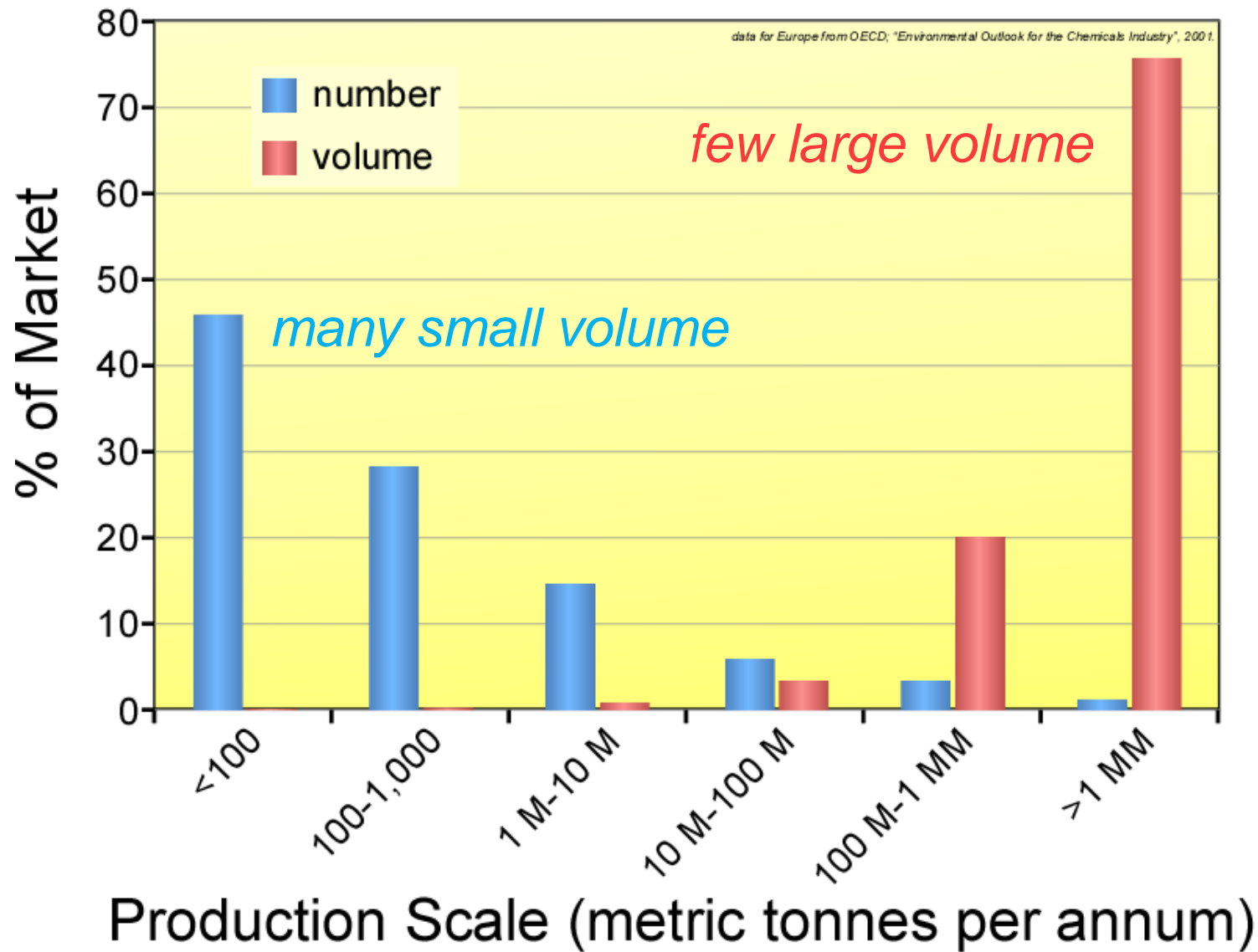


U.S. trend is toward lighter gas cracking and it is an old trend

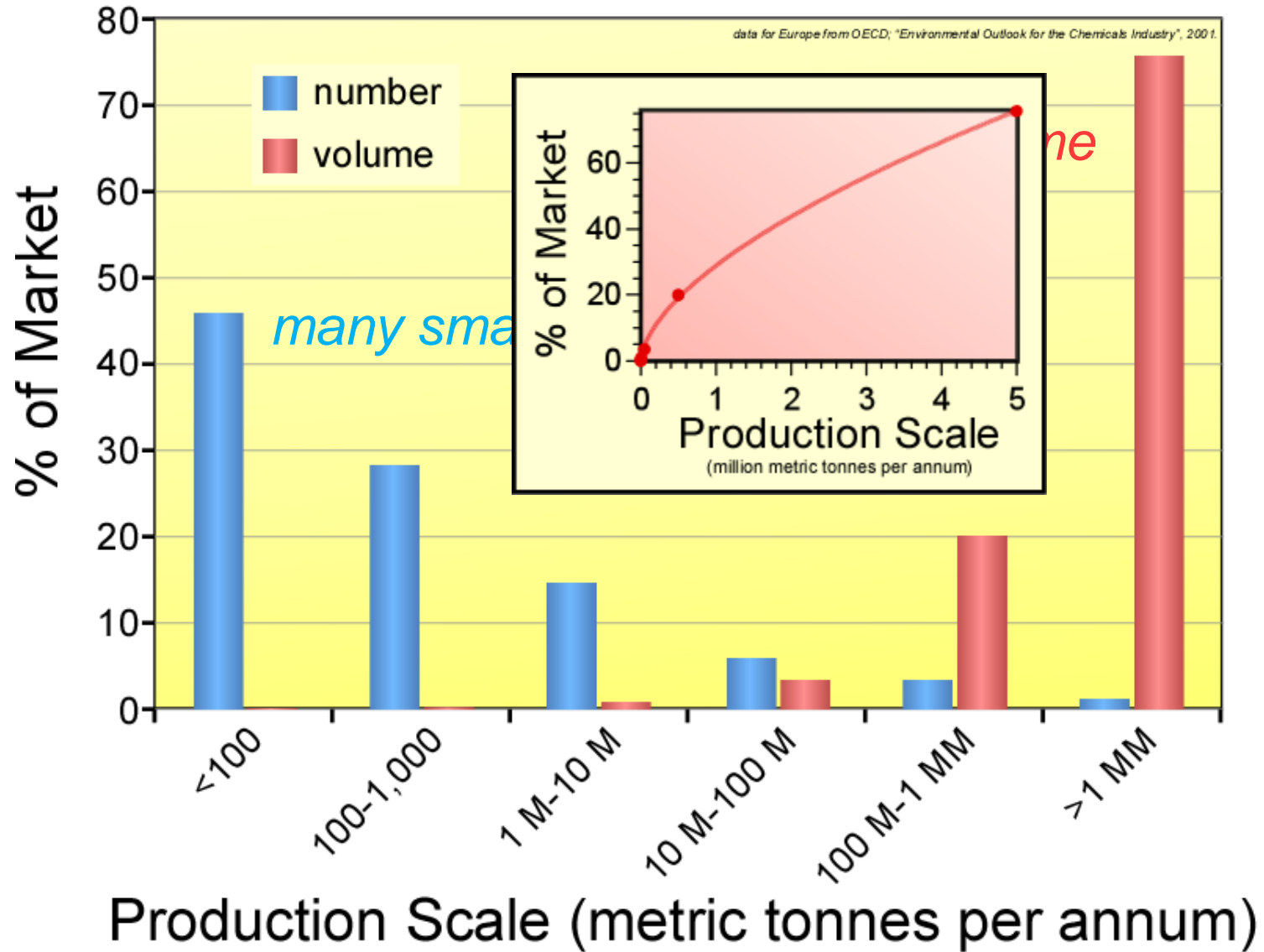
Implications:

- less propylene
- less butadiene
- less benzene

Truism 2: Scale Falls Quickly in Chemicals



Truism 2: Scale Falls Quickly in Chemicals



Truism 3

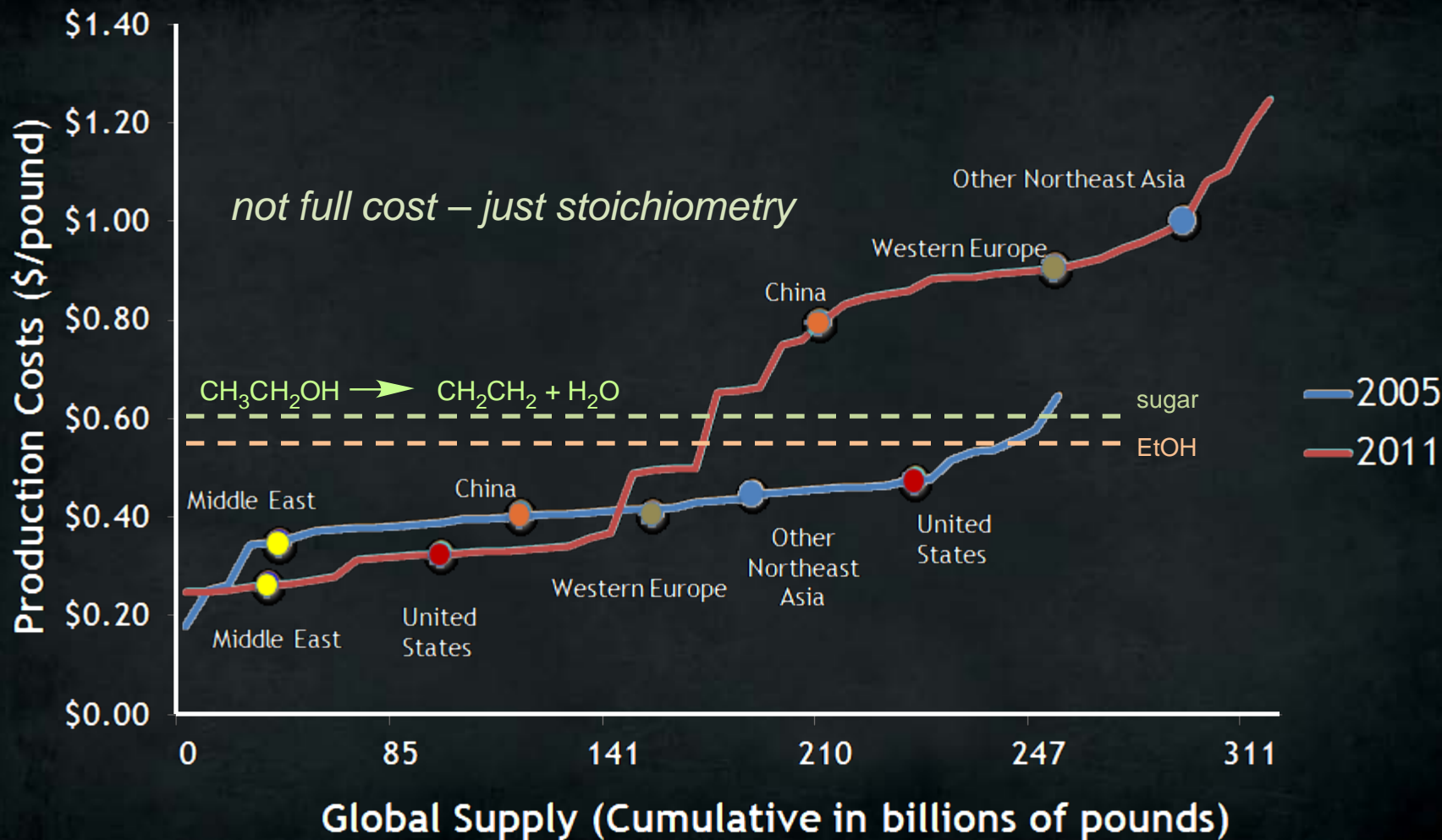
A mixture containing a valuable chemical is not the same as a valuable mixture of chemicals.

Truism 4: Scale Always Wins



If you are moving mass around, scale reduces cost faster than experience.

Fallacy 1: Bio Beats Fossil



Owen Kean and T.K. Swift, American Chemistry Council, "Industry-Transforming Natural Gas into Products", National Academy Forum on Unconventional Gas, 11 September 2012.

Fallacy 2: Green Premiums

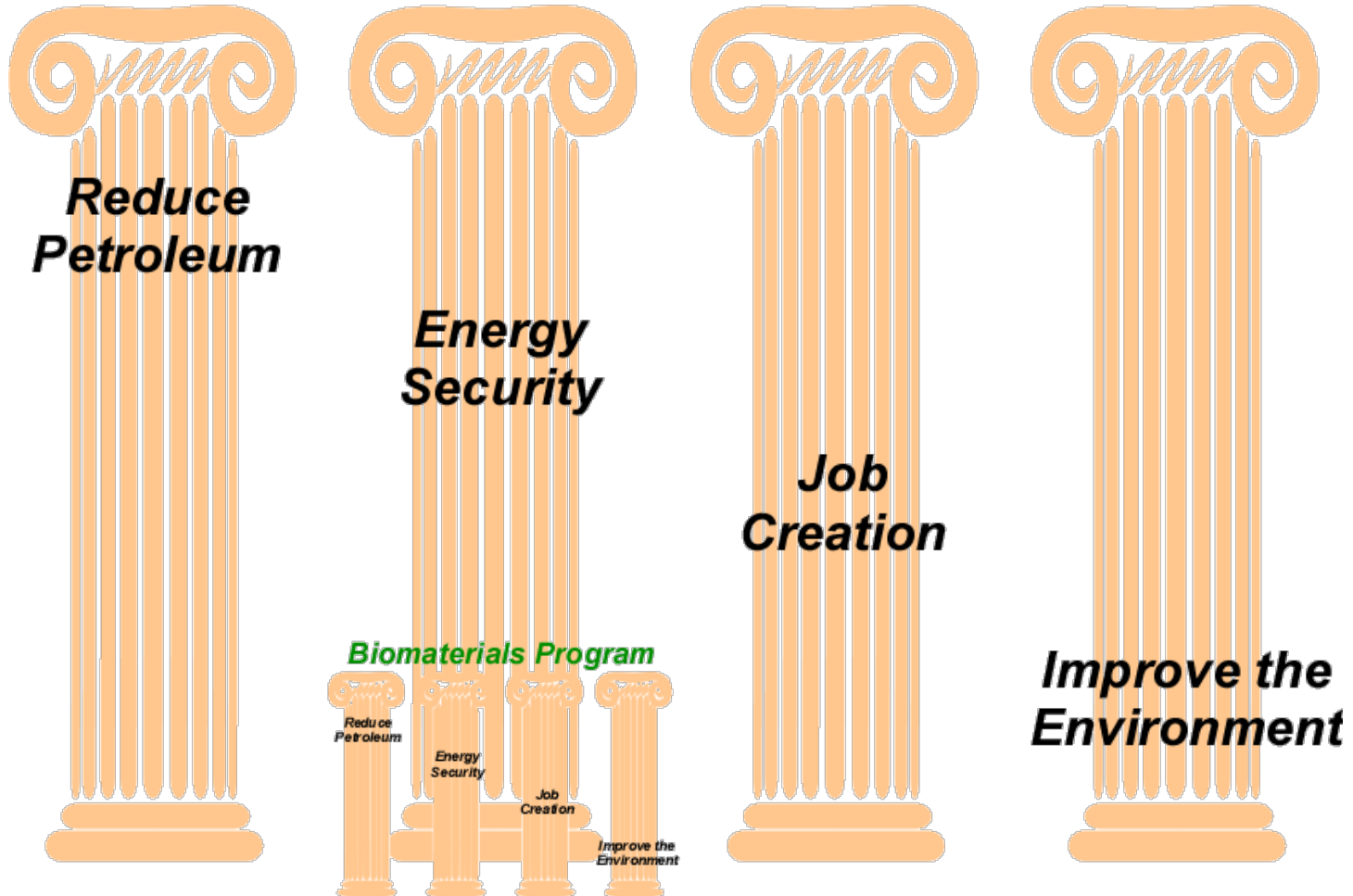
Chemical markets are driven by cost and premiums are difficult to sustain.

Fallacy 3: Shut-down Economics

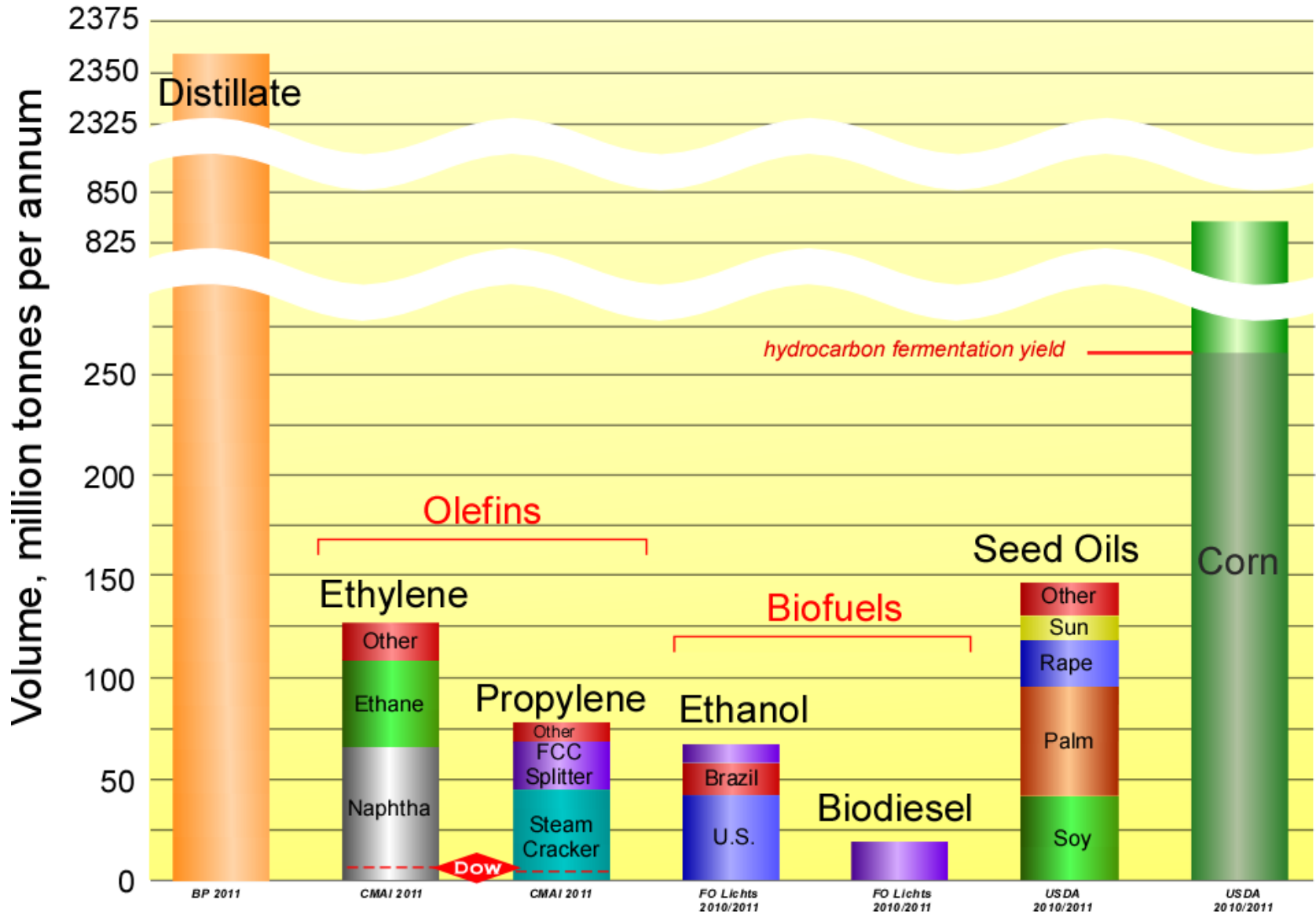
It takes decades for superior technology to displace standing assets.

Pivot to Biomaterials

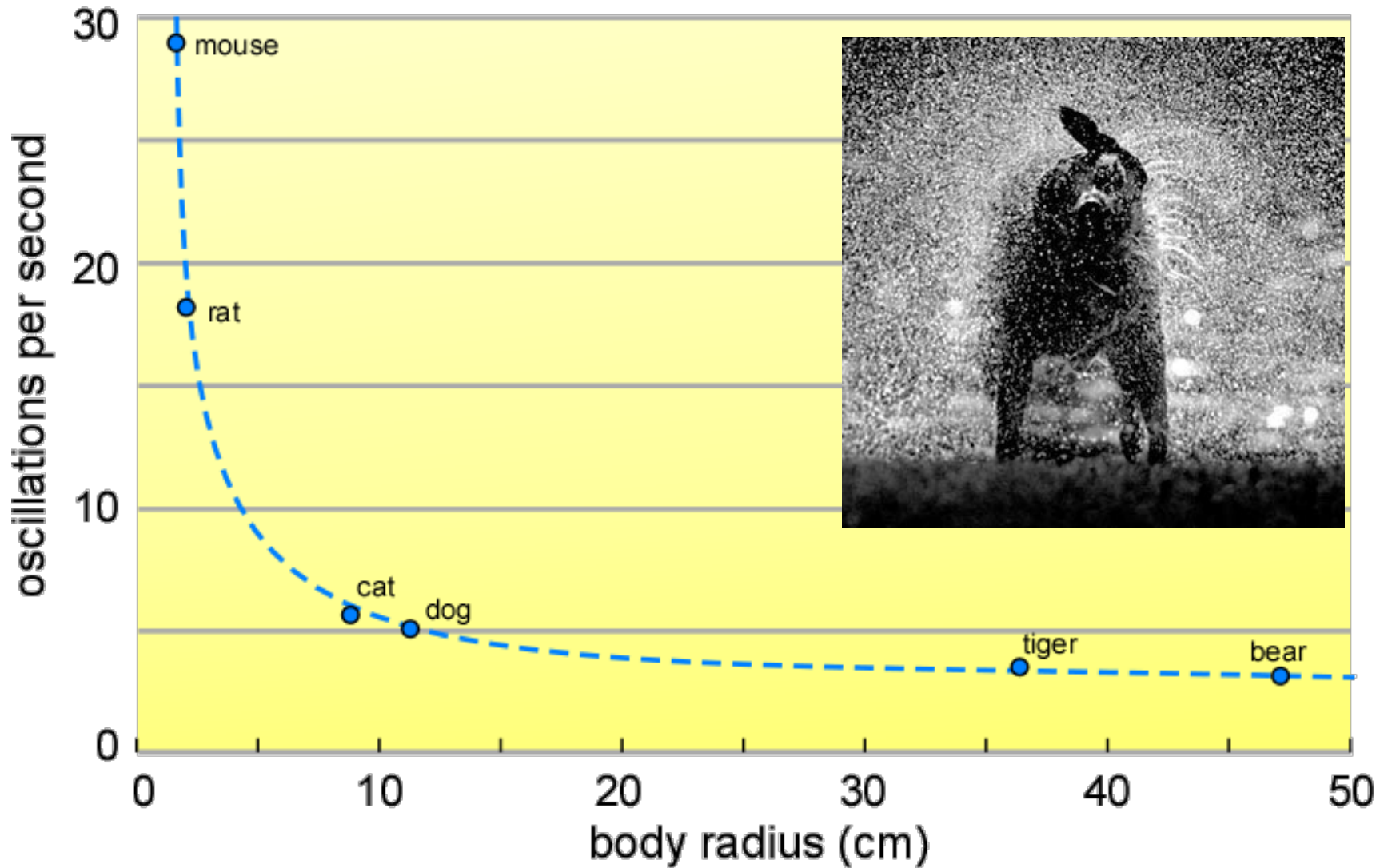
Biomass Fuels Program



Global Commodity Production

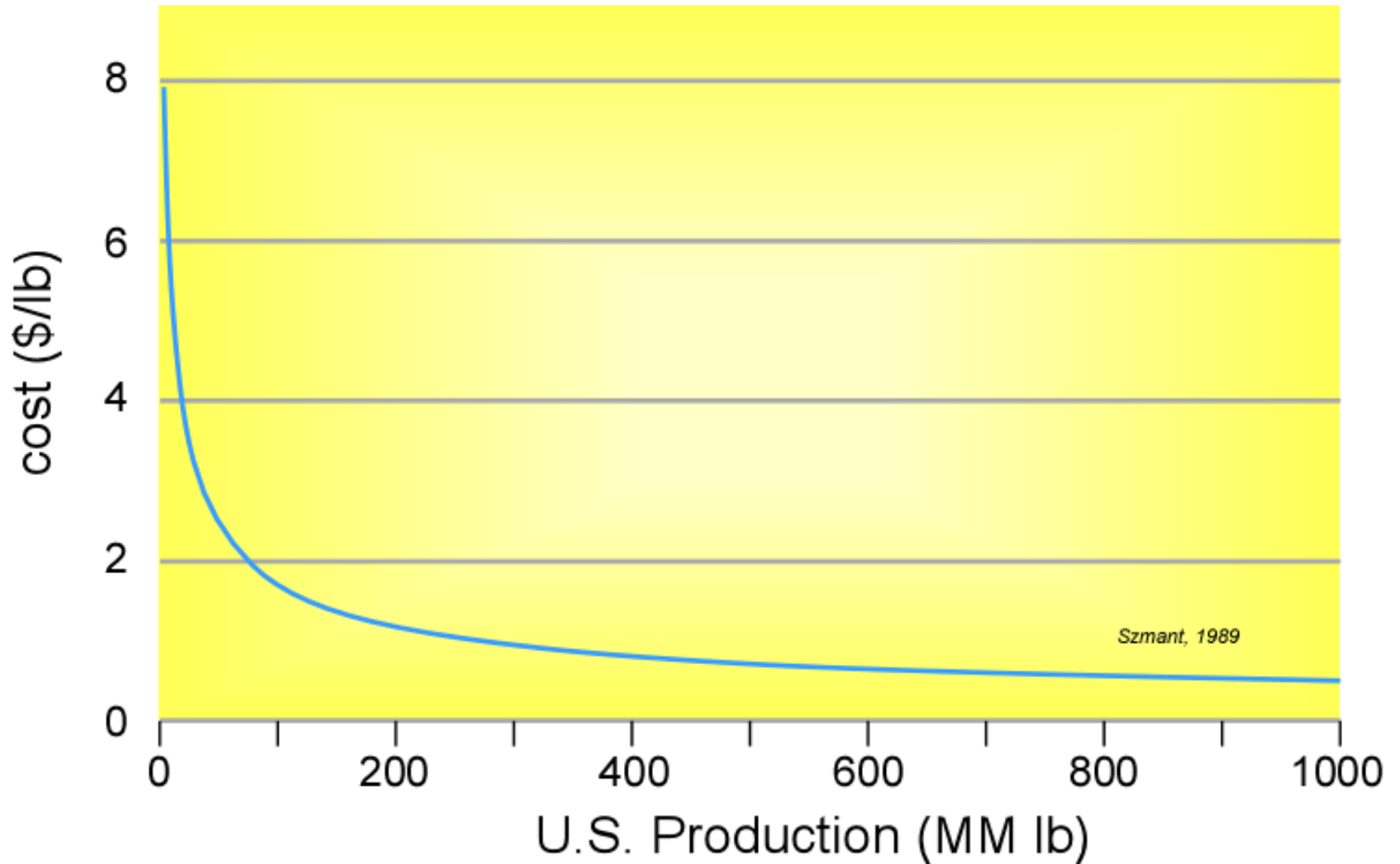


Interesting Correlation

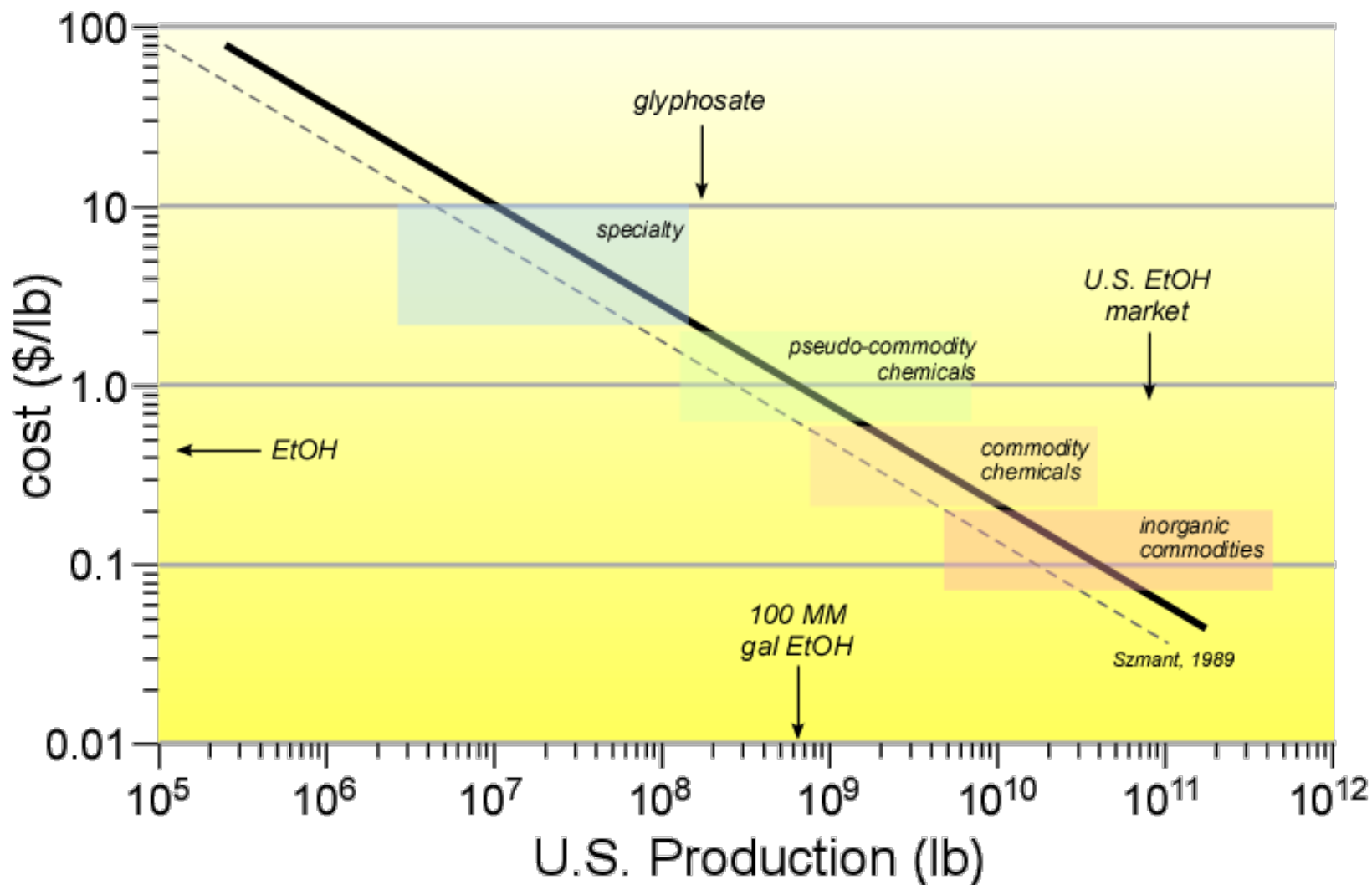


Andrew Dickerson, Grant Mills, Jay Bauman, Young-Hui Chang, David Hu, The Wet-Dog Shake, Fluid Dynamics, 15 October 2010.

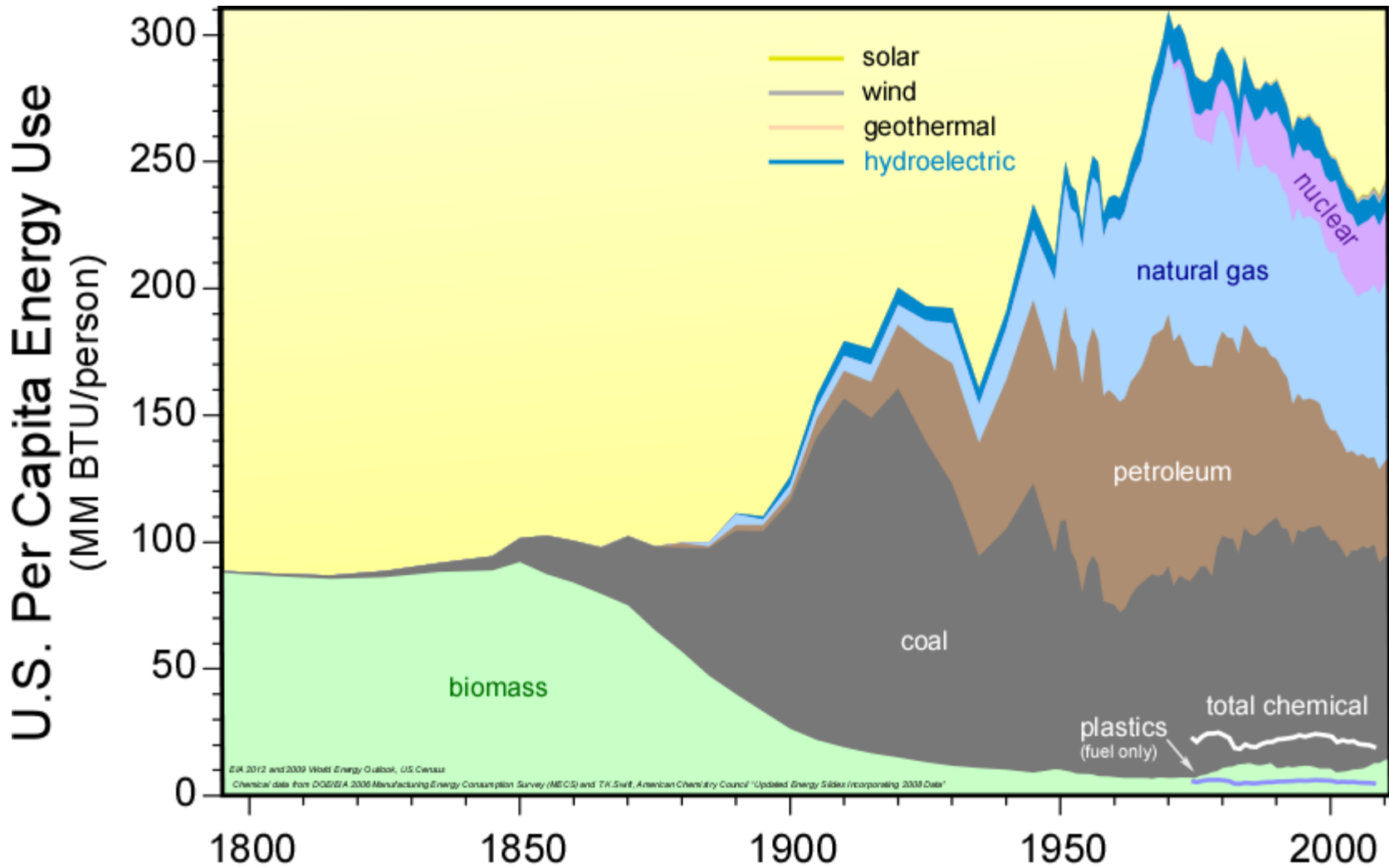
Scale Matters!



Most Common Version



Personal Impact



Plant Bottles



“At full capacity, it is estimated the facility will produce 500,000 metric tons of material per year. By using plant-based materials instead of non-renewable materials, the facility will remove the equivalent of 690,000 metric tons of carbon dioxide or the equivalent of consuming more than 1.5 million barrels of oil each year.”

Coca-Cola, 27 Sept 2012



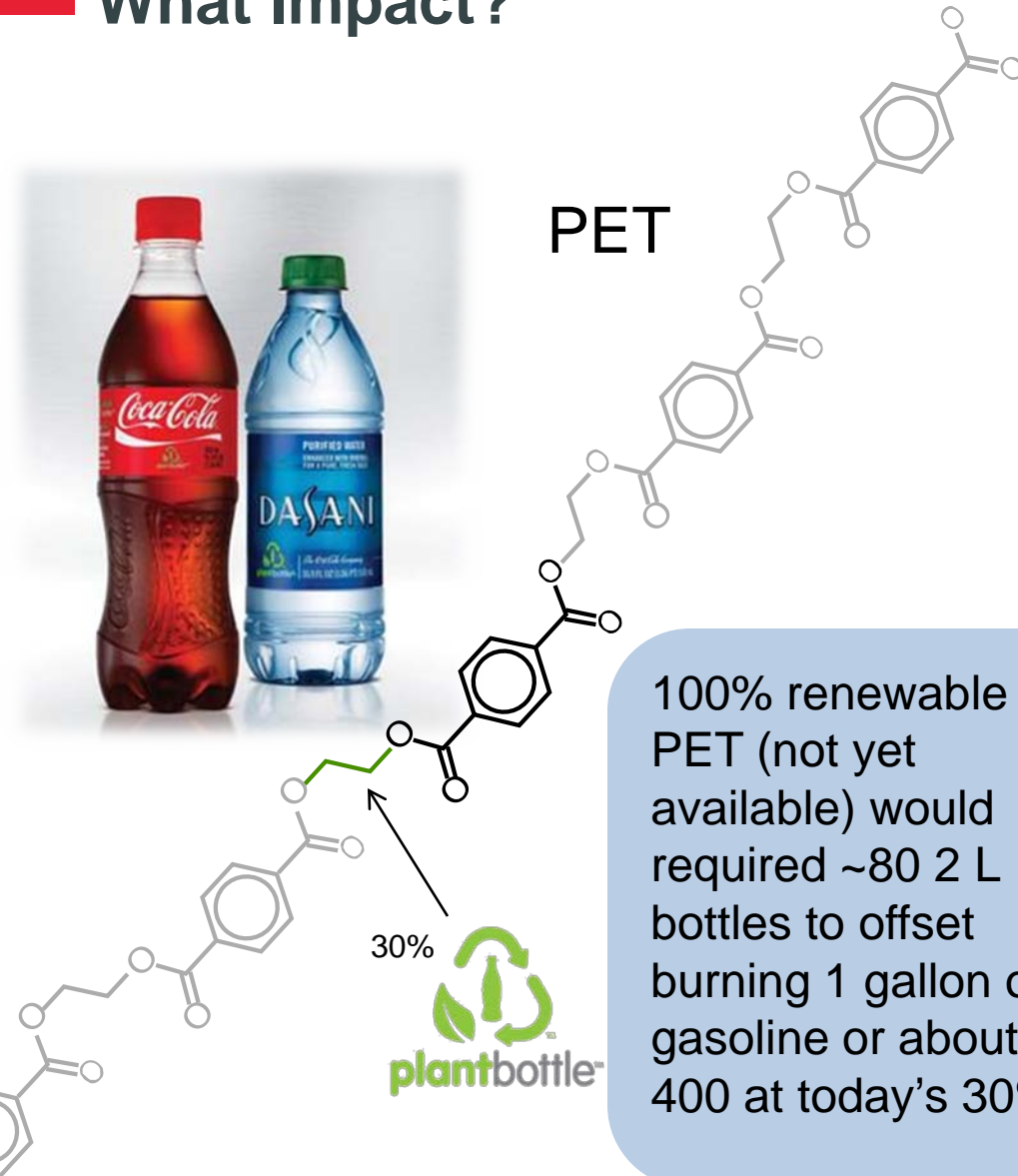
US consumption is 19 million barrels per DAY.
World, 90 million.



What Impact?



PET



30%



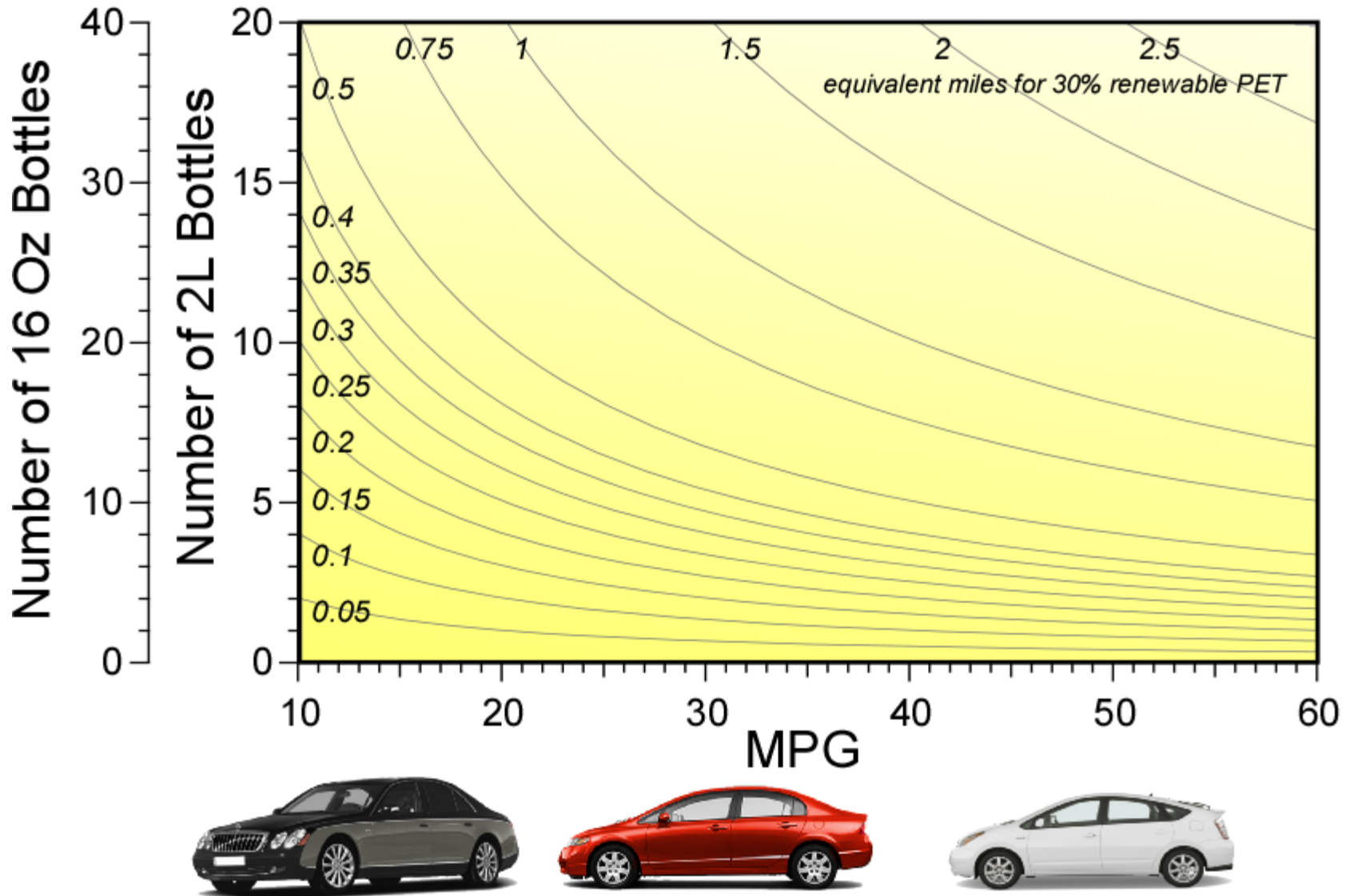
100% renewable PET (not yet available) would require ~80 2 L bottles to offset burning 1 gallon of gasoline or about 400 at today's 30%

material	per capita consumption (lb/yr)
PET packaging	17
petroleum	6619
natural gas	8037
coal	6439
gasoline	2495
sand and gravel	13923
cement	512
iron ore	340
salt	403
beef	54.3
chicken	55.7

data from HIS, 2012 ERS USDA, 2011 National Mining Assoc., World Bank



PET Comparison



Path to the Future

