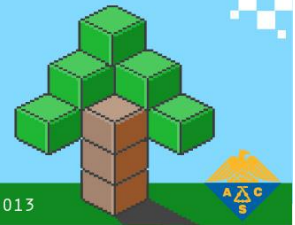




44TH CENTRAL REGIONAL MEETING OF
THE AMERICAN CHEMICAL SOCIETY

**BUILDING BLOCKS
FOR A SUSTAINABLE WORLD**



CERMACS ■ MT. PLEASANT, MICHIGAN ■ MAY 15-17, 2013

Scale Creates Challenges for Chemicals from Biomass

Mark Jones

Executive External Strategy and Communications Fellow

The Dow Chemical Company

Abstract

High value chemical markets have been touted as the savior for many biofuels companies. These discussions gloss over the differences between fuels and chemical markets, including market scale and market channels. “Green is good” needs to be replaced by clearly articulated benefits to the environment and consumers to generate a sustainable business.

Last Year Was A Big Year

THE NATIONAL
DIVISION ON EARTH AND LIFE STUDIES

Sustainable Development of Algal Biofuels in the United States

Jennie C. Hunter-Cevera
Committee Chair

Mark E. Jones
Committee member

ACADEMIES

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Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

Biofuels Are Like a Jetpack

HYPE



**ENERGY
DENSITY**

**LIMITATIONS
OF BIOLOGY**

**PRACTICAL
APPLICATION**



DOW

®

What Unhealthy Looks Like

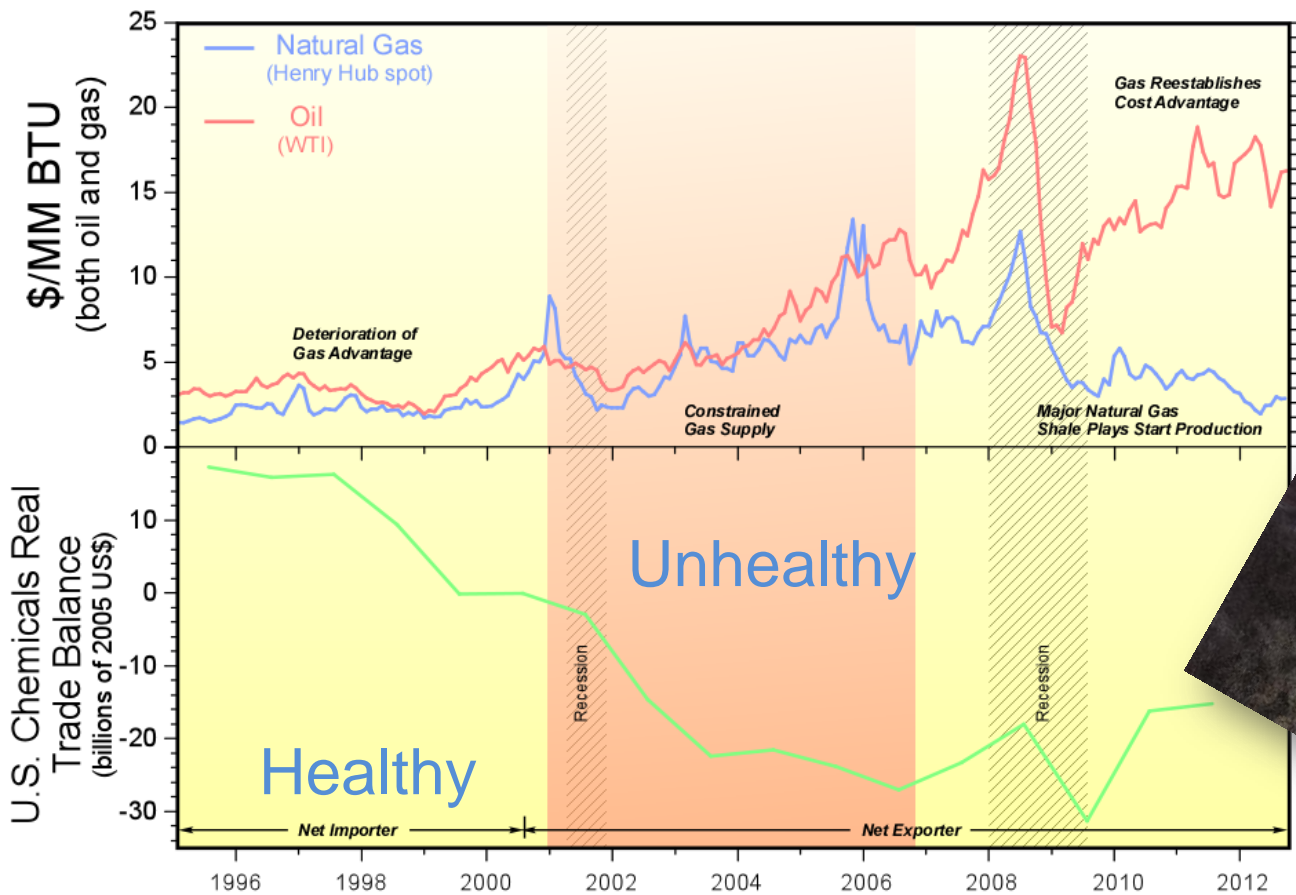
Healthy



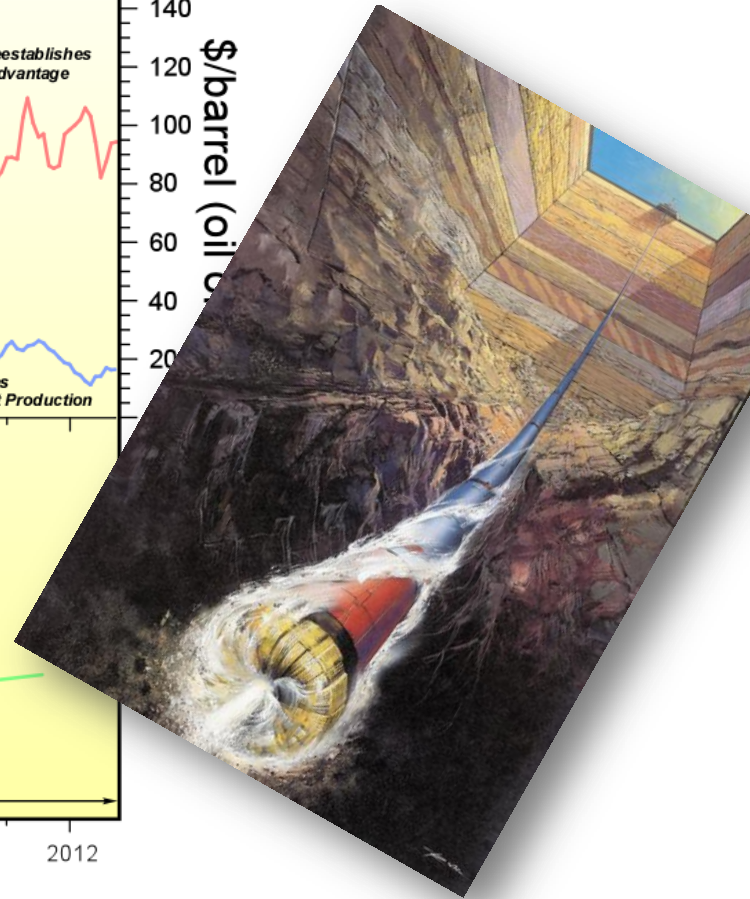
Unhealthy



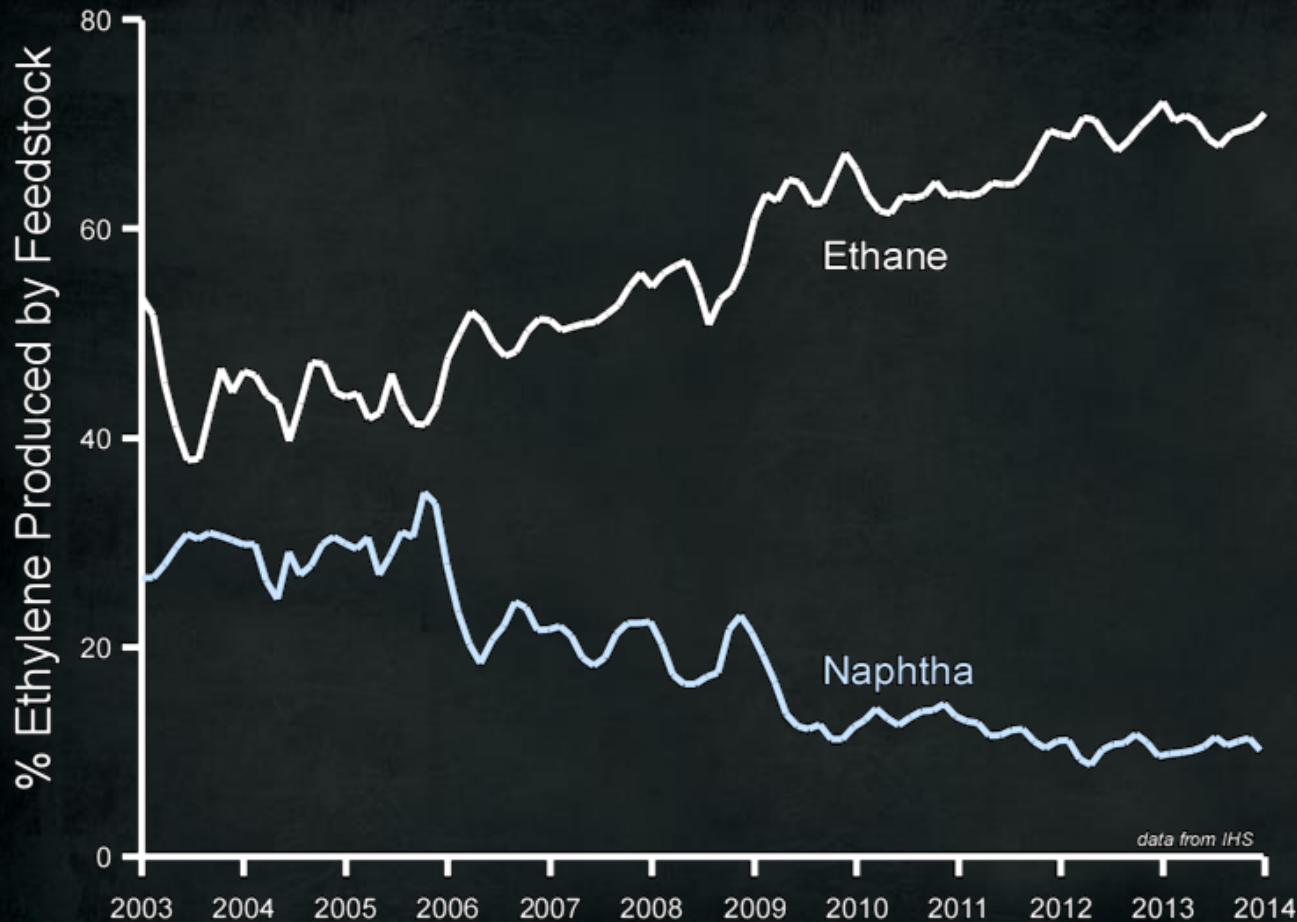
Truth 1: Chemical Industry is Returning to Health



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

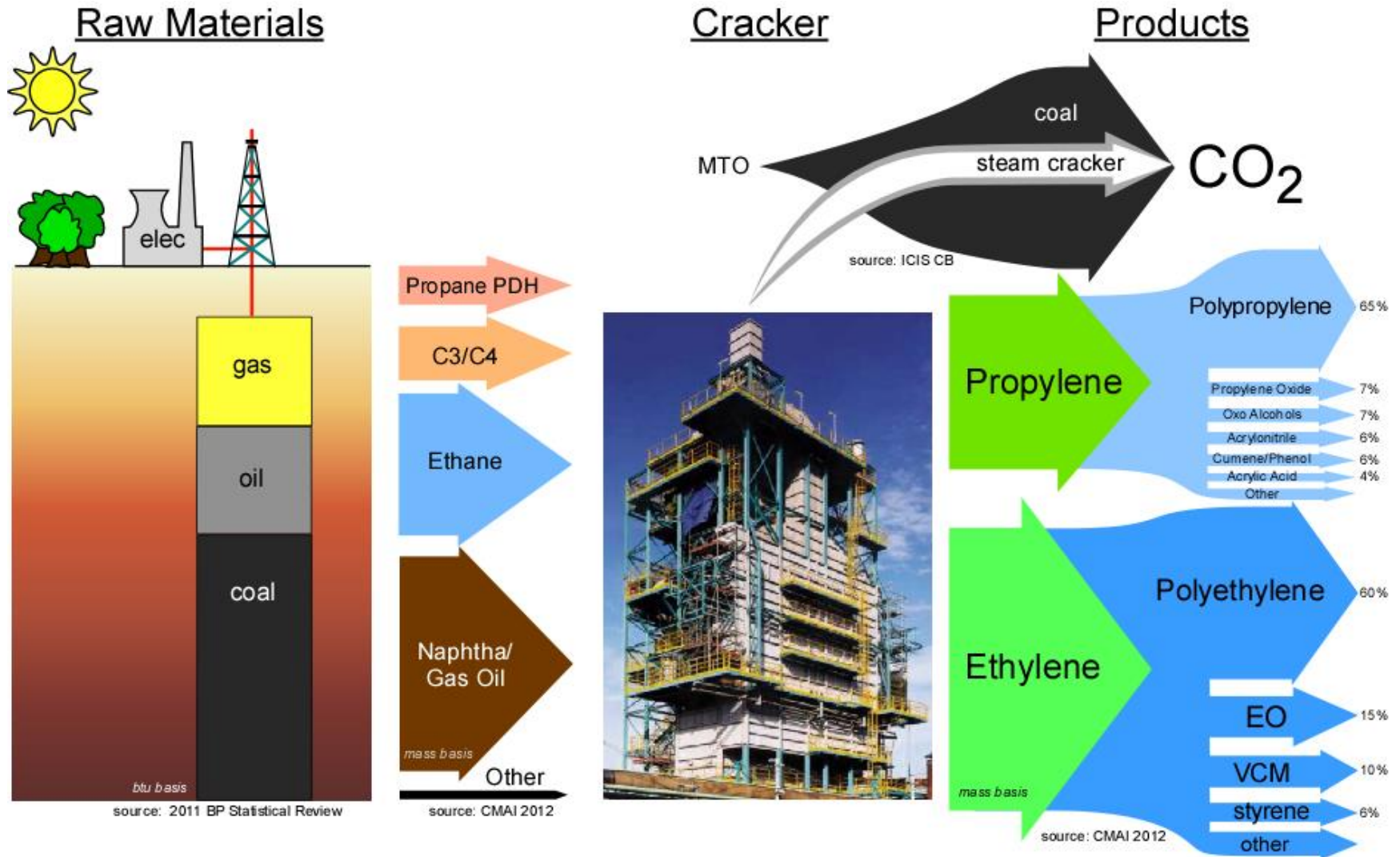


U.S. trend is toward lighter gas cracking and it is an old trend

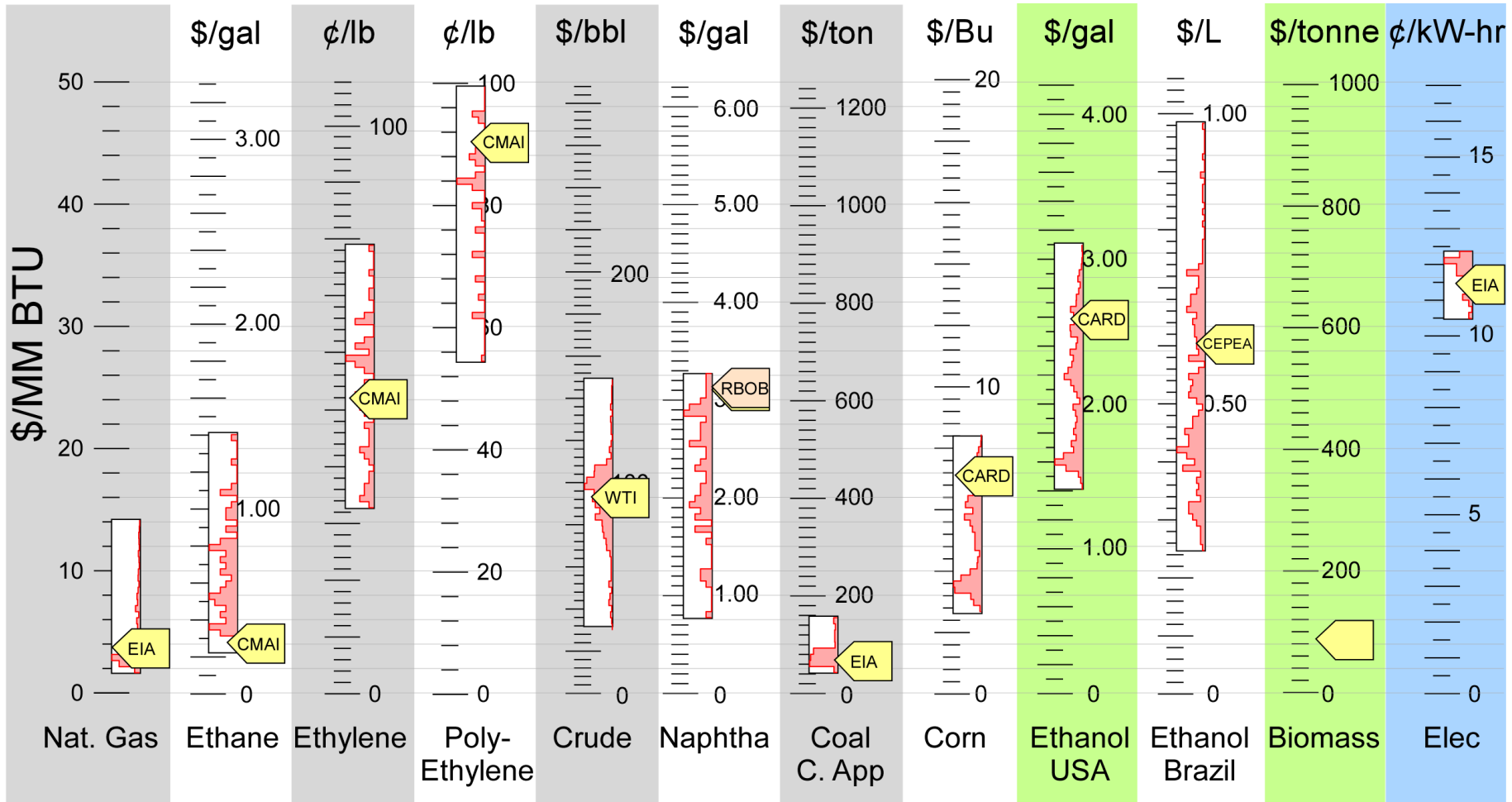
Implications:

- less propylene
- less butadiene
- less benzene

Chemical Industry



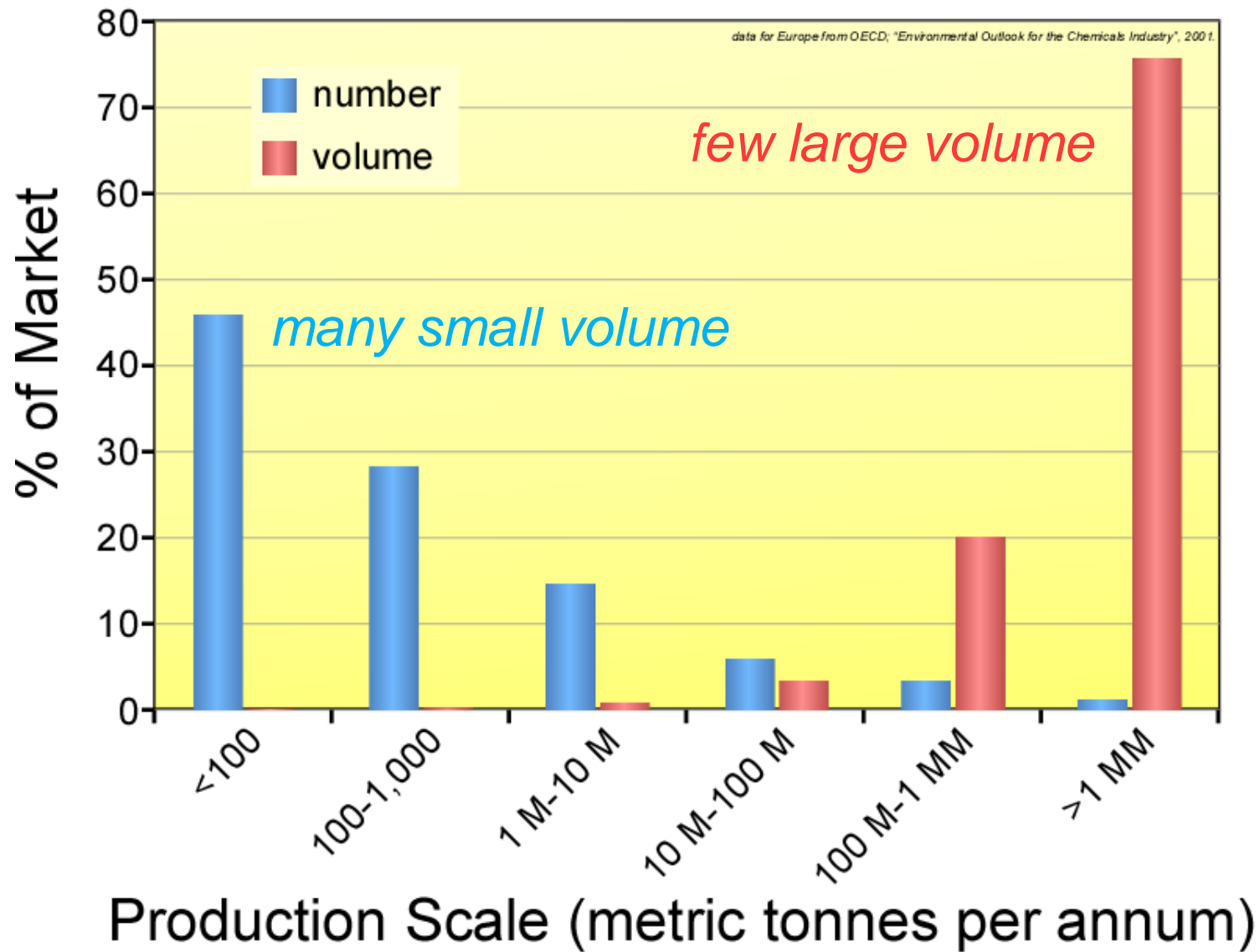
Energy Content



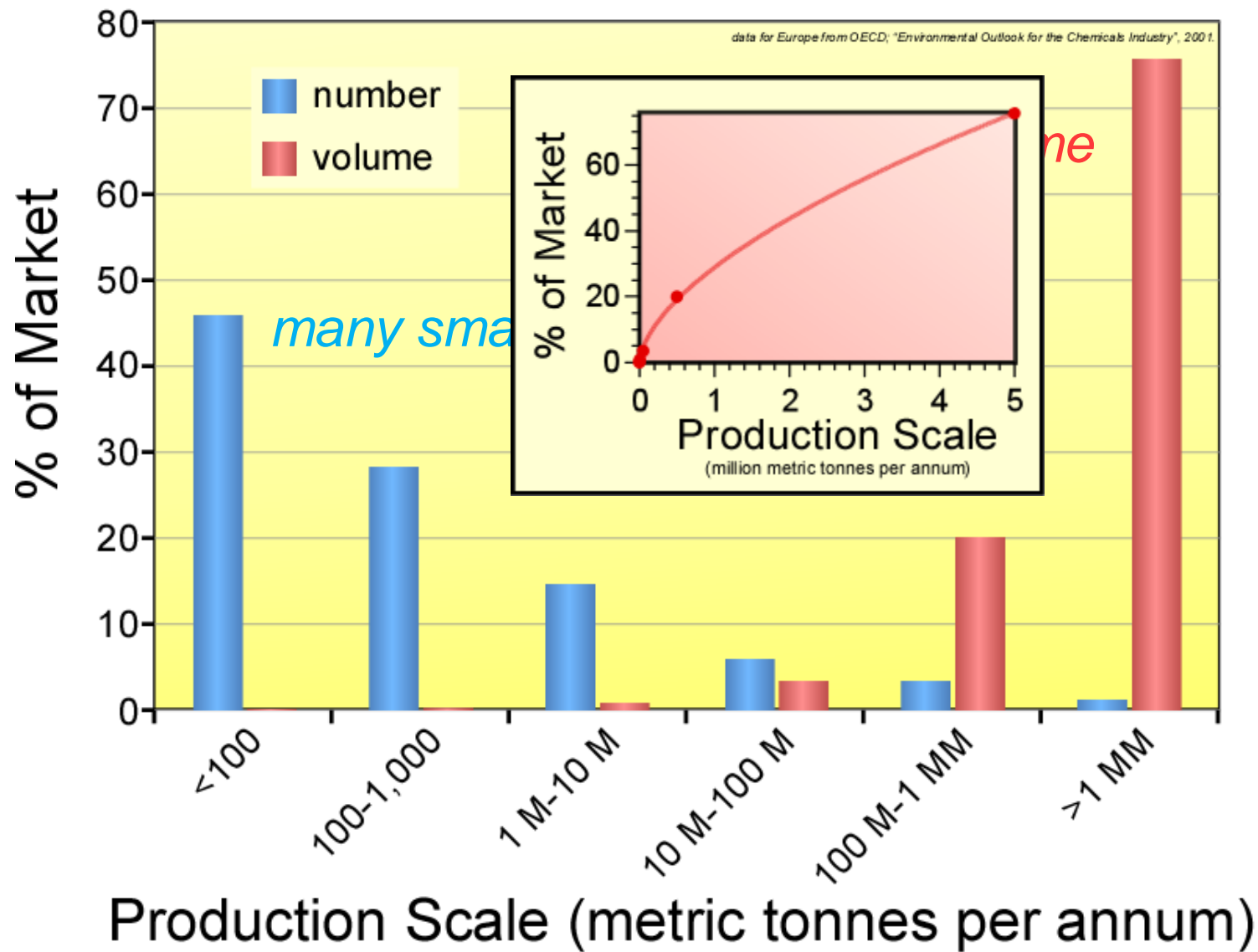
EIA is DOE Energy Information Agency, CMAI is an IHS affiliate, CARD is Iowa State Center for Agricultural and Rural Development, CEPEA is Centro de Estudos Avancado em Economia Aplicada – data for 3-5 years depending on source. updated 22 March 2013



Truth 2: Scale Falls Quickly in Chemicals



Truth 2: Scale Falls Quickly in Chemicals



Truth 3

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

Example



Truth 4: Scale Always Wins



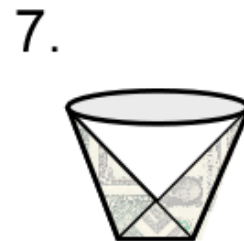
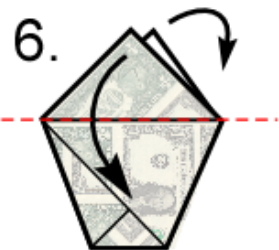
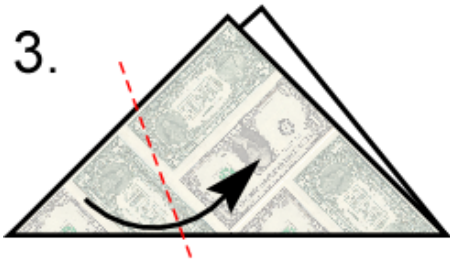
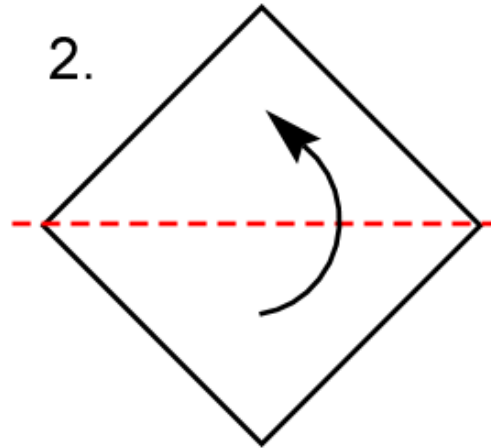
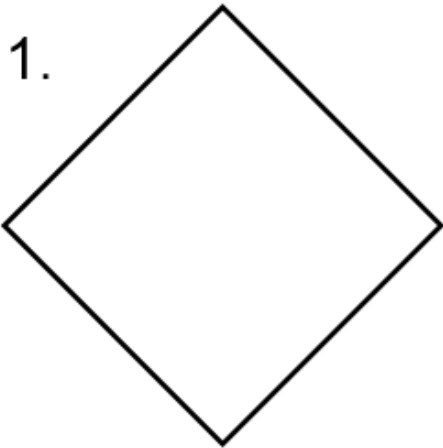
If you are moving mass around, scale reduces cost faster than experience.

Exercise

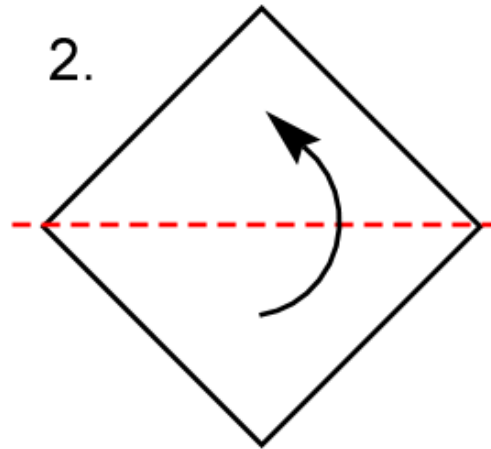
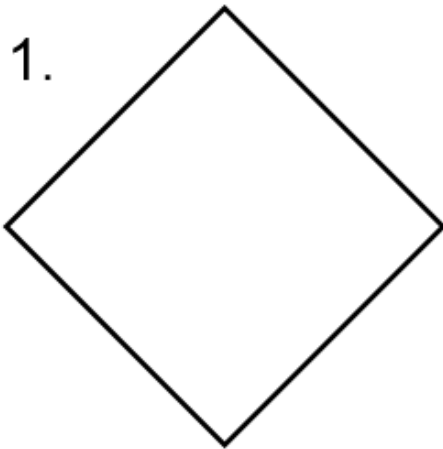


Scale is Important – *An Example*

Make a cup with an $8\frac{1}{2}$ " square and another with a $4\frac{1}{4}$ " square



Scale is Important – *An Example*

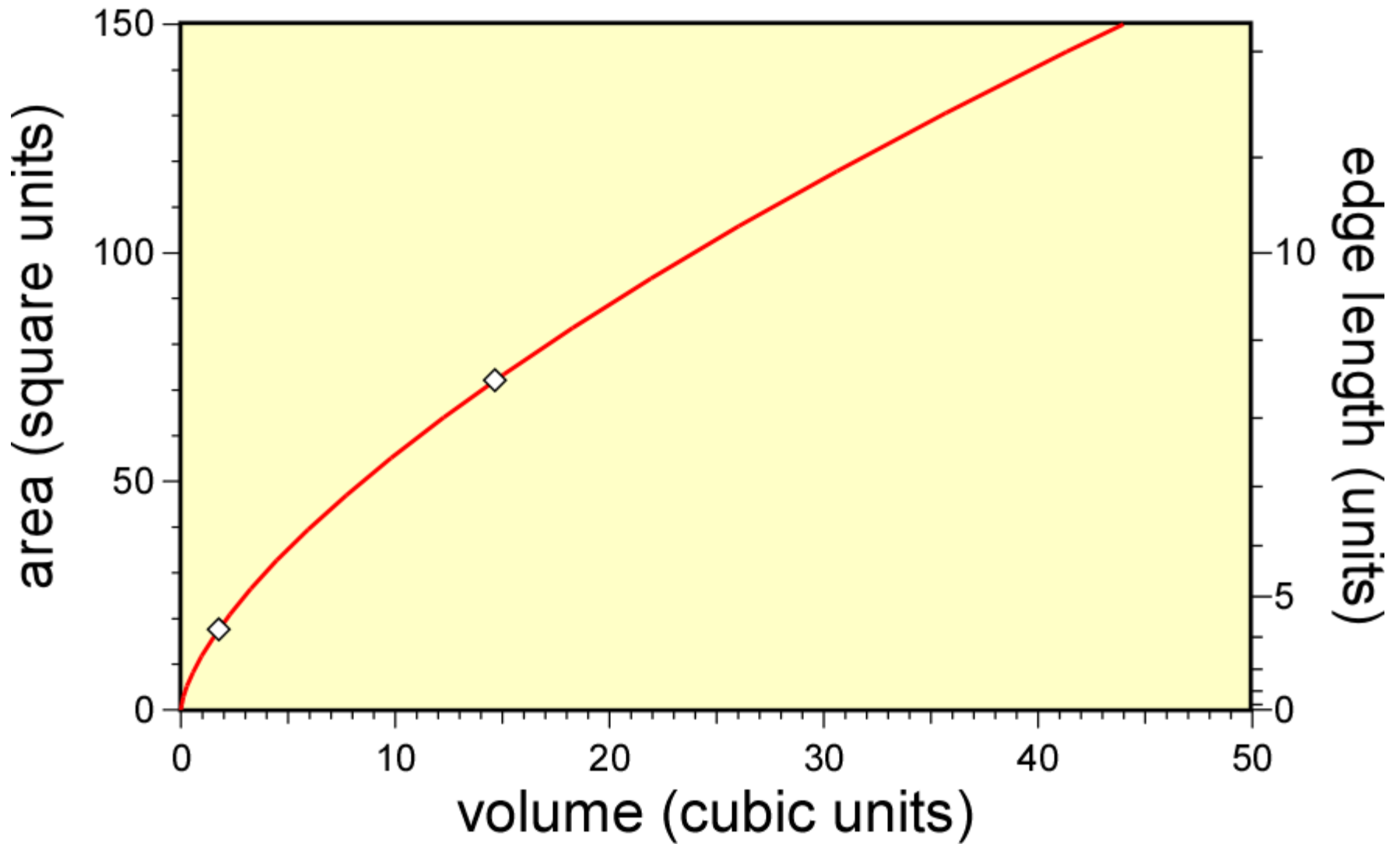


Make a cup with an $8\frac{1}{2}$ " square and another with a $4\frac{1}{4}$ " square

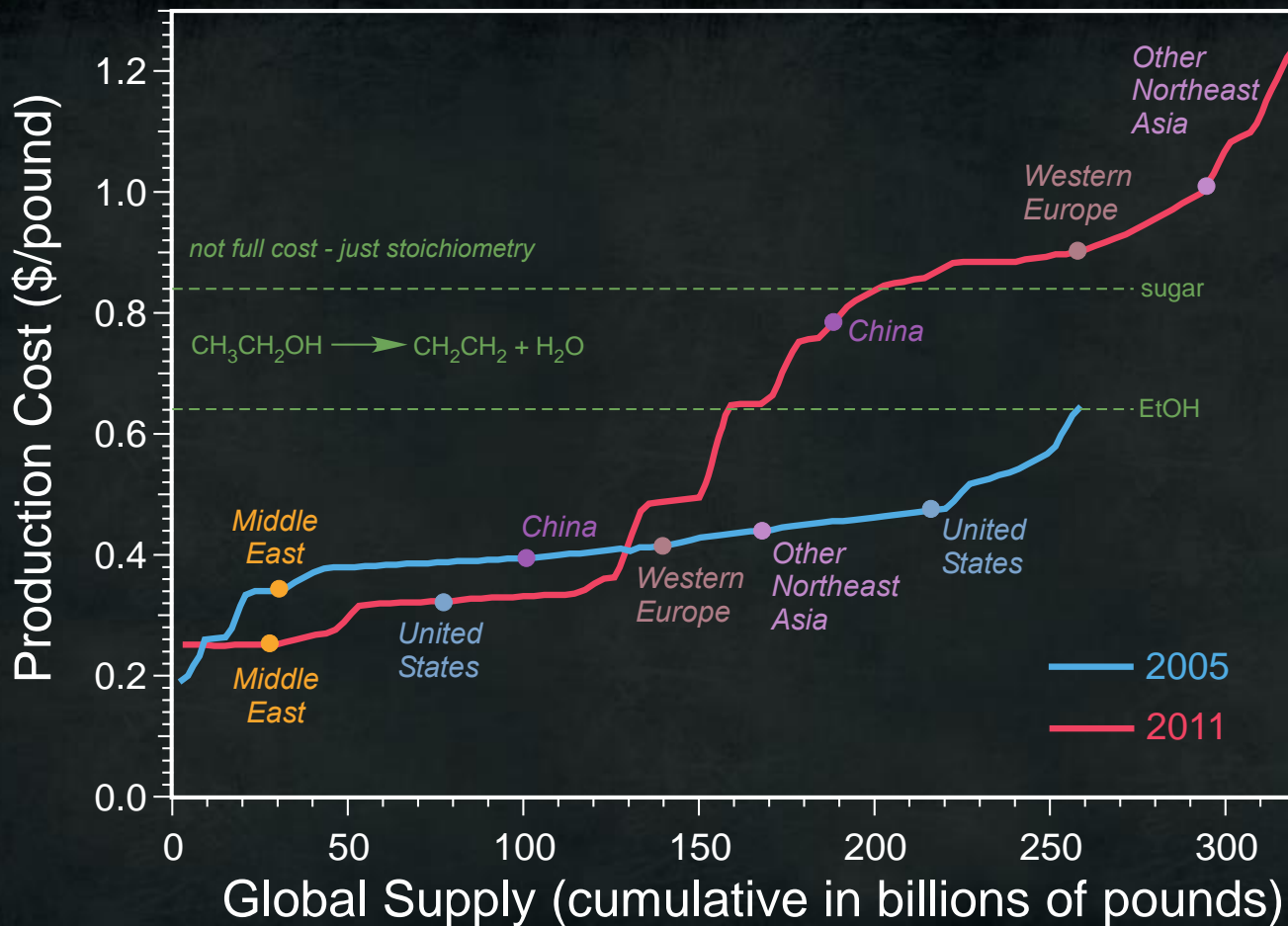


The bigger cup holds about a cup. The smaller only about $\frac{1}{8}$ of a cup. The amount of paper required increases by the volume to the $\frac{2}{3}$ power.

Power Law



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

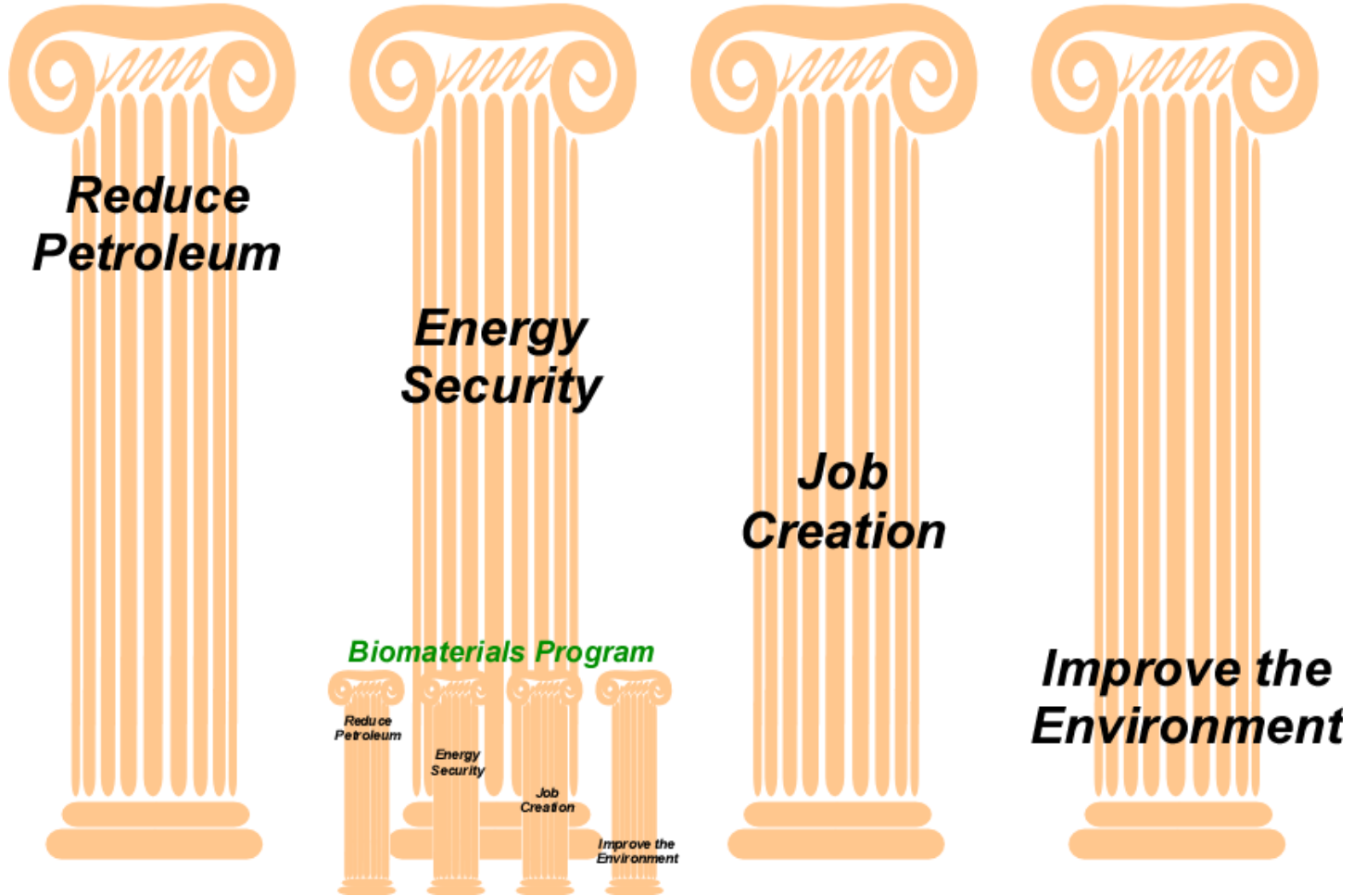
Chemical markets are driven by cost and premiums are difficult to sustain.

Fallacy 3: Shut-down Economics

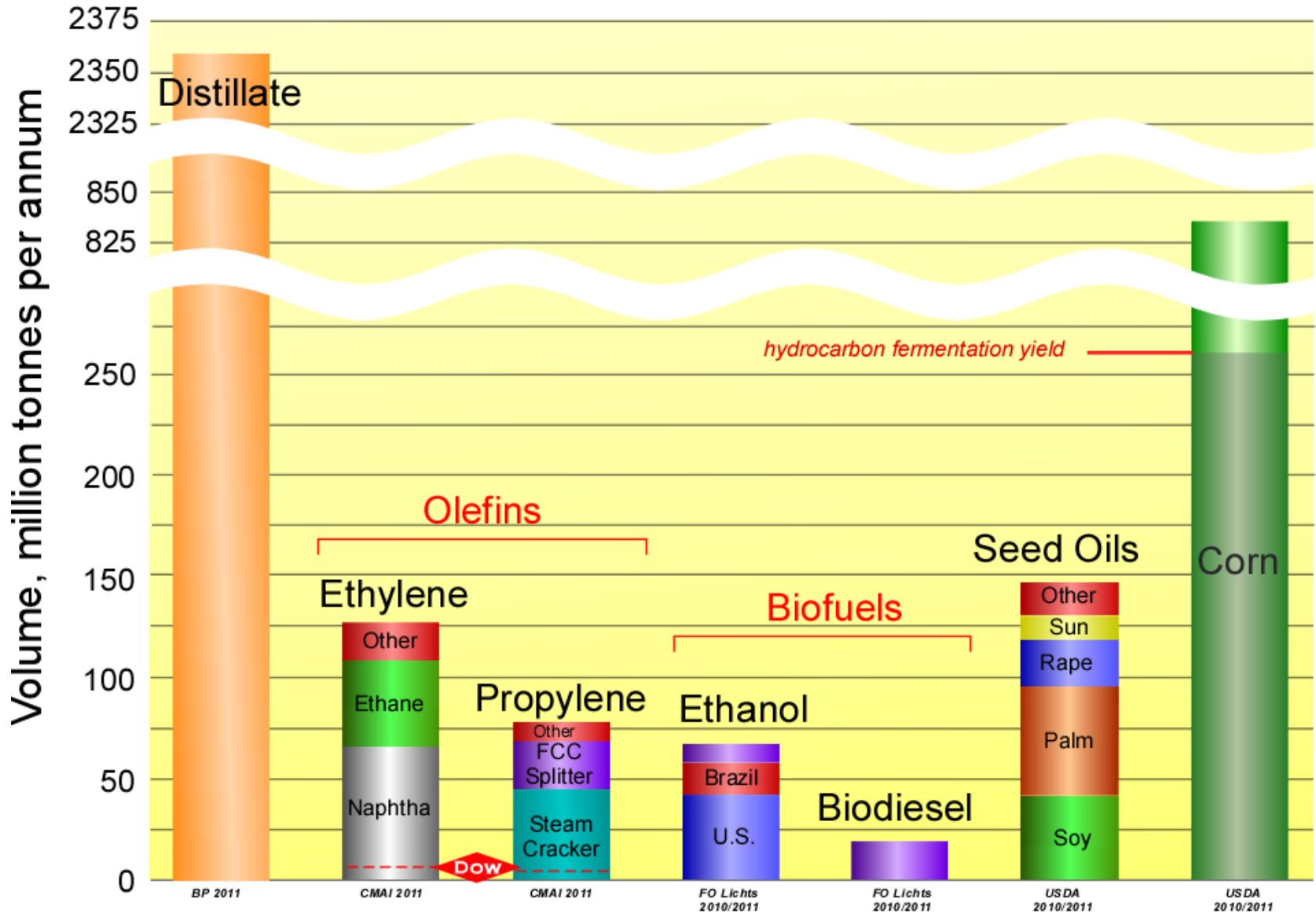
It takes decades for superior technology to displace standing assets.

Pivot to Biomaterials

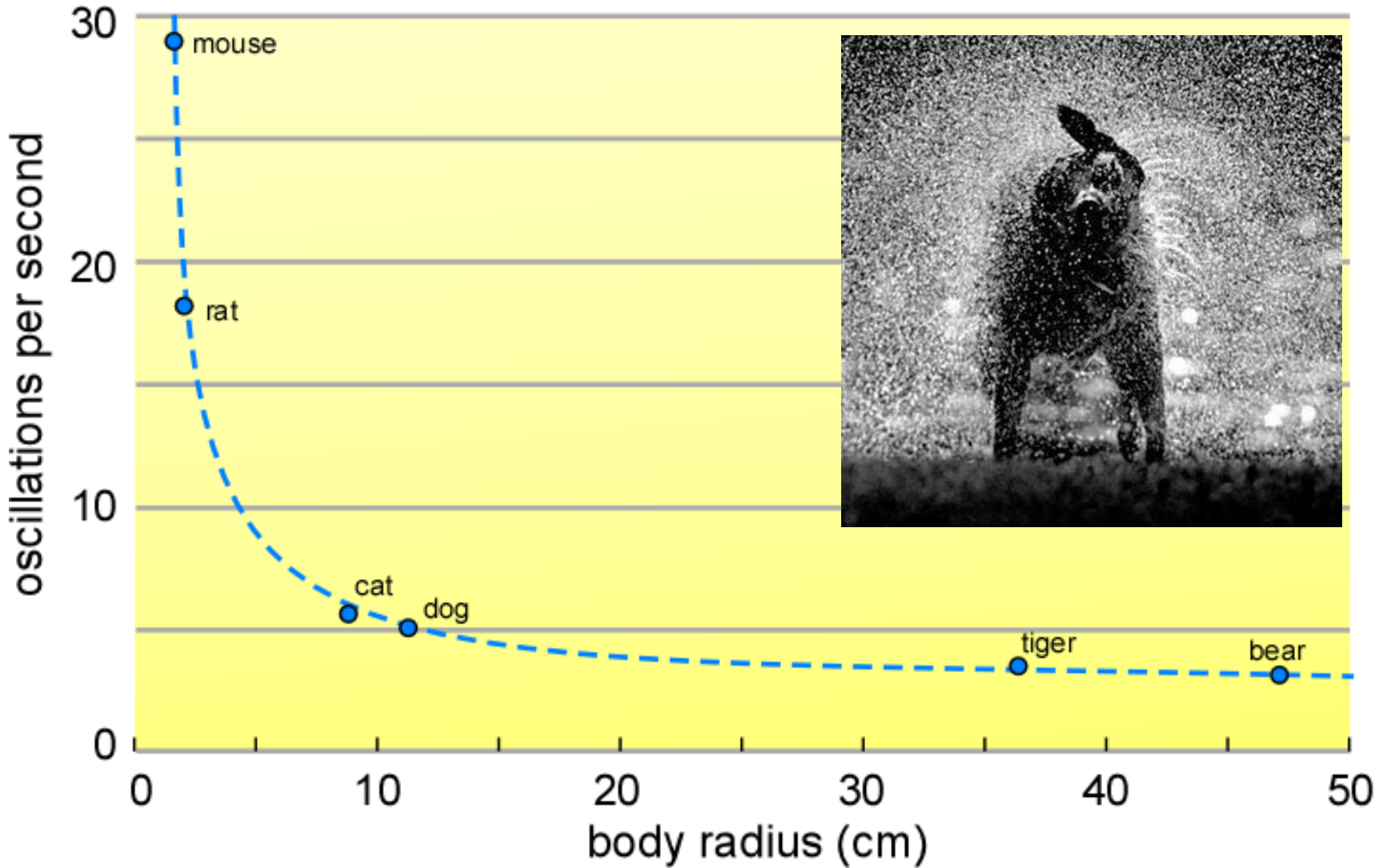
Biomass Fuels Program



Global Commodity Production

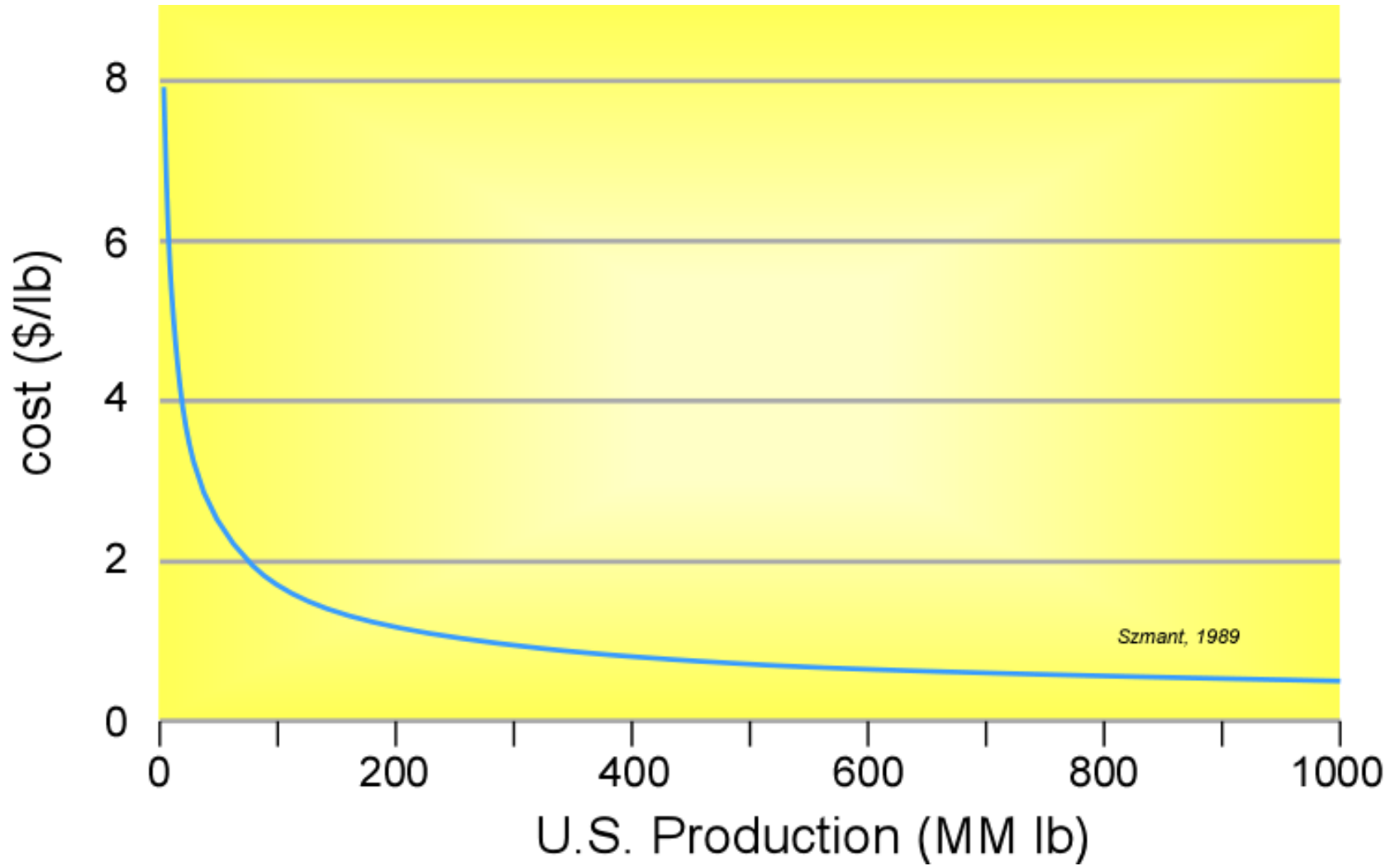


Interesting Correlation

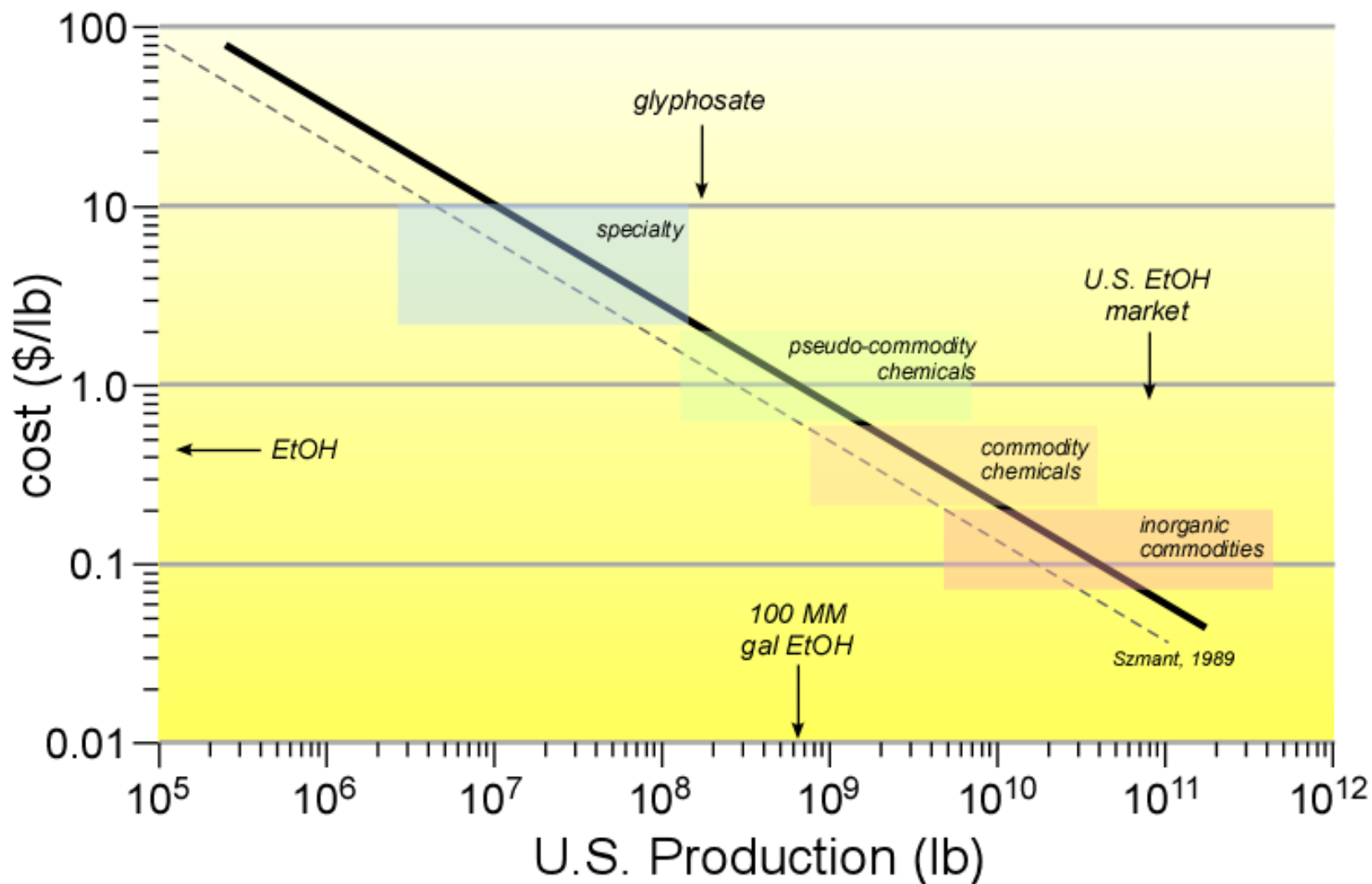


Andrew Dickerson, Grant Mills, Jay Bauman, Young-Hui Chang, David Hu, *The Wet-Dog Shake*, *Fluid Dynamics*, 15 October 2010.

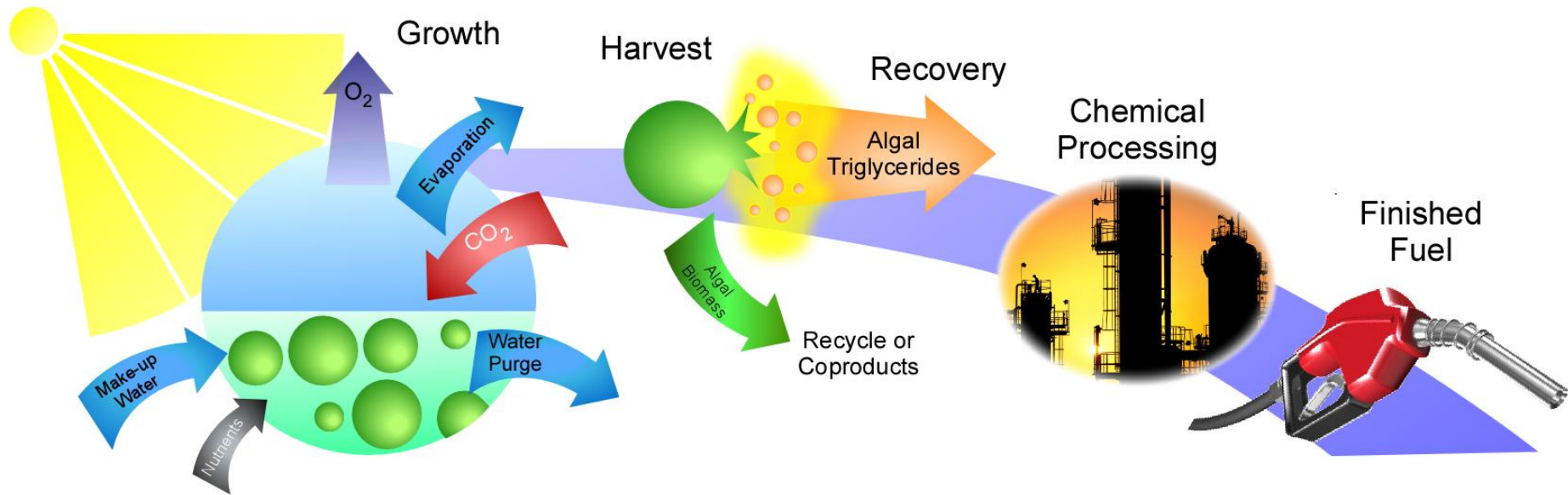
Scale Matters!



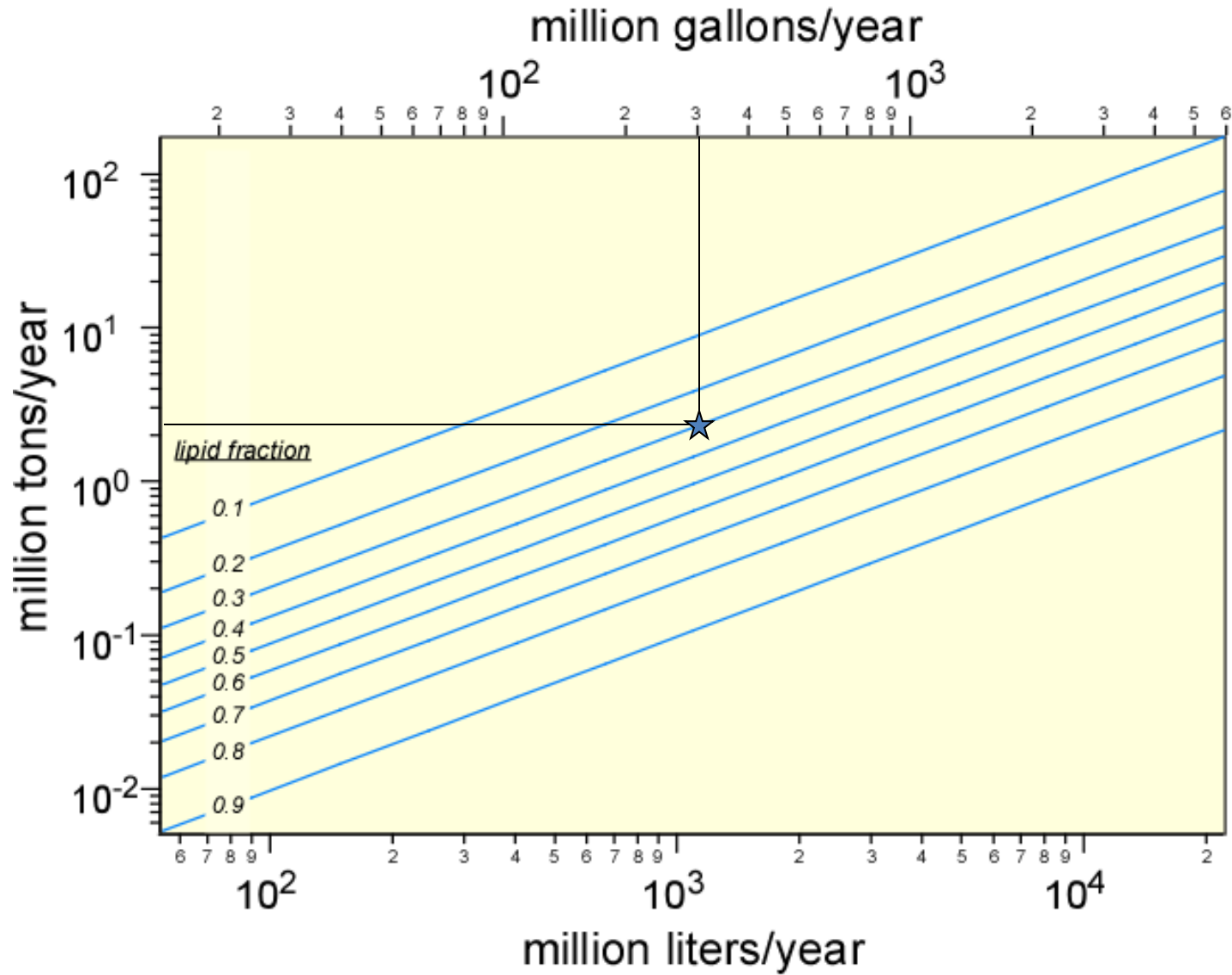
Most Common Version



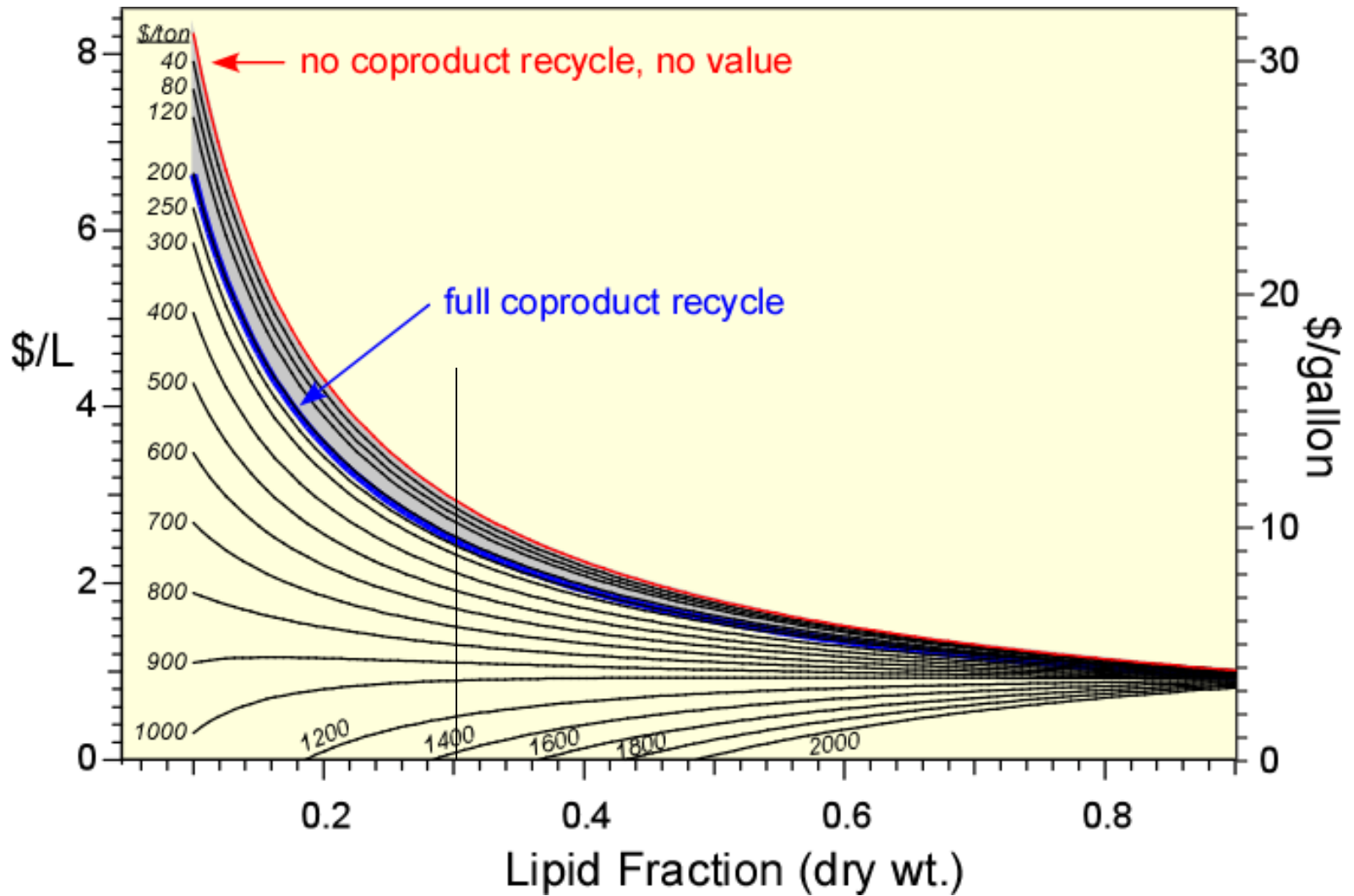
Algae



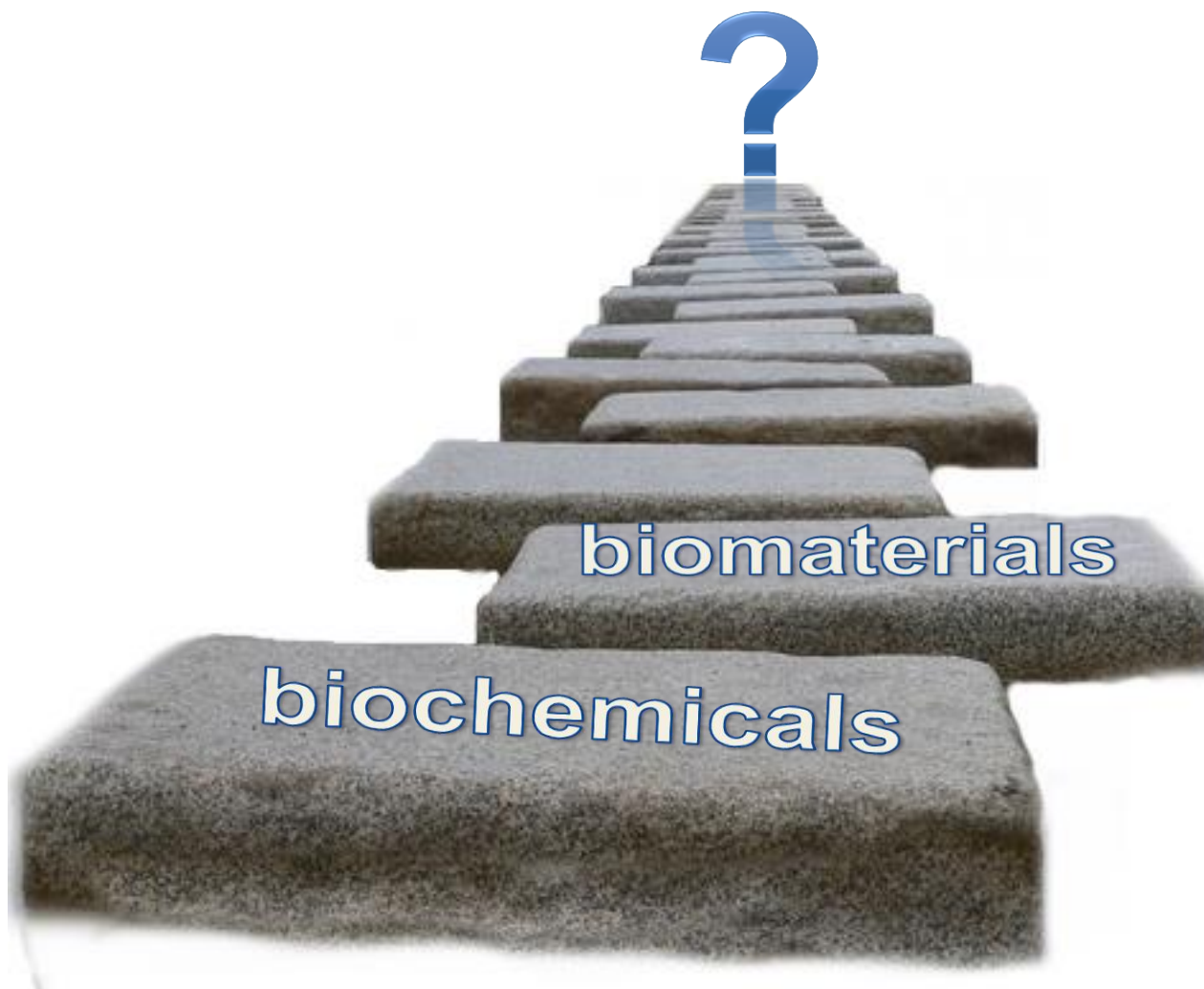
Co-products



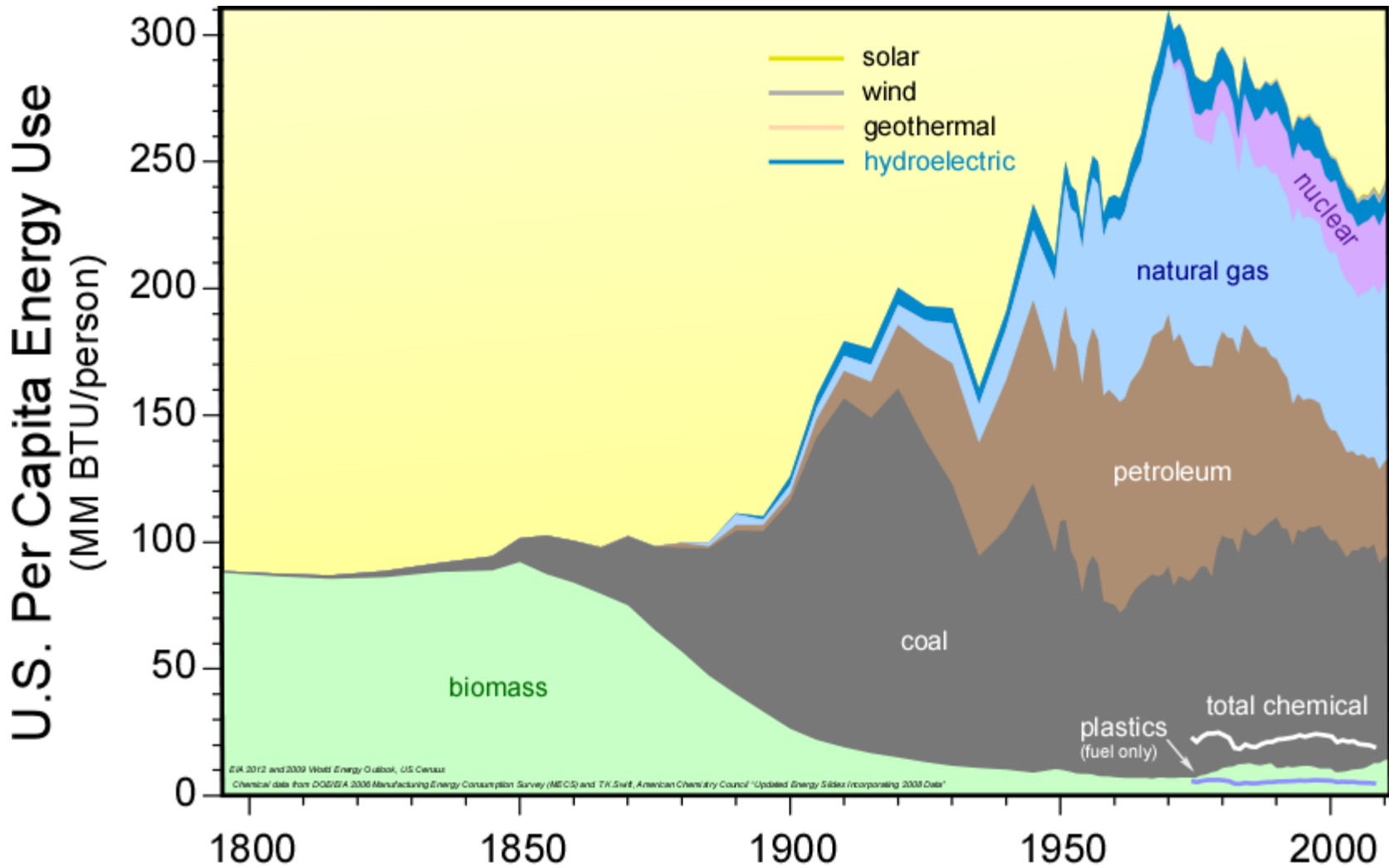
Coproducts



Path to the Future



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



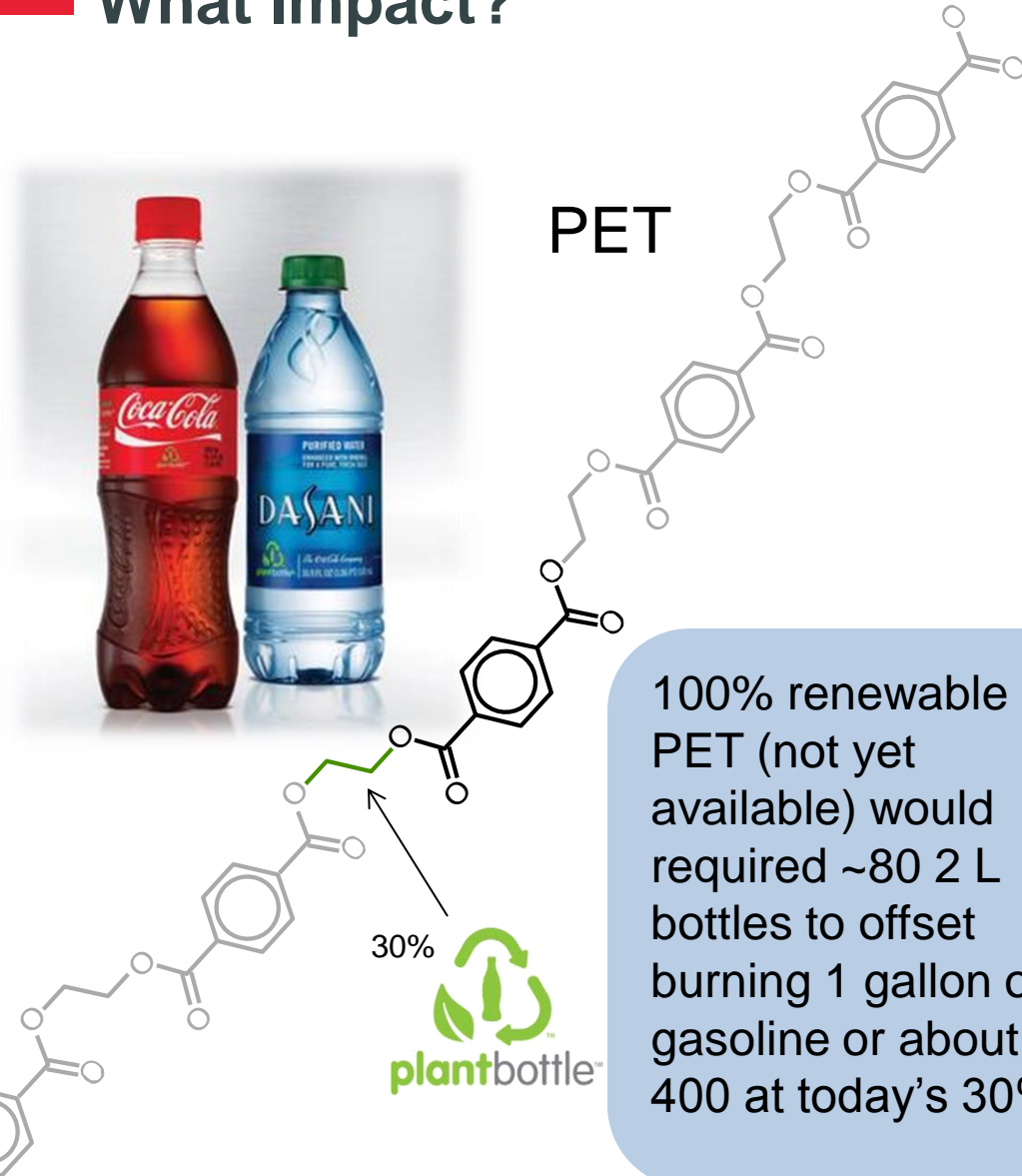
US consumption is 19 million barrels per DAY.
World, 90 million.



What Impact?



PET



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

