



Blueprints for Sustainable Infrastructure Conference
9-12 December 2008

Resource Scarcity

*- a Physical, not an
"Economic" Issue*

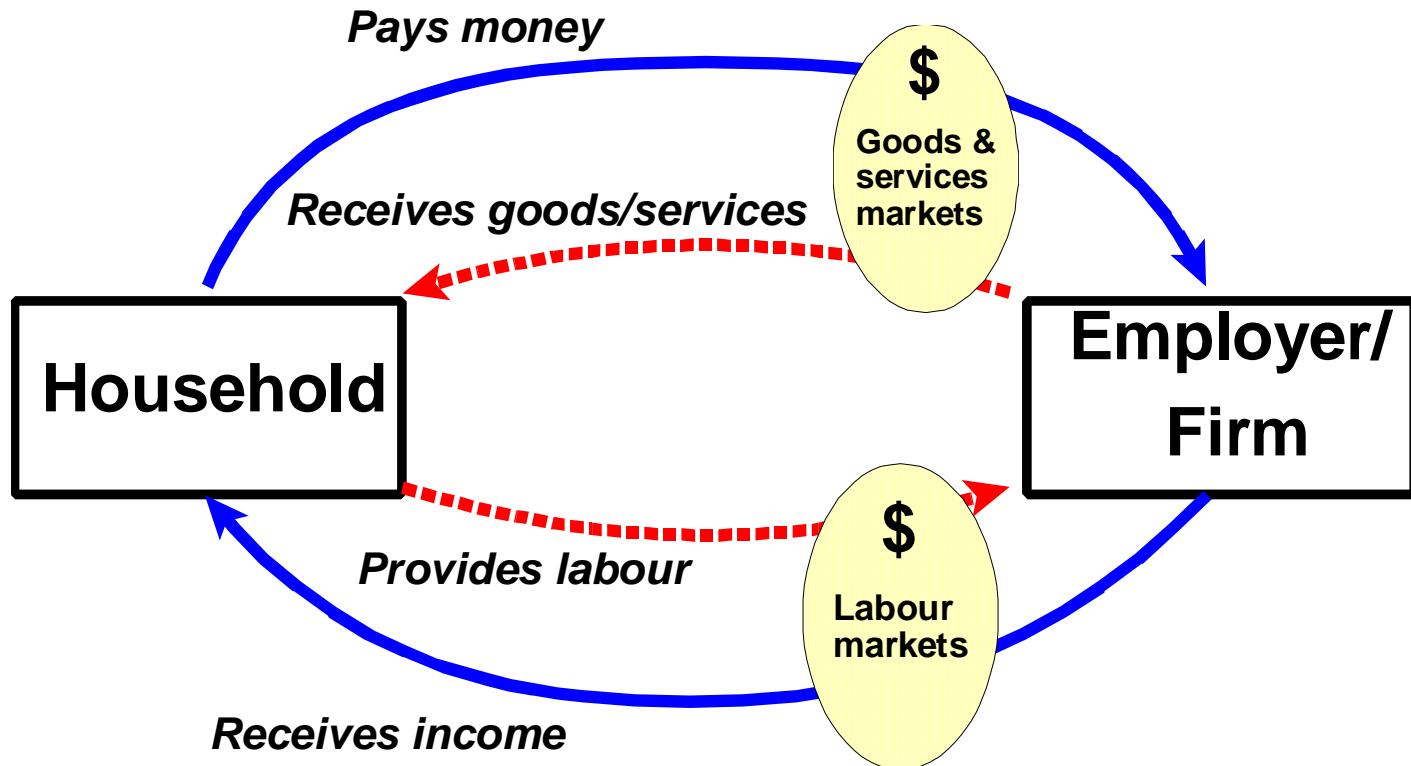
Dr John Peet



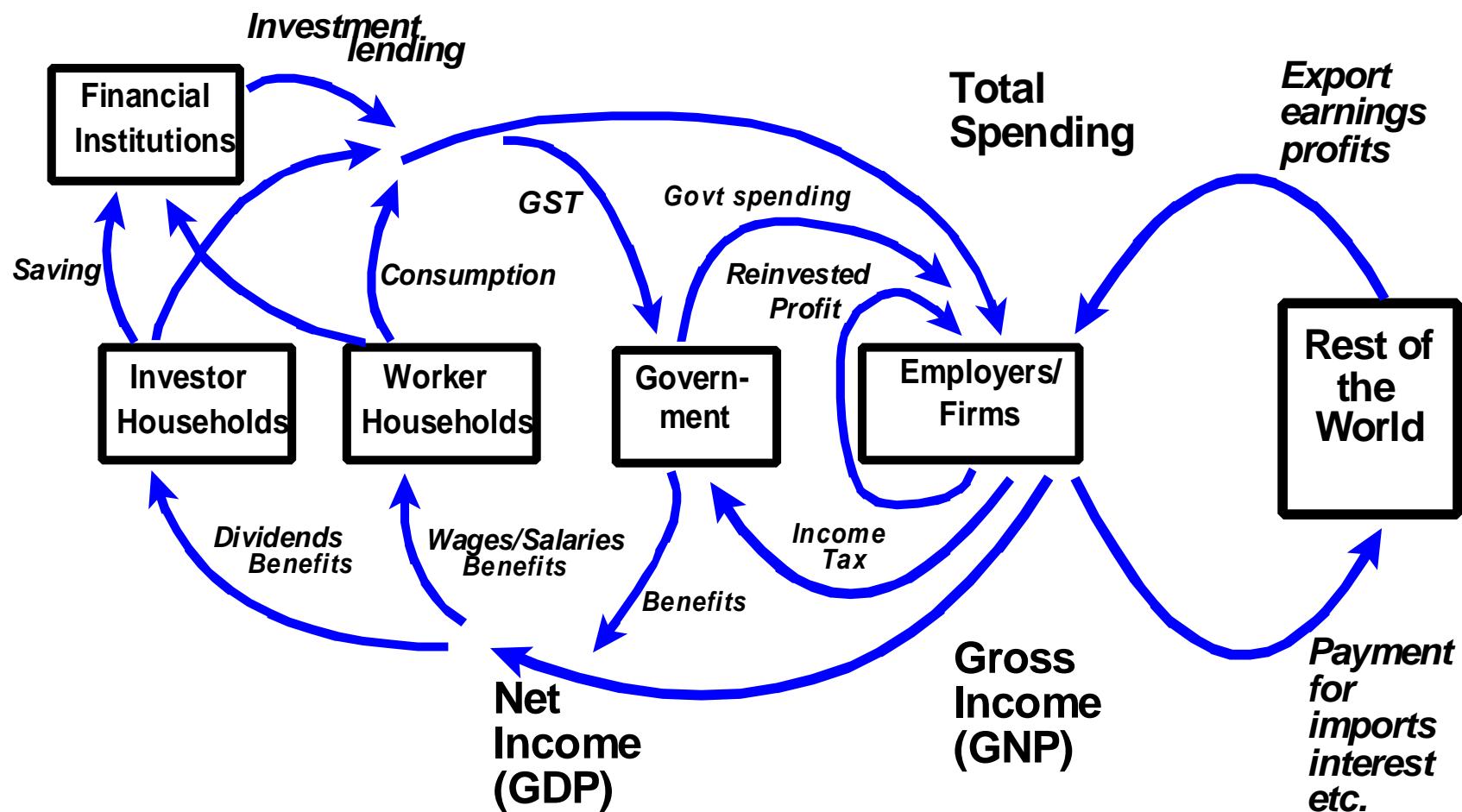
NETWORK *Waitangi* OTAUTAHI



The circular flow model of macroeconomics and the place of markets



Circular flow economic model of the NZ economy



Economics - 1

Capital \$16,600 ↗

Labour \$17,380 ↗

Taxes \$4,940 ↗

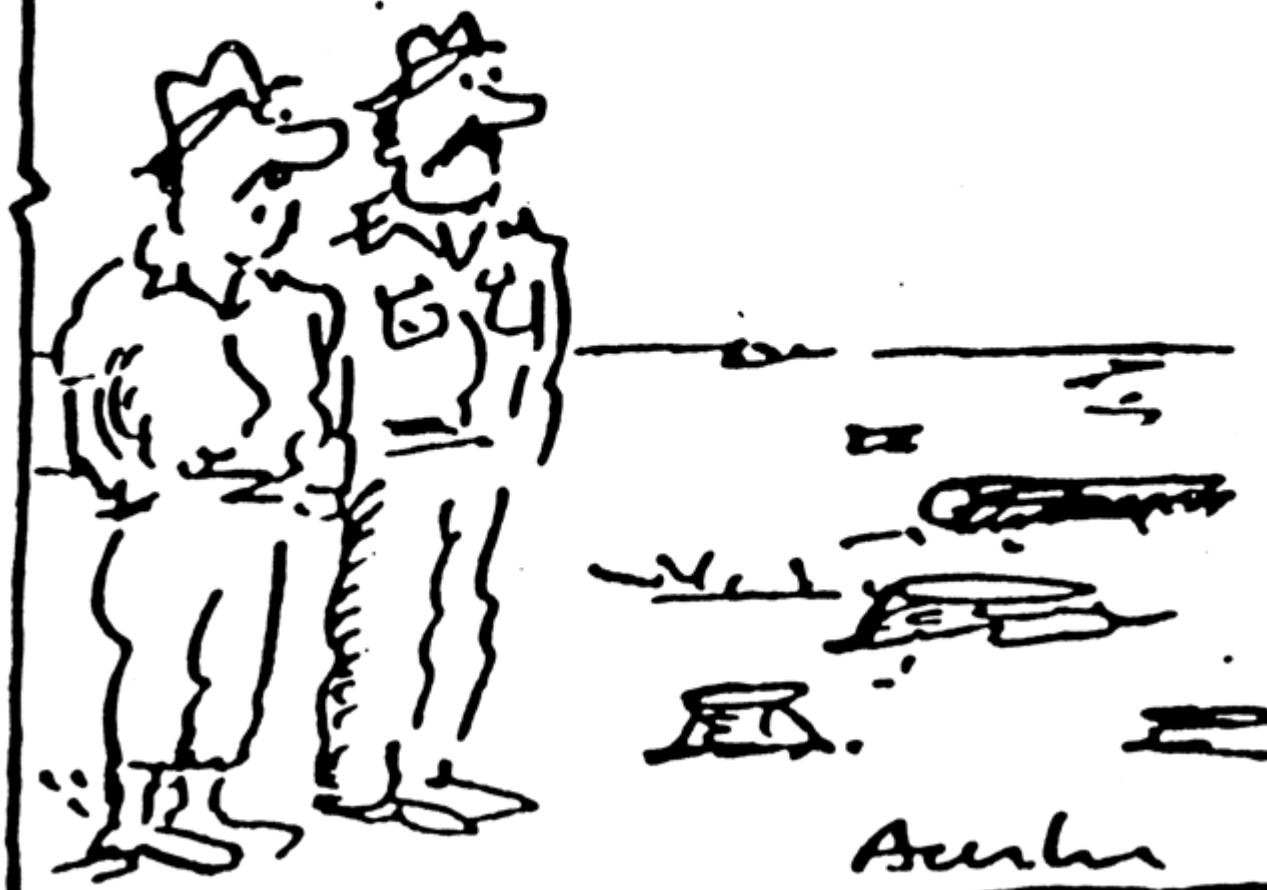
The paper
economy
per person per year

↗ GDP \$38,920

After Gowdy, 2006

NZ data 2005-7

THE DEFORESTATION IS DUE
TO THE GREENBACK EFFECT



BUT WHAT
IF YOU'RE
WRONG AND
WE RUIN
THE PLANET?

WHAT IF
YOU'RE WRONG
AND THE WATER
AND AIR ARE
TOO CLEAN?!

ENVIRONMENTAL DEBATE

PET

Treasury opinion (around 1988) in relation to moving the then Ministry of Energy functions into a section of the Ministry of Commerce:

"4 The key issue in both the Policy Framework for Energy Management and the Strategic Business Plan is whether or not energy is sufficiently different to other goods and services to justify a specific energy policy We consider that although energy is both essential and strategically important, it is not unique in these attributes."

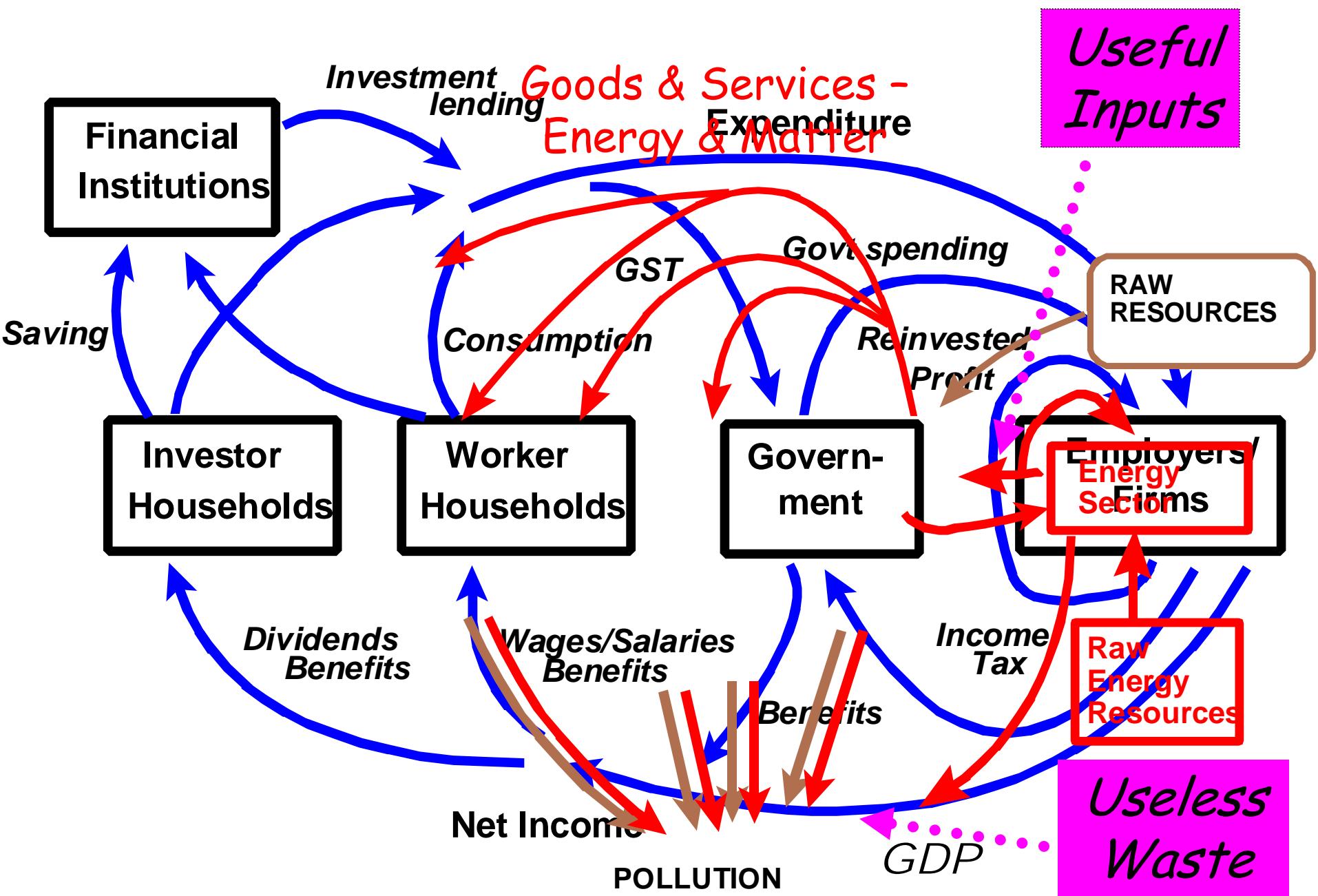
How to develop policy that addresses
the whole issue of sustainable
development coherently, rather than
just one or more parts, incoherently?

I start from the position enunciated by
Ernest Rutherford many years ago:

*"All science is either physics or stamp
collecting"*

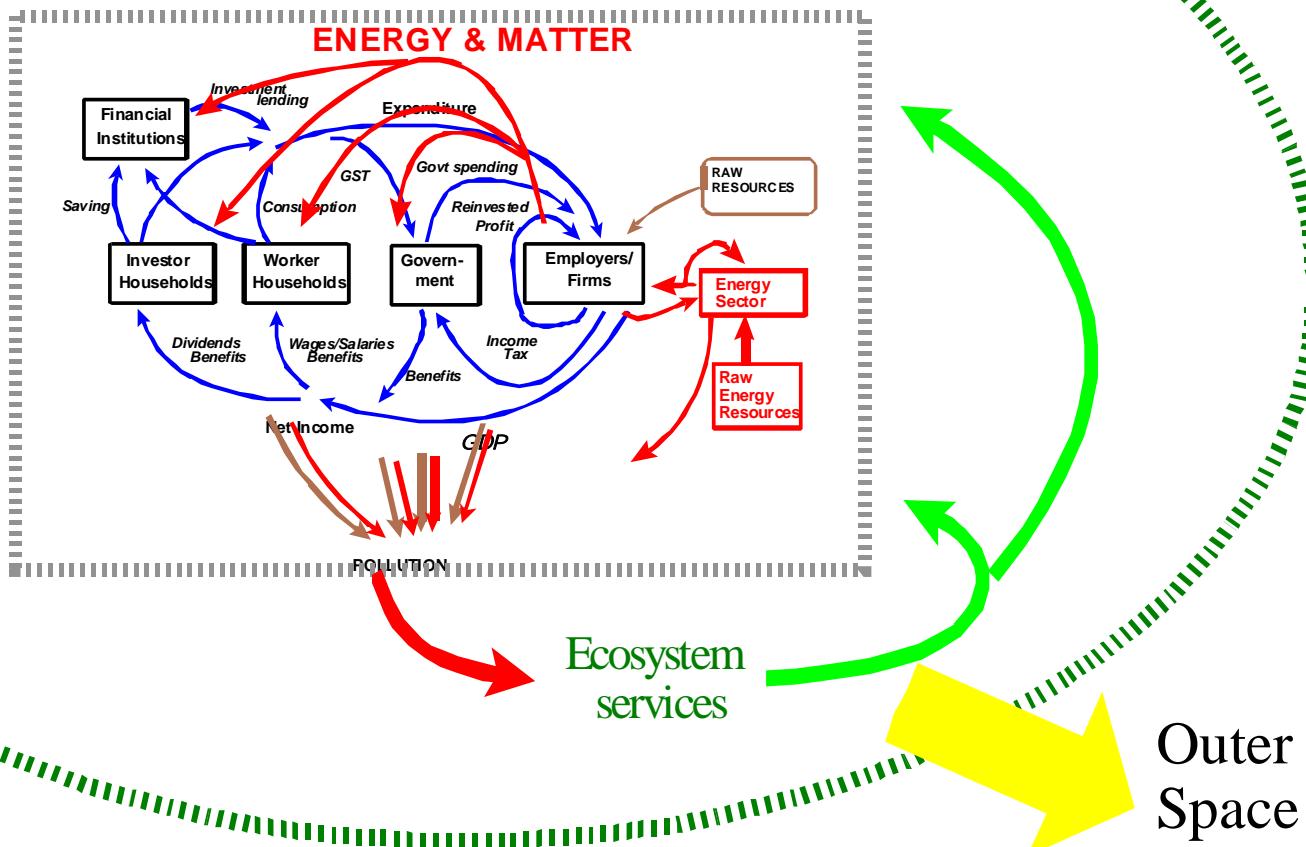
Relevant lessons from Physics:

- $F = ma$
 - Newton's First Law of Motion (1680s)
- $dS/dT \geq 0$
 - The Second Law of Thermodynamics (the Entropy Law) (Carnot, 1824, Clausius, Thomson, Gibbs etc, 1860/70s)
- $e = mc^2$
 - Einstein's Mass-Energy relationship (Relativity - 1904)
- $i\hbar \partial\Psi/\partial t = H\Psi$
 - Schrodinger Equation (Quantum Mechanics - 1926)

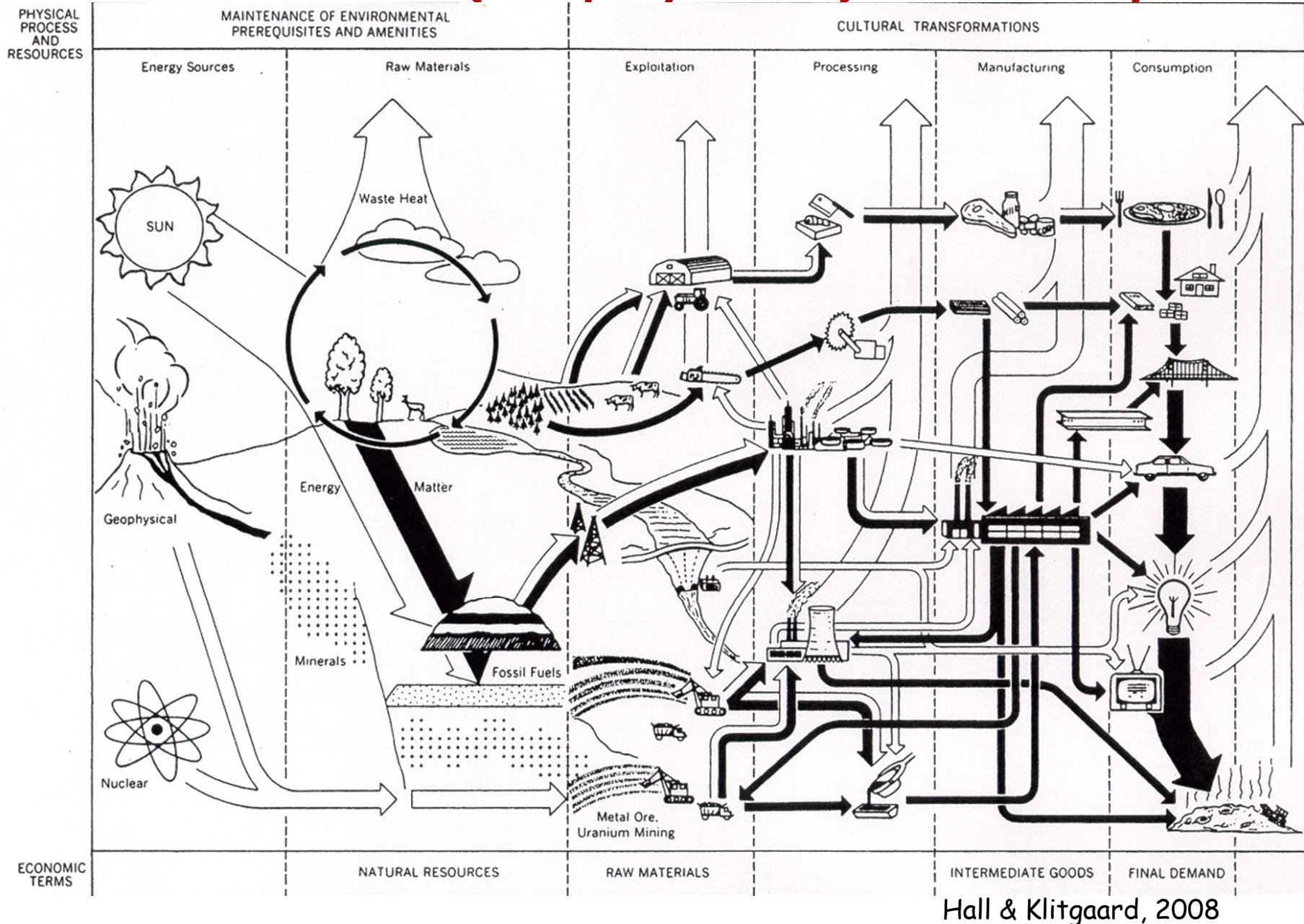


Sun

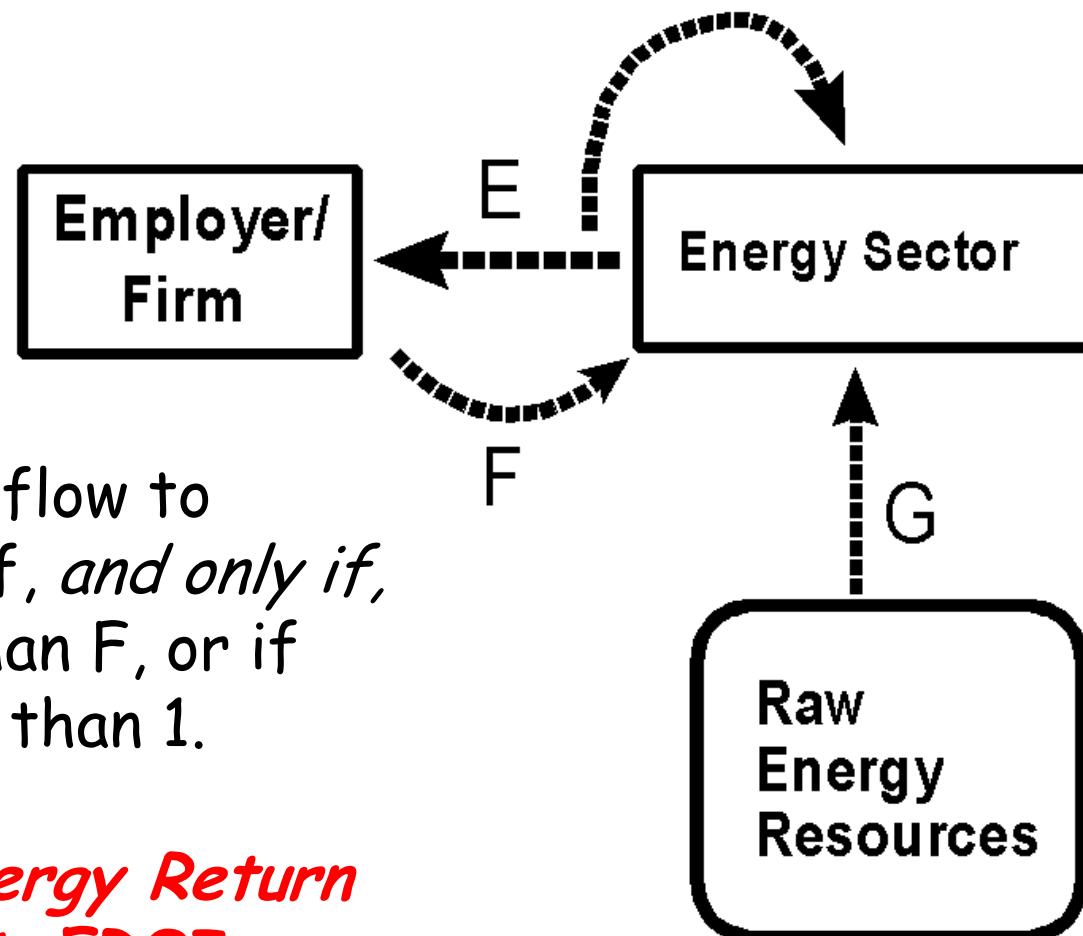
ECOSYSTEM



The Real (biophysical) Economy



Energy Transformation System

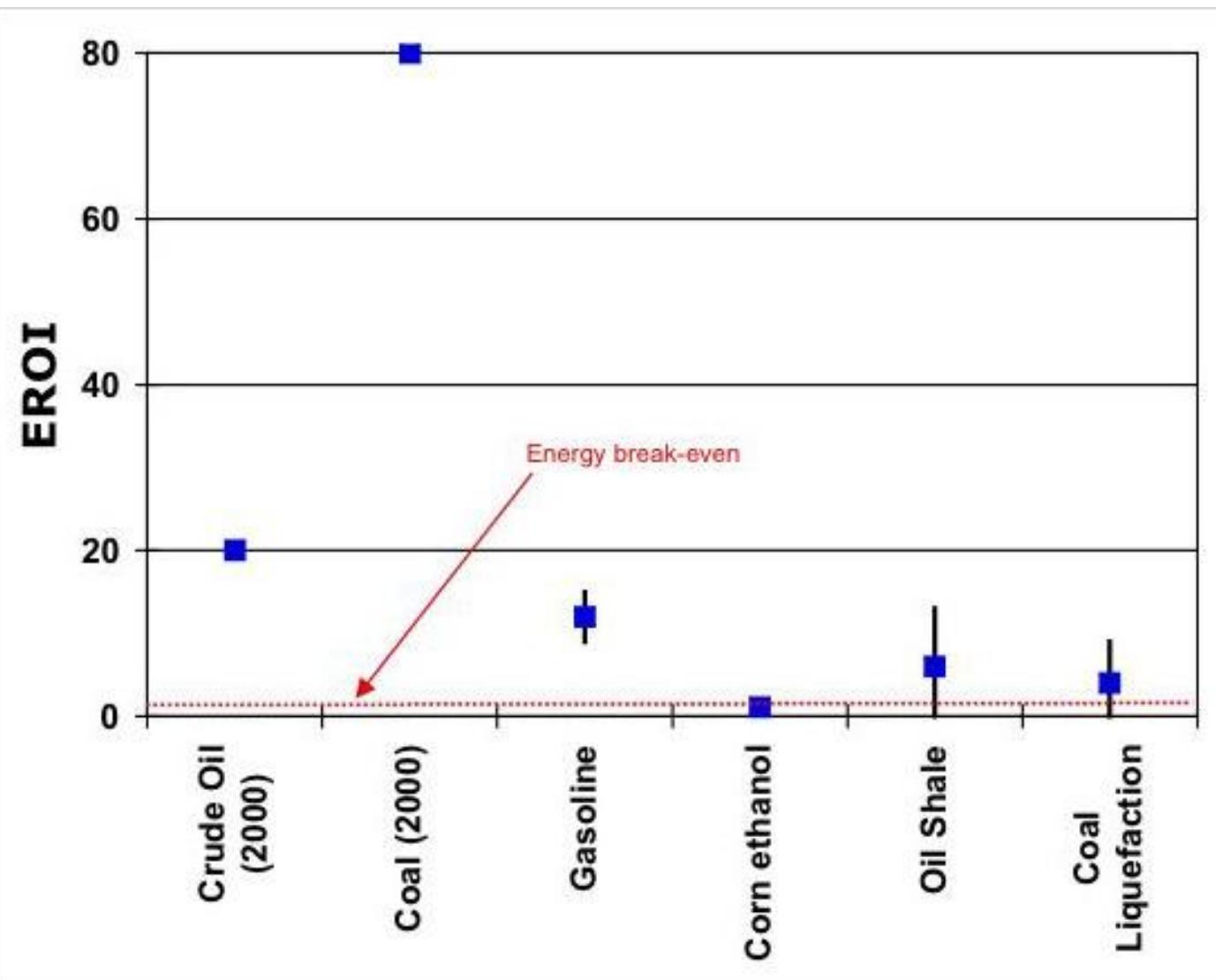


Net Energy

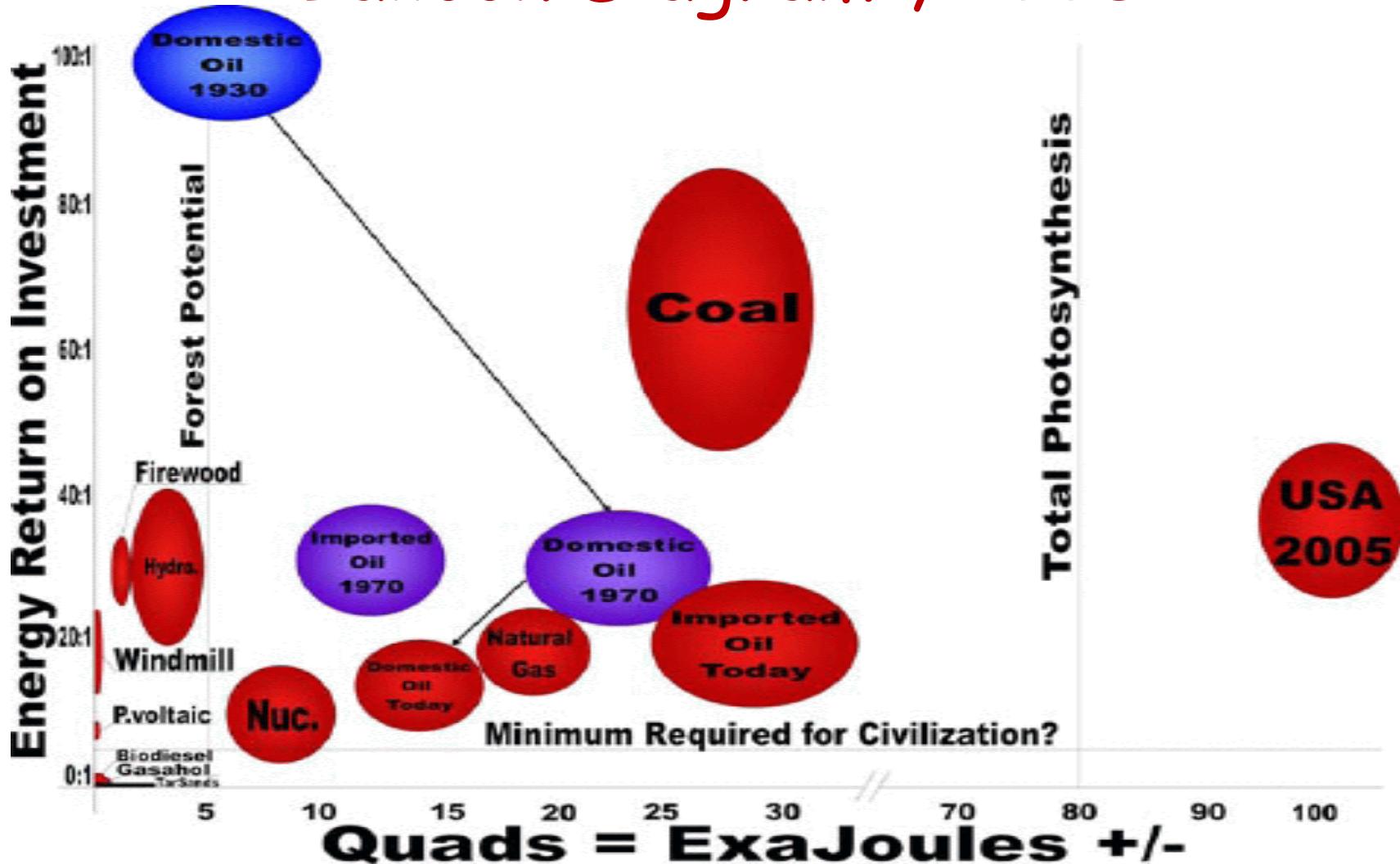
There is a *net* flow to
The economy if, *and only if*,
E is greater than F, or if
E/F is greater than 1.

E/F is the *Energy Return
on Investment, EROI*

Cleveland's (US) data, 2008



Hall & Lambert's (US) data: "Balloon Diagram", 2008



Some current EROI data

- Global oil EROI roughly 26:1 in 1992, about 19:1 in 2005
- Running average EROI for US domestic oil dropped from about 100:1 in 1930s to about 12:1 today
- Oil used within the US for products exported to import oil had an EROI about 30:1 in 1970, about 20:1 in 2005
- Ethanol from corn EROI in the US is at best 1.6:1 and at worst less than 1:1 (Brazilian cane ethanol around 7 or 8:1)
- Biodiesel EROI around 3:1
- Oil shale EROI around 6:1
- Tar sands EROI around 1:1
- Coal liquefaction EROI around 3:1
- Nuclear debatable but around 5 - 15:1
- Wind energy EROI around 15 - 20:1

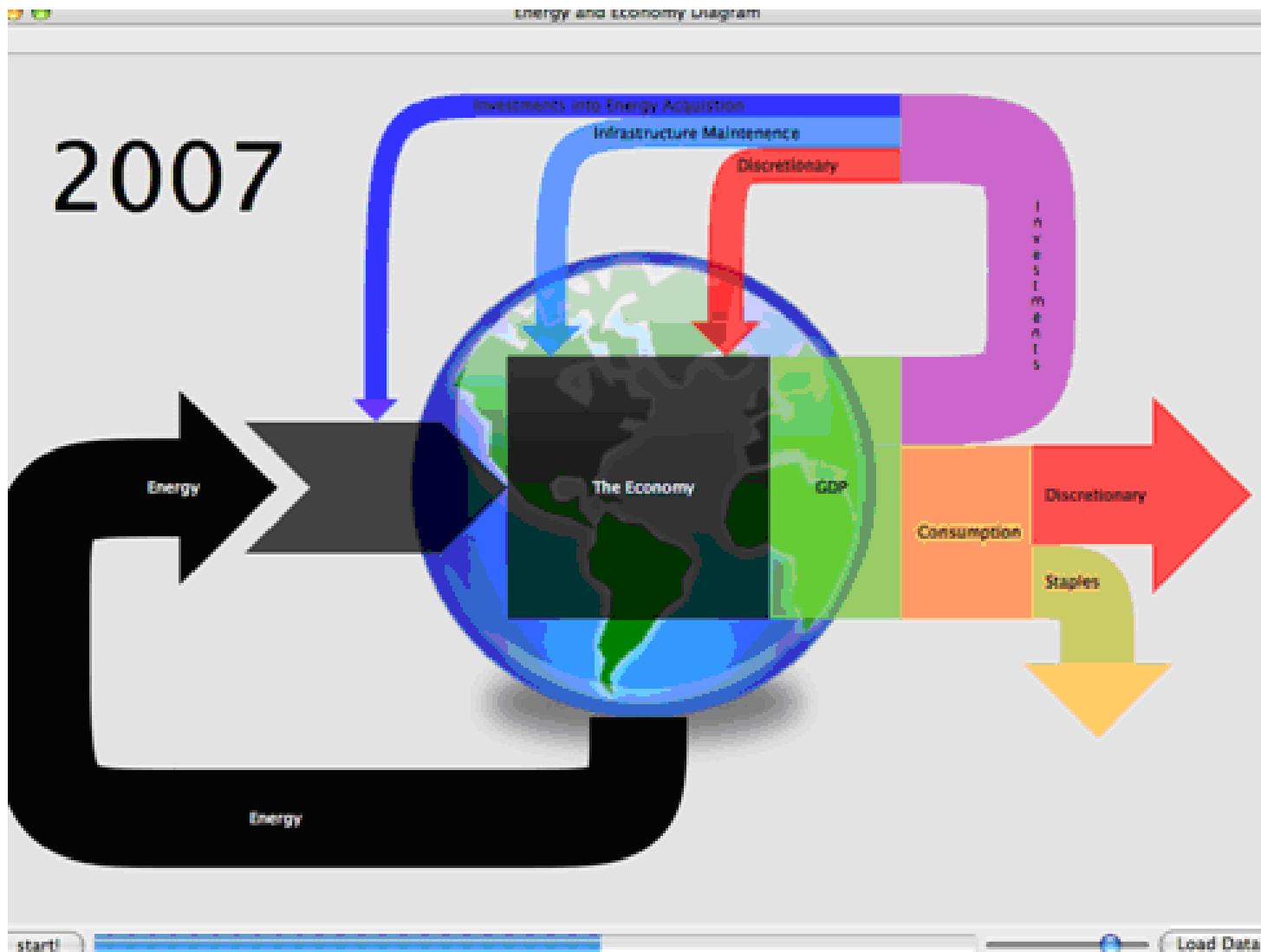
Data from Hall et al, 2008 and Cleveland, 2008

Consequences of the transition to lower EROIs

Irrespective of which resources and technologies are used, lower EROI values mean that, to maintain anything like current outputs of (for example) liquid fuels, much higher levels of investment and maintenance will be needed than was the case in the past .

The resultant energy and resource requirements will mean less economic output is available for consumption, especially discretionary consumption.

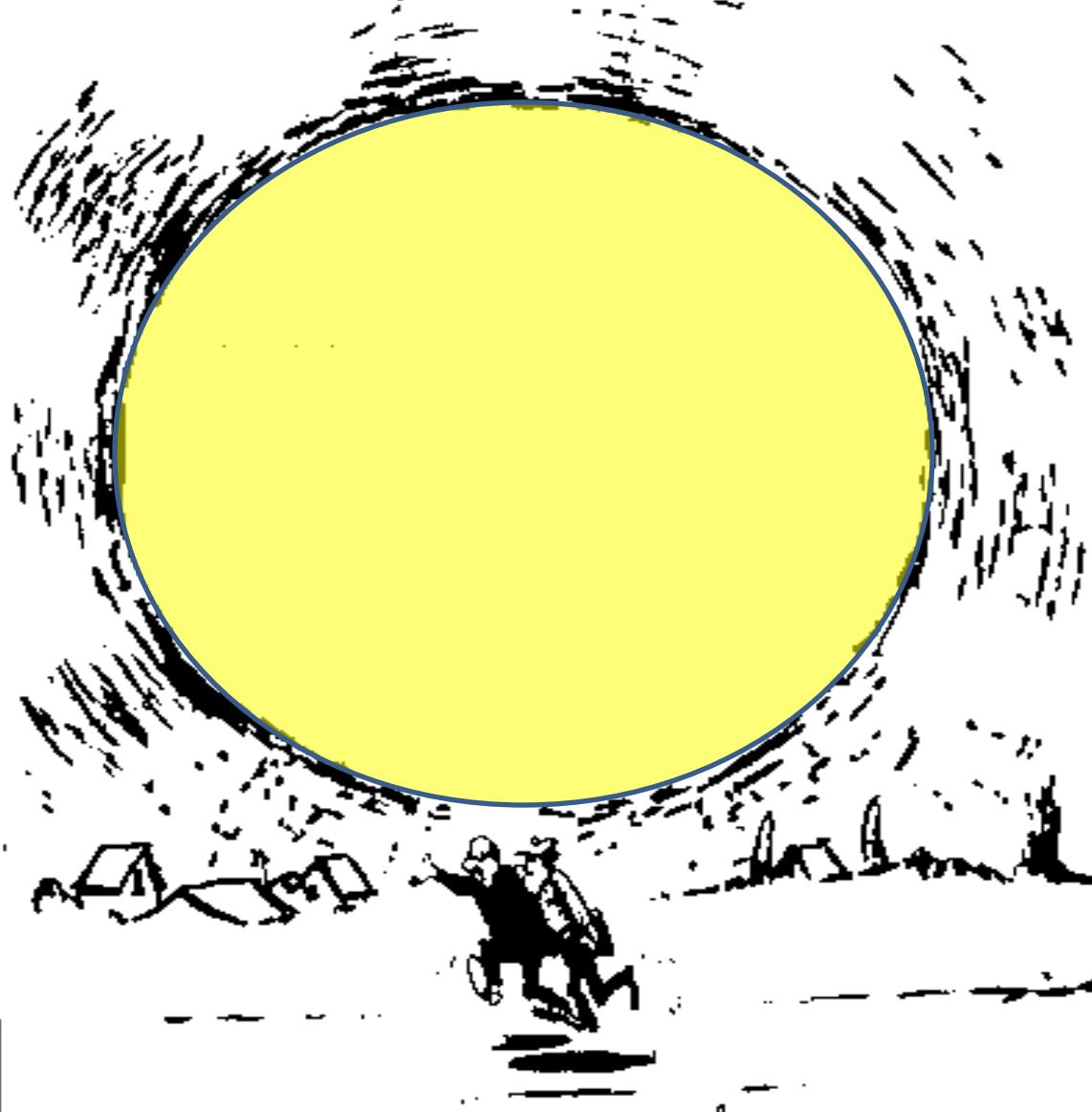
Energy in the Economy



The Daly Rules (1990)

- The Output Rule
 - wastes ... should be kept within the assimilative capacity of the local environment:
- The Input Rule
 - for renewables - harvest rates of renewable resource inputs shall not exceed the regenerative capacity of the natural system that generates them.
 - for non-renewables - depletion rates shall equal the rate at which renewable substitutes are developed by human invention and investment.

'We've got to look for a new source of energy'

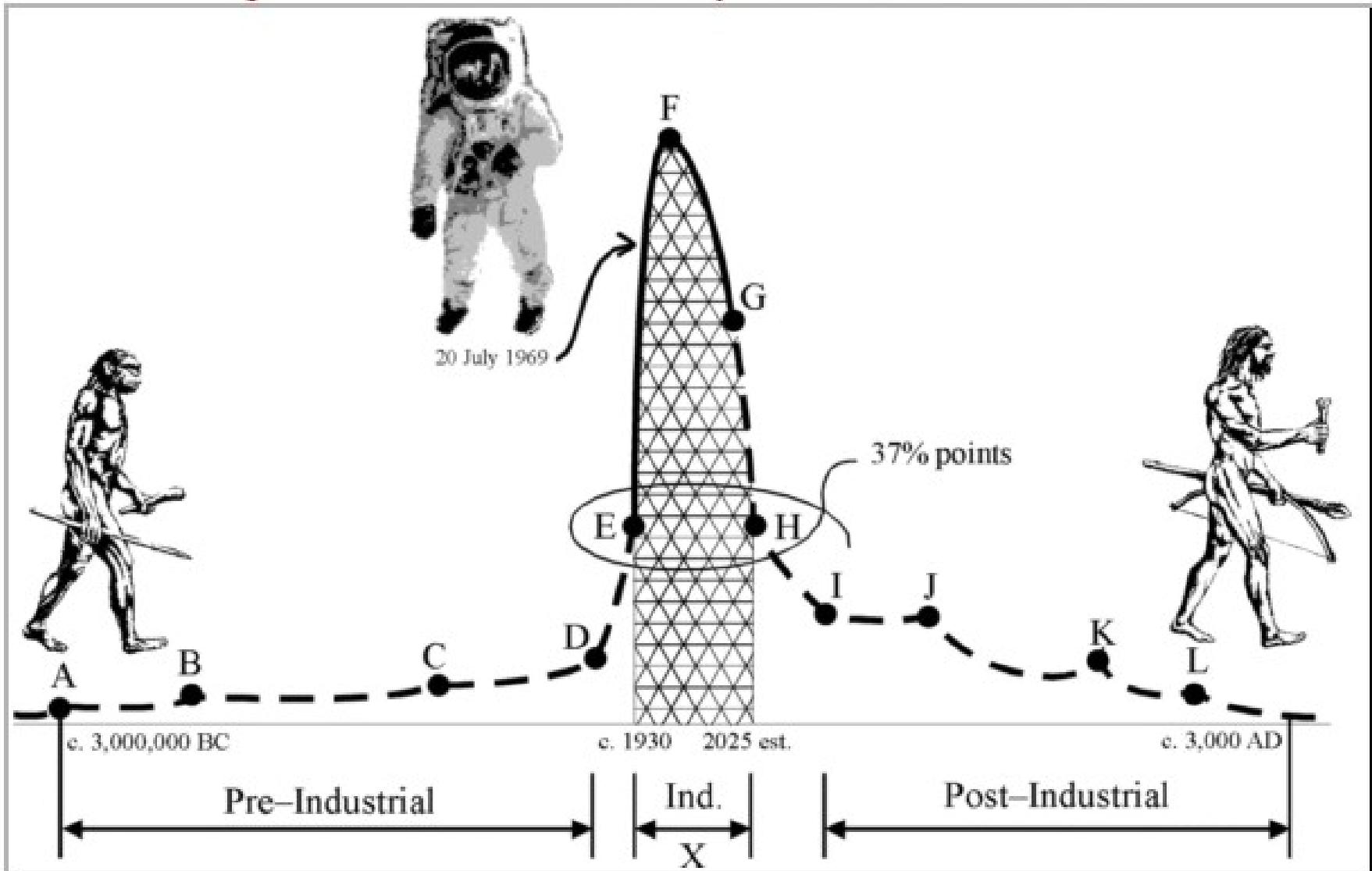


E. H.
Shepard

The Christian Science Monitor

A possible (post Peak Oil) future?!

Figure 1. The Olduvai Theory of Industrial Civilization



Economics - 2

Petroleum 1.12 t
Coal (net) 0.72 t
Gas 38 GJ
Water 470 t
Aggregate 11 t



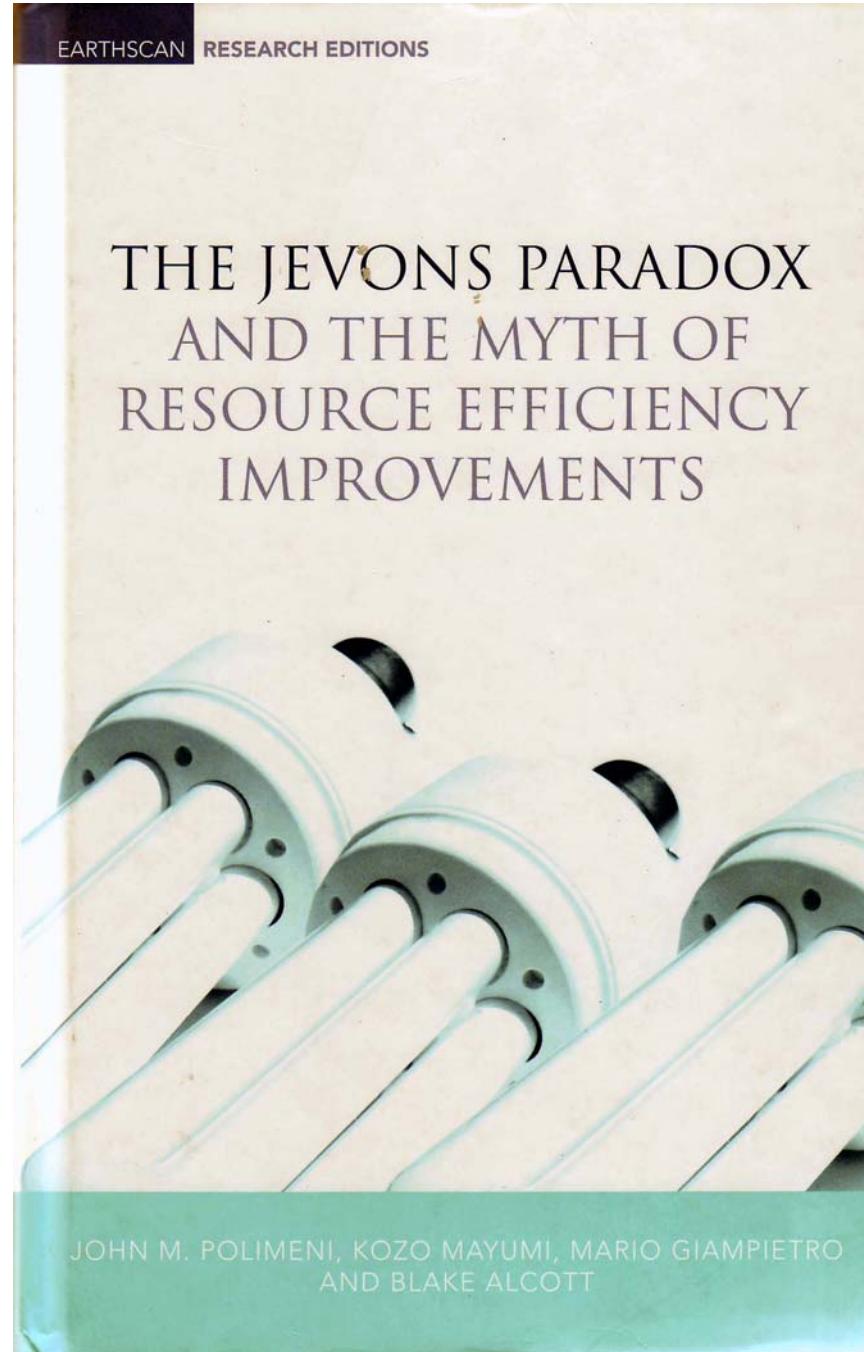
The
biophysical
economy
per person per year

↗ Greenhouse gases
18.6 t
↗ Solid waste 0.55 t
↗ Sewage 117 t
↗ Biodiversity loss,
erosion etc.

After Gowdy, 2006

NZ data 2005, 2006, 2007

**"Resource
efficiency" is
the answer?**



Peak Everything?

The *real* issue, it can be argued, is not so much Peak Oil alone, as it is

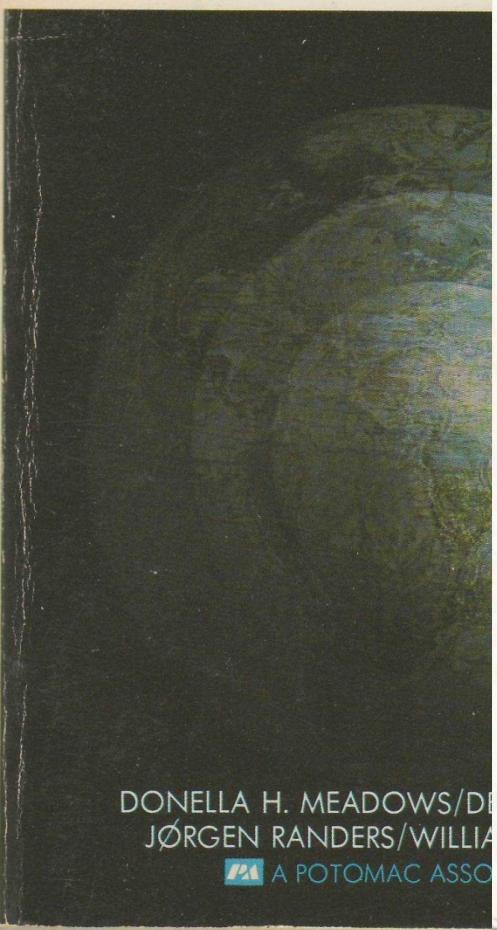
Peak Consumption of *Stuff!*

(e.g. Richard Heinberg's "Peak Everything", 2007)

Sequel to the international bestseller

THE LIMITS TO GROWTH

The headline-making report on the imminent limits to humanity—and what we can do about it. One of the most important documents of our time.



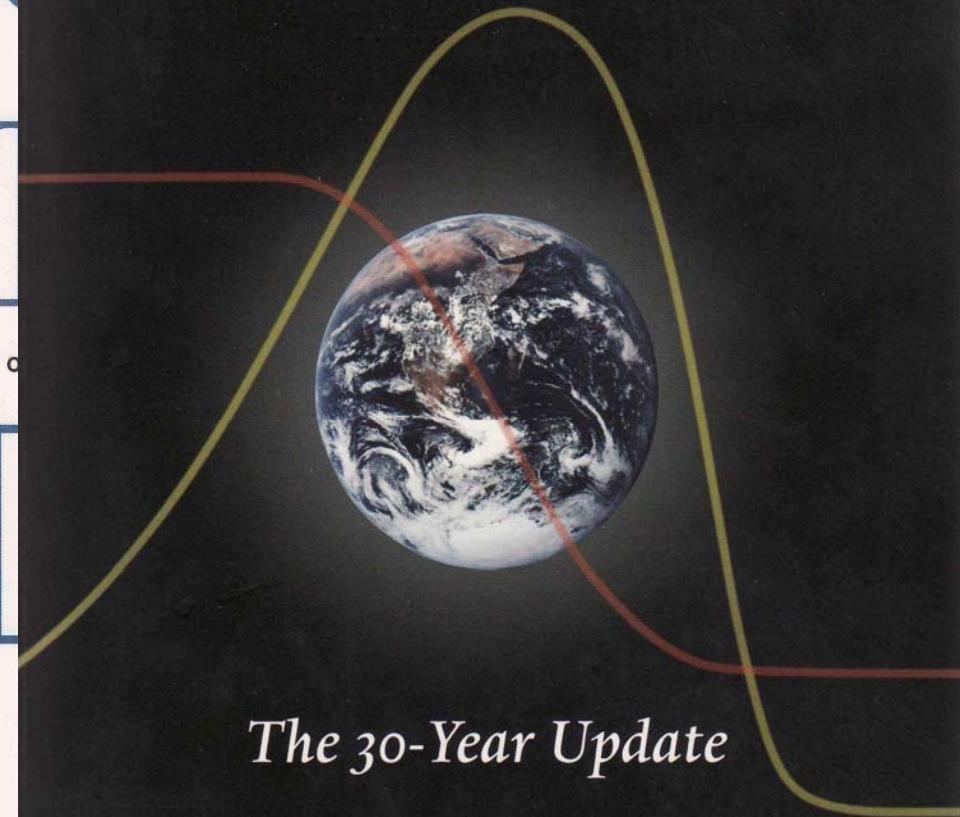
BEYOND THE LIMITS



LIMITS

DONELLA H. MEADOWS, DENNIS L.

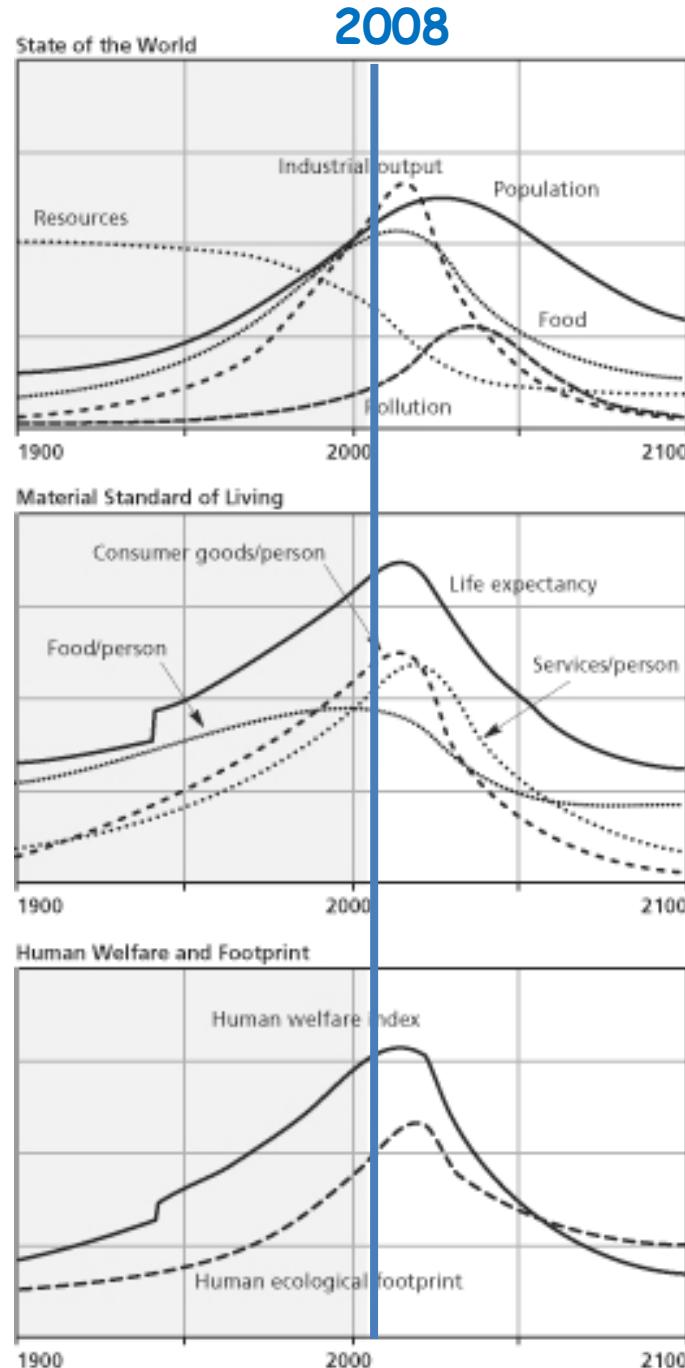
LIMITS TO GROWTH



DONELLA MEADOWS | JØRGEN RANDERS | DENNIS MEADOWS

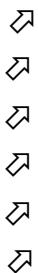
Limits to Growth?

Meadows, Randers, Meadows
"Limits to Growth: The 30-year
Update",
Figure 4-11 Scenario1:
A Reference Point



Economics - 3

Voluntary work
Unemployed
Retired
Children
Gift work
Mahi



The (invisible) social economy

↗ Children in poverty
↗ Elderly in poverty
↗ Median income
people
↗ Rich-poor gap
↗ Social cohesion

Questions relevant to Sustainable Development

- Are people satisfied and happy?
 - (sufficiency and equity)
- Can more well-being be achieved with less throughput?
 - (efficiency of the transformation process)
- Are ecosystems healthy, resilient and thriving?
 - (environmental sustainability)



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**CENTER
for the
ADVANCEMENT
of the
STEADY STATE ECONOMY**

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"CASSE is the foremost organization in advancing the precepts of the steady state economy to citizens and policy makers – an indispensable resource!" [Herman Daly](#)



The Truth About Economic Growth

Economic growth is simply an increase in the production and consumption of goods and services. Economic growth has provided many benefits over time, but now it is causing more problems - dire problems - than it solves. Slowly but surely, economic growth has become a primary threat to the environment, national security, international stability, and future generations. Yet it remains the highest priority in the domestic policy arena of the United States and most other nations. Citizens, especially students, are continually told that there is no limit to growth, in defiance of ecological principles and basic physics. To refute the misleading rhetoric that there is no conflict between economic growth and environmental protection – as well as economic sustainability – CASSE provides [resources](#) about the perils of growth with an emphasis on ecological reality.

The Steady State Economy

A prosperous and dynamic economy does not have to be a growing economy. A steady state economy features stabilized population and consumption. Such stability means that the amount of resource throughput and waste disposal remains roughly constant. The key features of a steady state economy are: (1) sustainable scale, in which economic activities fit within the capacity provided by ecosystems; (2) fair distribution of wealth; and (3) efficient allocation of resources.