SAND2015-2618PE

Choosing the Best Alternative: A Forward Look at Our Energy Future

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Sandia National Labs

April 7th, 2015
Energy, Culture, and Social Organization

My goals for this presentation

- Introduce myself, and my background in activist engineering
- Resource Rebound, and the Jevon's Paradox
  - Declining marginal returns on added investments in complexity
- Energy as material, and the concept of energy obesity
- Energy Return on Energy Investment
- ***The*** way forward (or one of many)

Culture demands better technology *AND* technology demands better culture

Who am I

Academic Pedigree

2002-2007 College Park, MD

BS Mathematics

BS/MS Aerospace Engineering

2008-2013 Ann Arbor, MI

PhD Aerospace Engineering

2013-Present Livermore, CA

Sandia National Labs

Combustion Research Facility

my technical specialty is in applied laser diagnostics of optically accessible internal combustion engines

I remain a student of the environment, diversity, and music (among others)

Where does growth come from?

Joseph Tainter - The Collapse of Complex Societies (1988)

Complexity, Problem Solving, and Sustainable Societies (1996)

"When some new input to an economic system is brought on line, whether a technical innovation or an energy subsidy, it will often have the potential at least temporarily to raise marginal productivity" (p. 124). Thus... innovation that increases productivity is – in the long run – the only way out of the dismal science dilemma of declining marginal returns on added investments in complexity.

"With subsidies of inexpensive fossil fuels, for a long time many consequences of industrialism effectively did not matter... When energy costs are met easily and painlessly, benefit/cost ratio to social investments can be substantially ignored. Fossil fuels made industrialism, and all that flowed from it (such as science, transportation, medicine, employment, consumerism, high-technology war, and contemporary political organization), a system of problem solving that was sustainable for several generations."

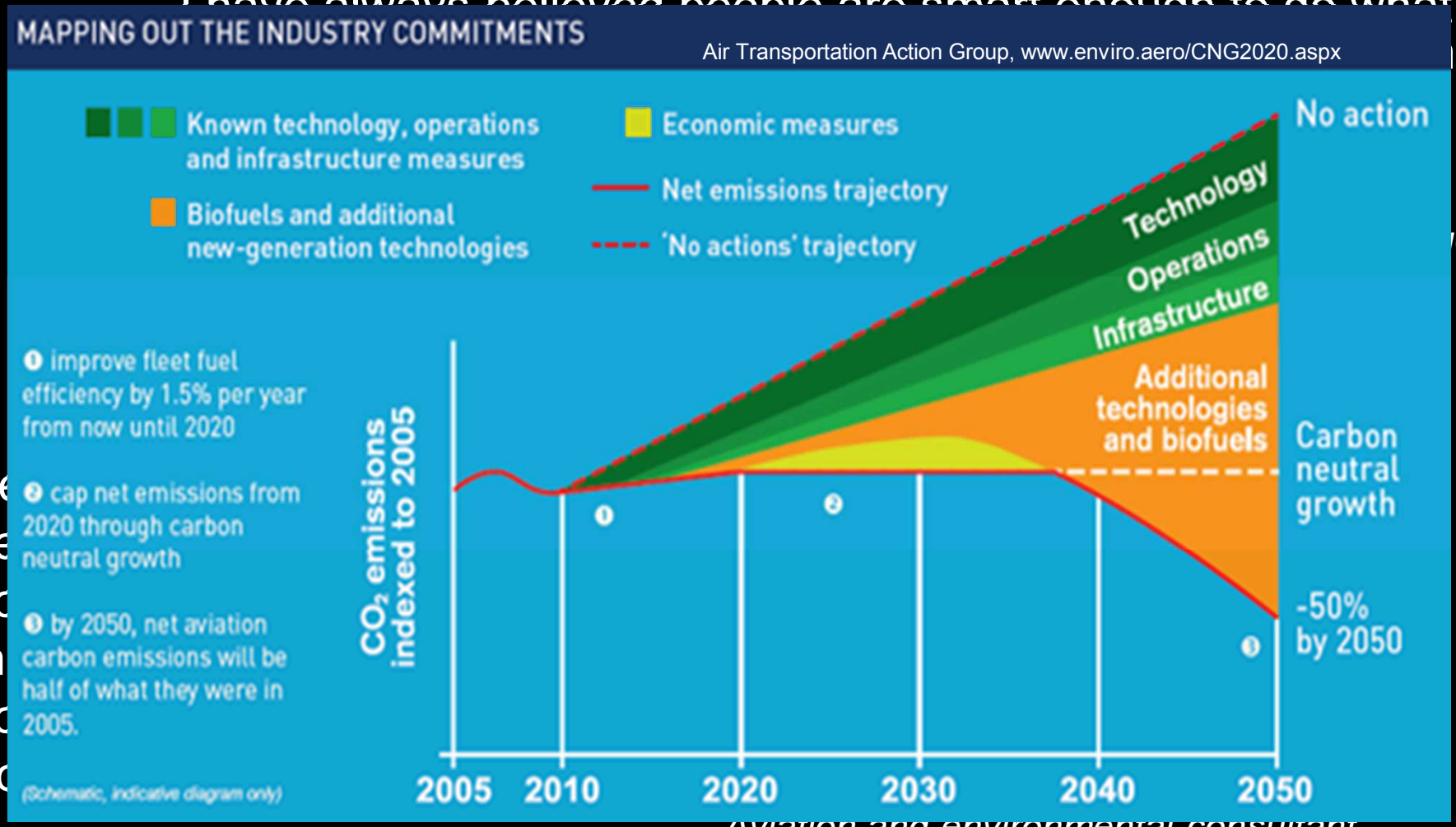
"Energy has always been the basis of cultural complexity and it always will be."

the foundations of the current energy paradigm

- infinite material growth through technological advance
- technological development: a teleological ethic
  - Invention is morally neutral considered apart from its uses
  - “The stone age didn’t end when we ran out of stones”
- technological “fact” divided from political “value”

how contemporary engineers view climate change

"I have always believed people are smart enough to do what



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Aviation and environmental consultant

Winner of the 2007 Nobel Peace Prize as part of the IPCC

the foundations of the current energy paradigm

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The socioecological and political implications of energy have been left to be evaluated by others.

Praxis – a vision for the activist engineer

It is the role of the activist engineer to create a new paradigm : equipped not only with technical tools, but also with the requisite socioecological perspectives and ethics

We need socioecological scholars trained to understand the world's technical content too!

Taking these ideas to work

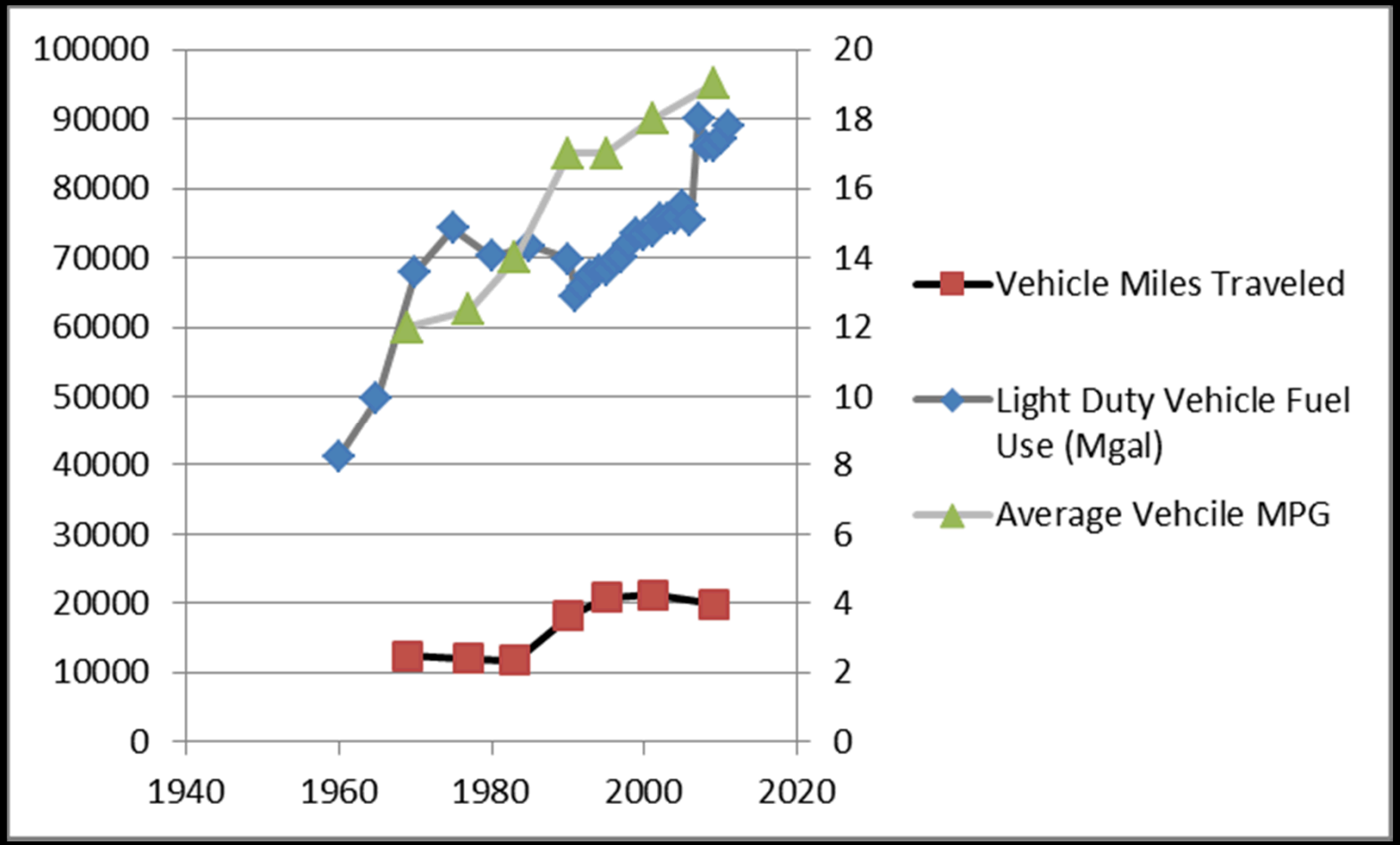
Criteria for evaluating the work of an activist engineer

current			***activist***	
infinite growth	*quarterly profit and liability*	→	*long-term resiliency*	**peace and satisfaction**
technological advance and ahistoricity	*extractive industry and efficient growth*	→	*modularity and repurposeability*	**sufficiency**
lack of agency and apoliticism	*large corporatism and capitalism*	→	*community engagement, democracy, and equality*	**being political, incorporating new ethics**

What is Jevon’s Paradox?

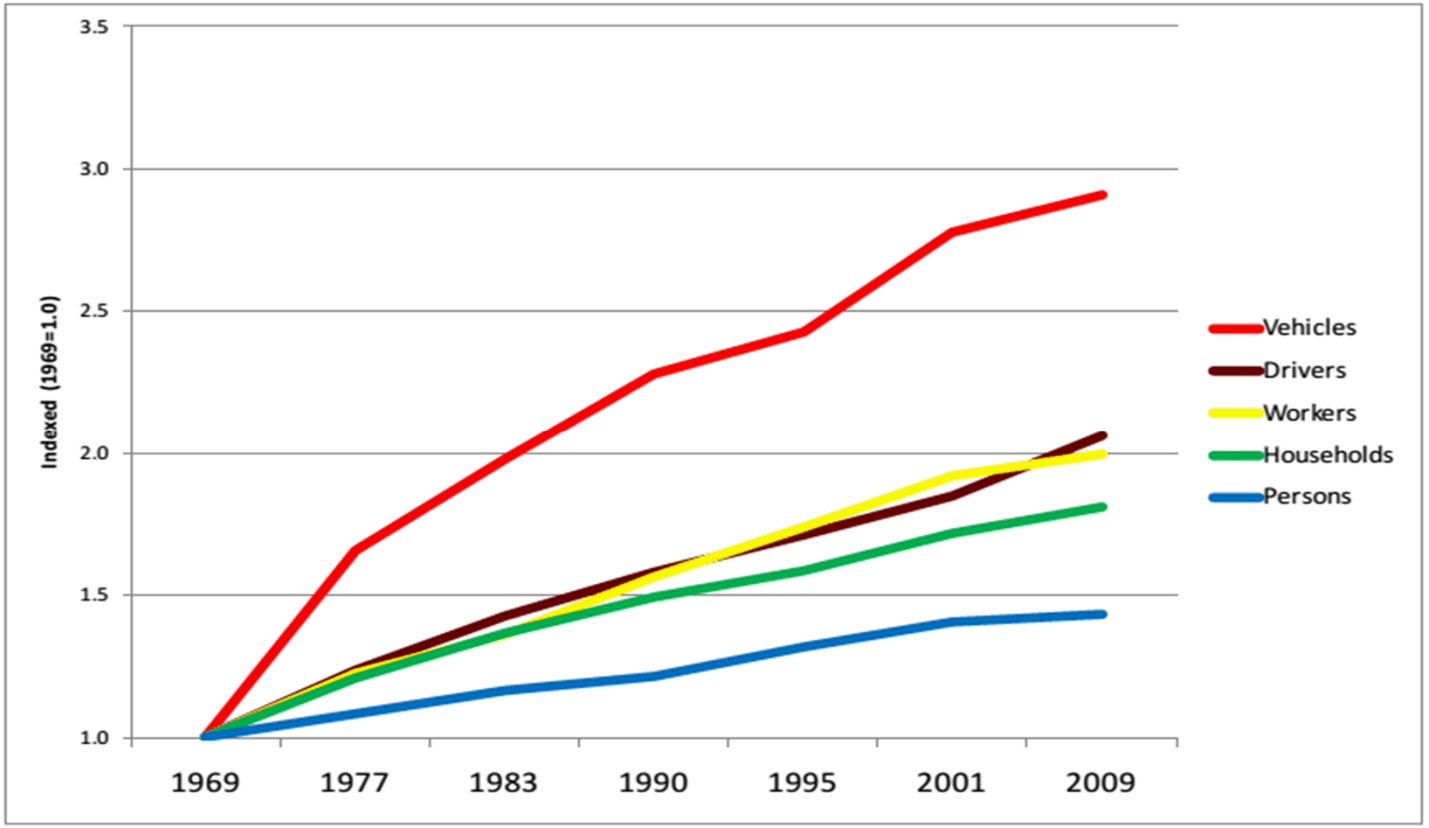
The dilemma of high-efficiency

The **Jevons paradox**



What has been the result of increased MPG on vehicle fuel use?

Figure 1. Changes in Summary Statistics on Demographics and Total Travel 1969, 1977, 1983, 1990, and1995 NPTS, and 2001 and 2009 NHTS.



Note:

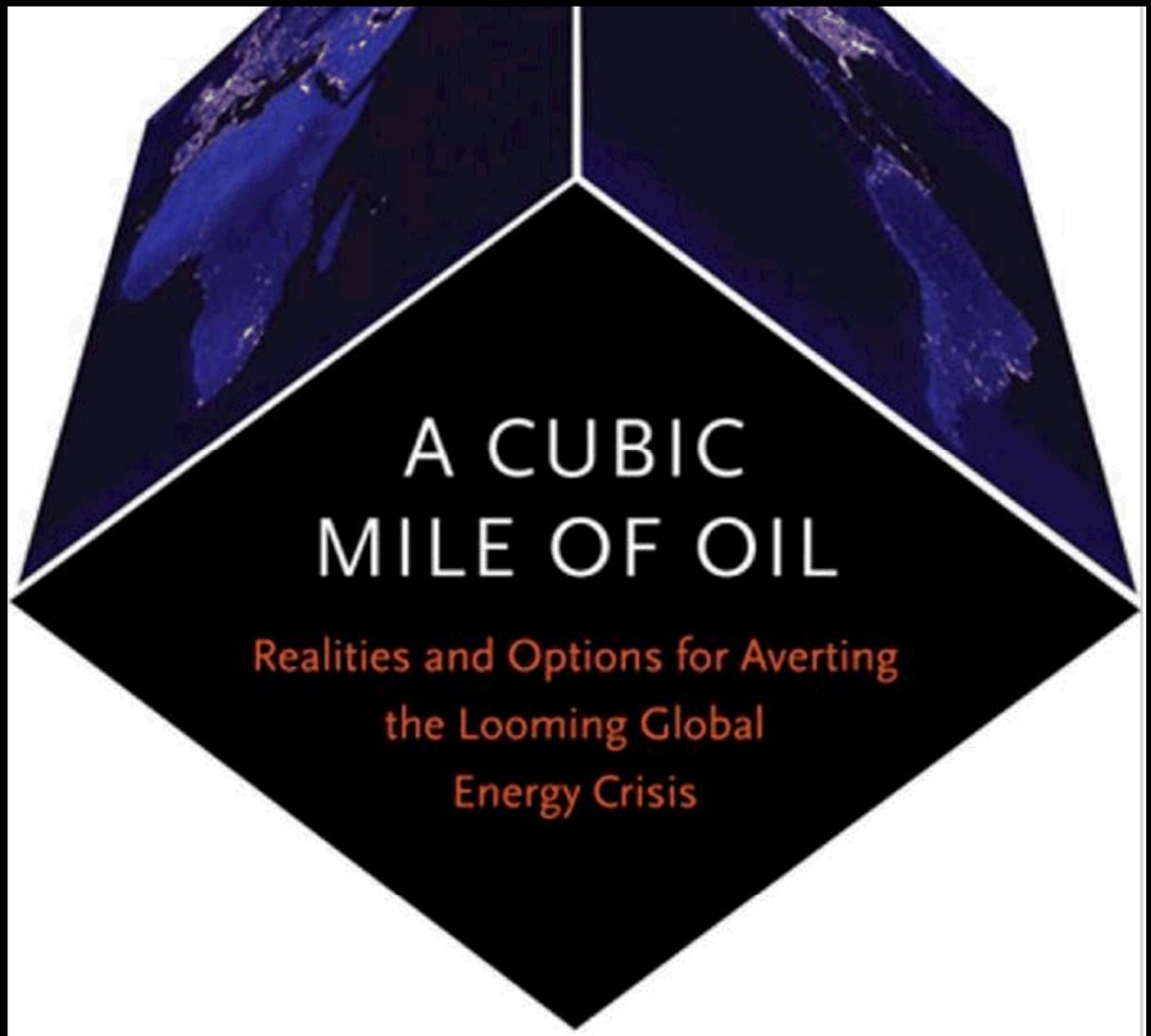
- The1969 NPTS did not include pick-up trucks as household vehicles, therefore the growth between 1969 and 1977 is exaggerated.

Increasing efficiency has not offset growth in personal automobiles or vehicle miles driven.

Not all bad news!

http://www.nasa.gov/content/goddard/new-nasa-images-highlight-us-air-quality-improvement/

https://www.flickr.com/photos/gsfc/14320500668/in/set-72157645366137035



A CUBIC MILE OF OIL

Realities and Options for Averting the Looming Global Energy Crisis

Hewitt D. Crane
Edwin M. Kinderman
Ripudaman Malhotra

PETER TERTZAKIAN

AUTHOR OF *A THOUSAND BARRELS A SECOND*

WITH KEITH HOLLIHAN

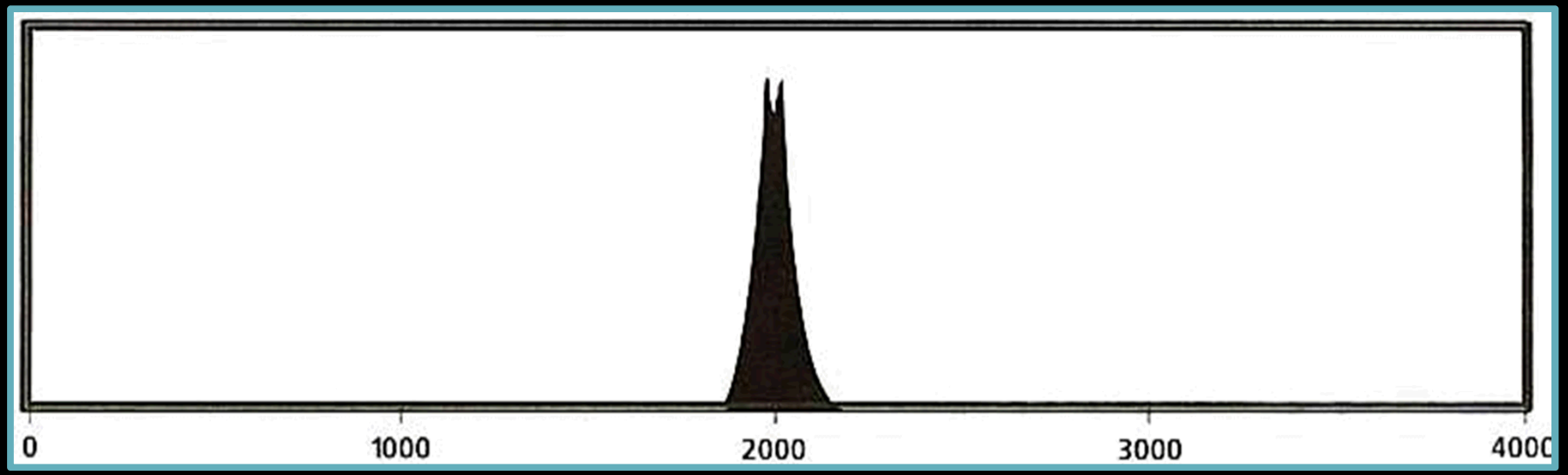
The END of ENERGY OBESITY

How do you eliminate waste?

Why the need for research and development? Why is our energy future 'insecure'?

"The nonrenewable resources that went into building industrial civilization were vast, but they were never limitless."

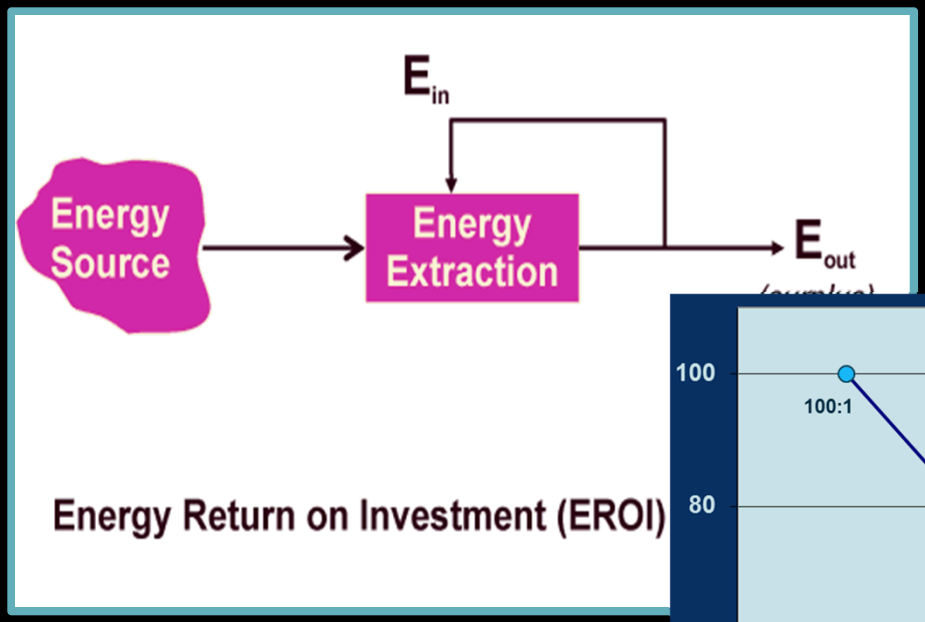
J. M. Greer (2009) *The Ecotechnic Future*

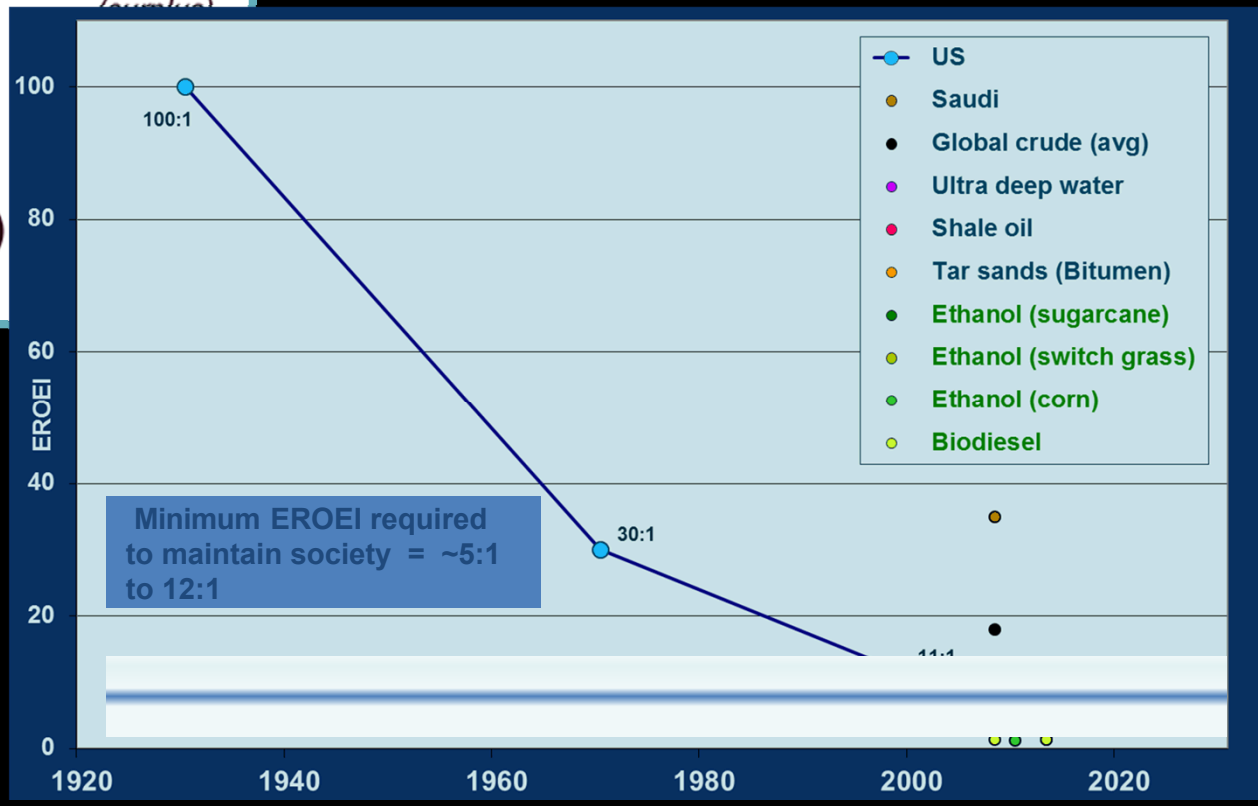


Data source: Hubbert (1954)

"Energy has always been the basis of cultural complexity and it always will be."

Why the need for research and development? Why is our energy future 'insecure'?





Joseph Tainter
The collapse of complex societies (1988)

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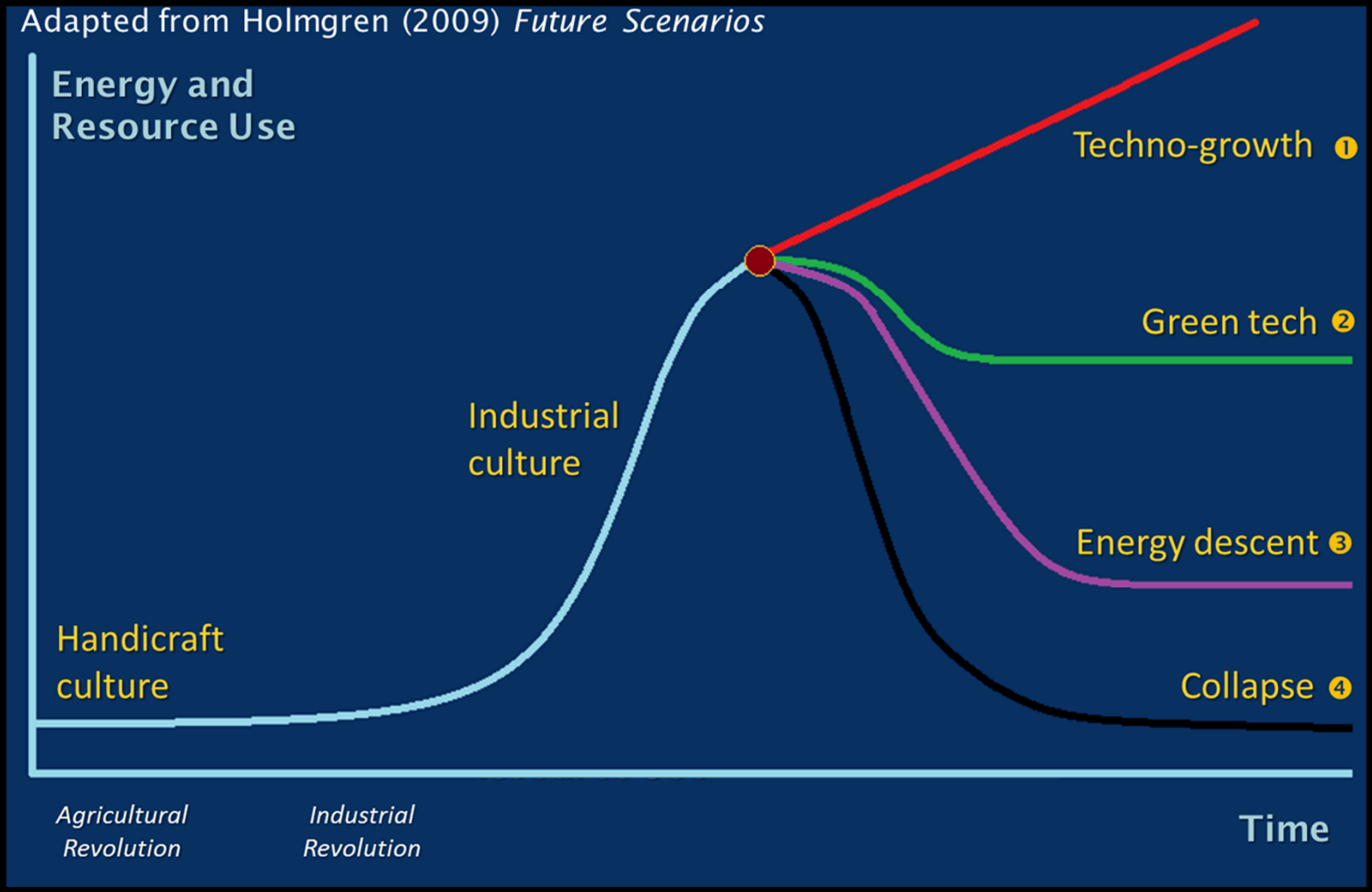

Sustainable Targets

- To achieve sustainability targets requires a Factor 4 approach.
  - global factor 2 increase in efficiency, factor 2 decrease in consumption.
- Realistically, developed nations will require Factor 10.
  - factor 2 increase in efficiency, factor 5 decrease in consumption.

- Vehicle efficiency is half of the story, the other half or more is drastically reduced consumption.
  - My approach: study turbulence and ride a bicycle!

Darshan Karwat, **W. Ethan Eagle,** Margaret Wooldridge, and Thomas Princen "*Are there ecological problems that technology cannot solve?*" International Journal of Engineering, Social Justice, and Peace; accepted for publication May 2014

praxis in practice

- redefine the problem
  - expand the group of stakeholders
  - understand the impact of technology
- be responsible, differently
  - replace ‘small parts of the larger whole’ and diffuse personal accountability with strong ties to people and place
  - alert people to activist engineering’s overt socioecological purposes and ability to change culture
- learning from other knowledges
  - philosophically: urban and infrastructure planning is founded on social theory (although many times it doesn’t seem that way…)
  - practically: urban gardening

practicing praxis in the Global North

- changing education and evaluative metrics
- working in the public interest to promote socioecological integrity, peace, and justice through 10% of our money and 10% of our time
- working with others: engineers, sociologists, urban planners, historians, psychologists and public interest groups
- serving on local, state, or national committees or task forces and lending our expertise to citizen activists, thereby reframing energy problems by insisting that public and non-human stakeholders be included in technical decision-making and design
- designing technologies that provide impoverished and underserved communities such as those living close to industrial sites with the real, timely data, knowledge and knowhow to challenge local municipalities about their living conditions
- deliver technology that is culturally sensitive and that can be adopted specifically, rather than universally

Where to get more information

- Center for Science, Technology, Medicine and Society – http://cstms.berkeley.edu/teaching/undergraduate-course-thread/

105 Classes!! http://coursethreads.berkeley.edu/courses/1474/all

From anthropology, chemical engineering, computer science, history, environmental science policy and management, English, rhetoric, and sociology – Among others!

Websites:

dieoff.org

endofenergyobesity.com

crf.sandia.g