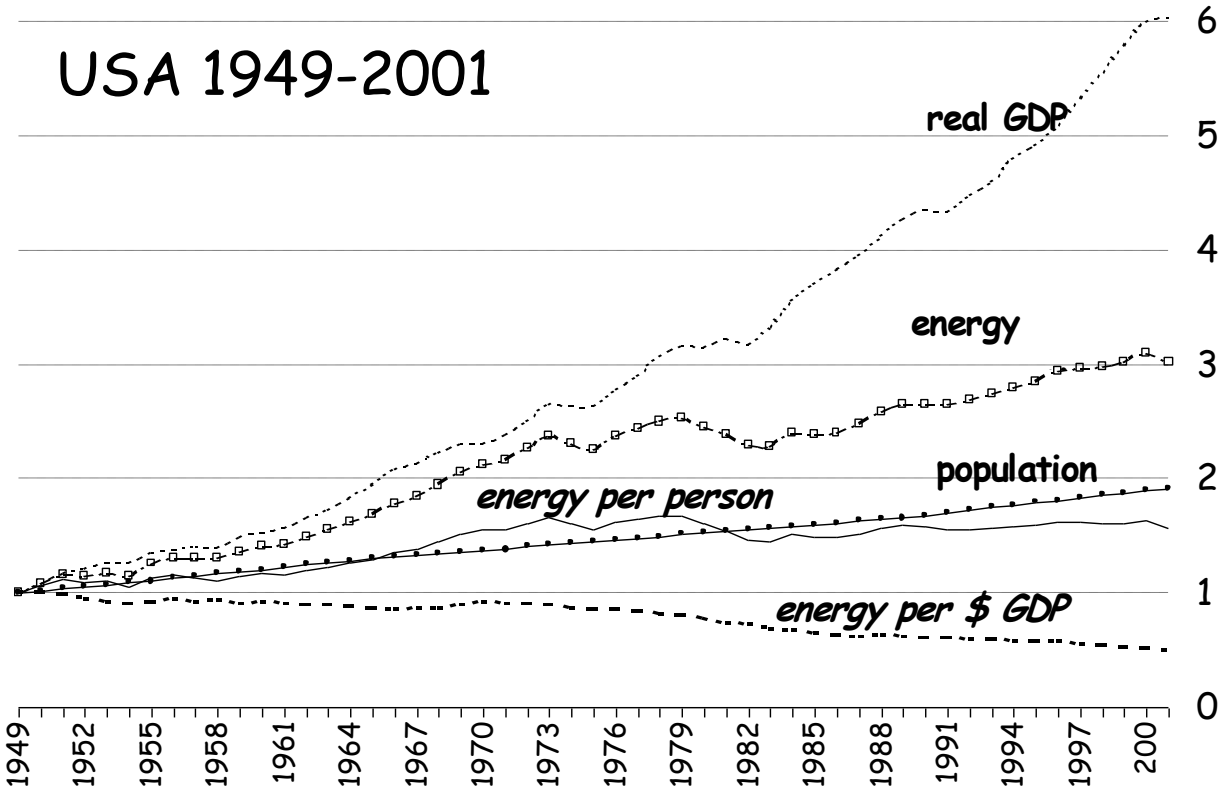
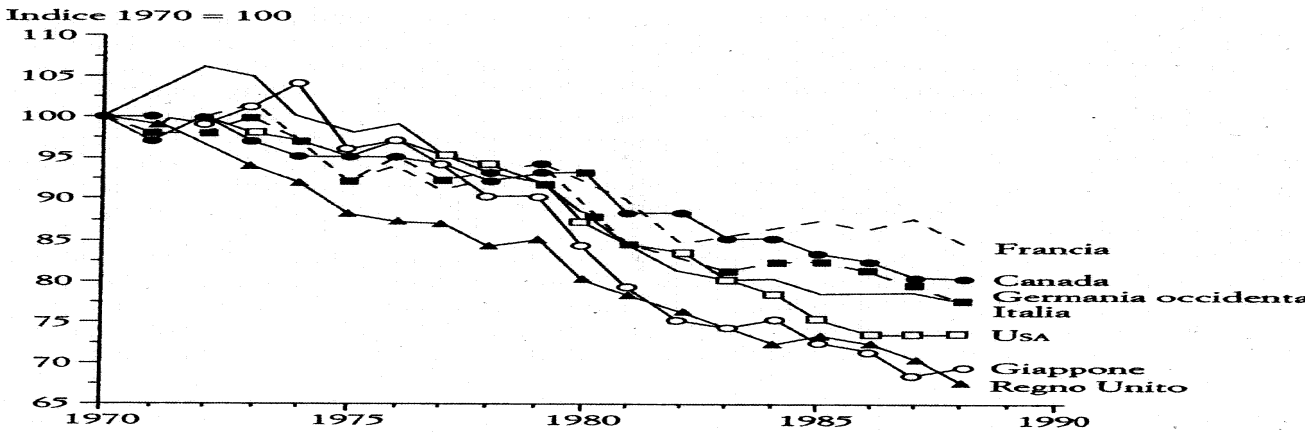
Rebound effects

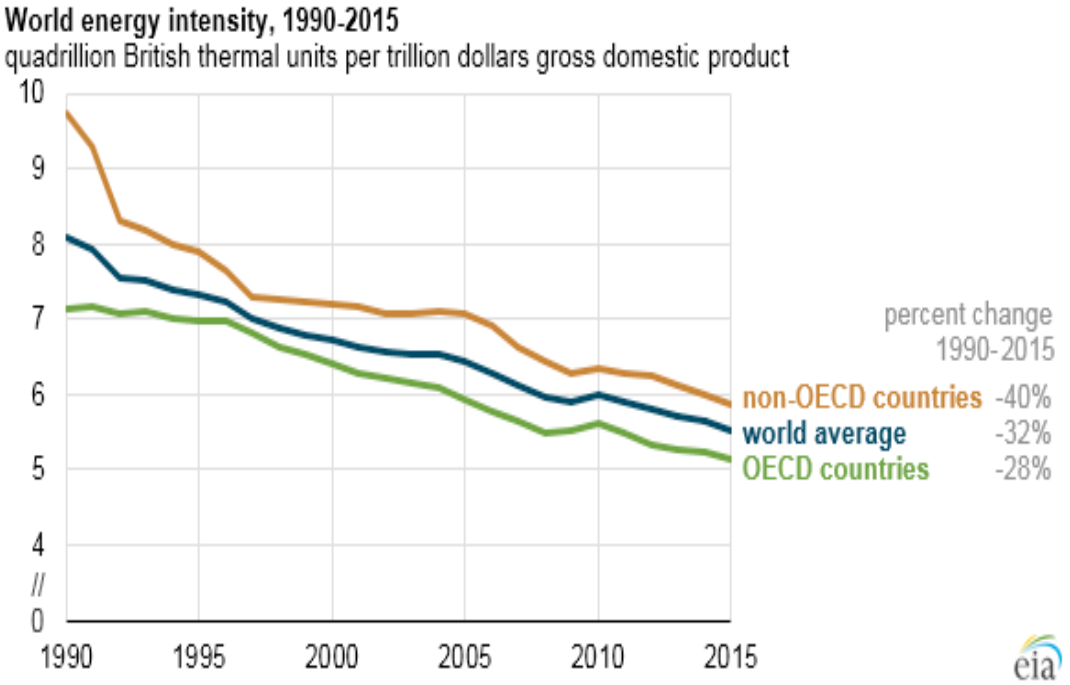


DATA: EIA (Energy Information Administration)
http://www.eia.doe.gov/

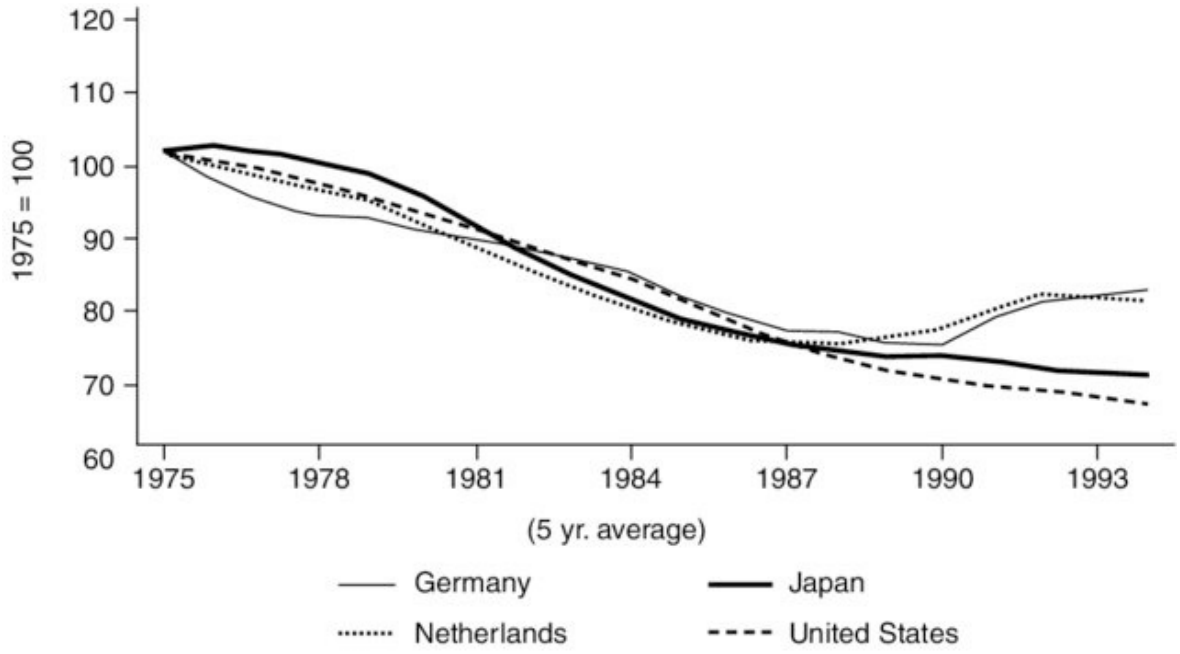
GOOD NEWS?

Energy intensity of GDP





GDP Material Intensity (TMR/GDP)



ADRIANSEE et al 1997

Mouse to elephants curve

KLEIBER'S CURVE (1932)

Basal metabolic rate $\Delta E/\Delta t = k M^{\frac{3}{4}}$

E=energy M =mass

True over 18 orders of magnitude from microbes to whales! (v. ad esempio Blaxter 1989, Kleiber 1975, Miller 1986)

In absolute terms: big animals need more energy

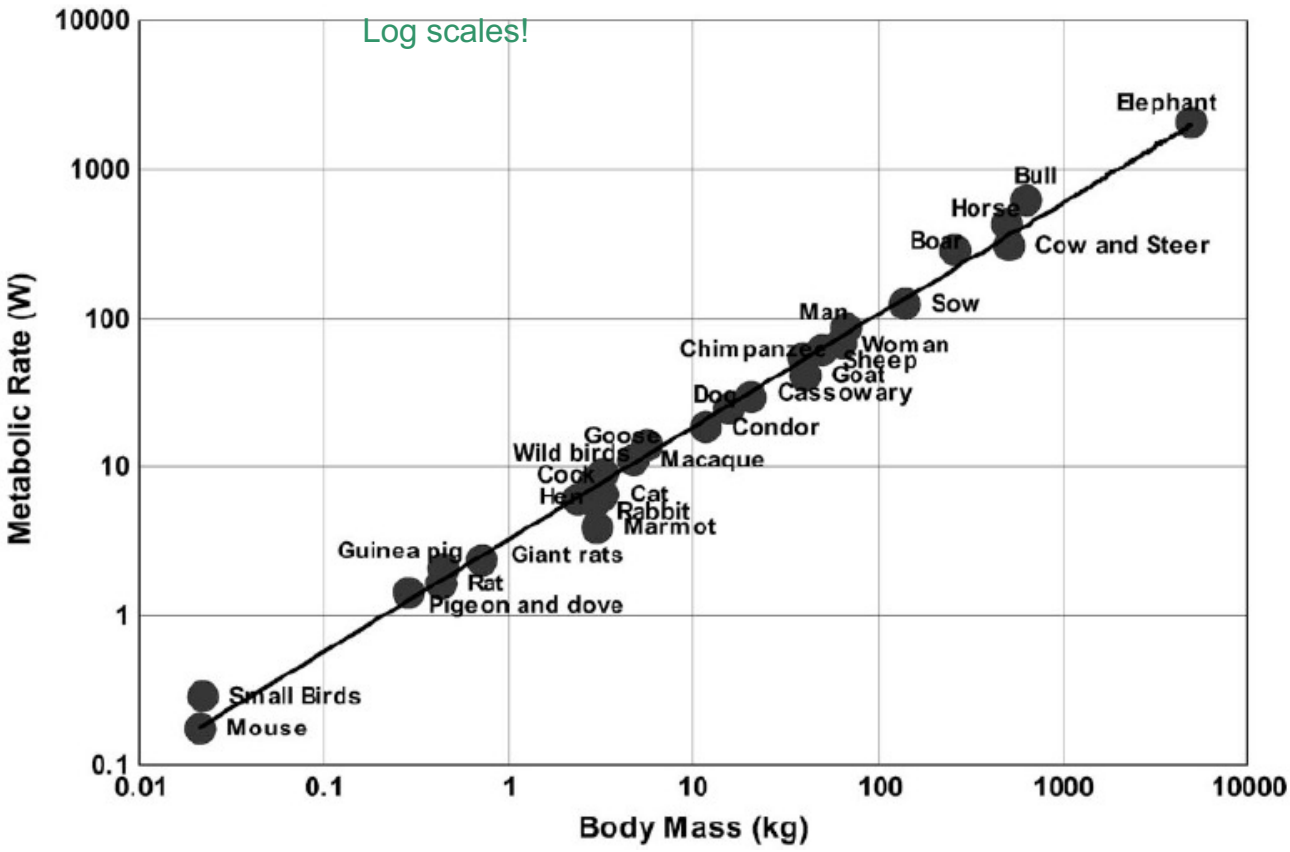
In relative terms: big animals need less energy per mass units

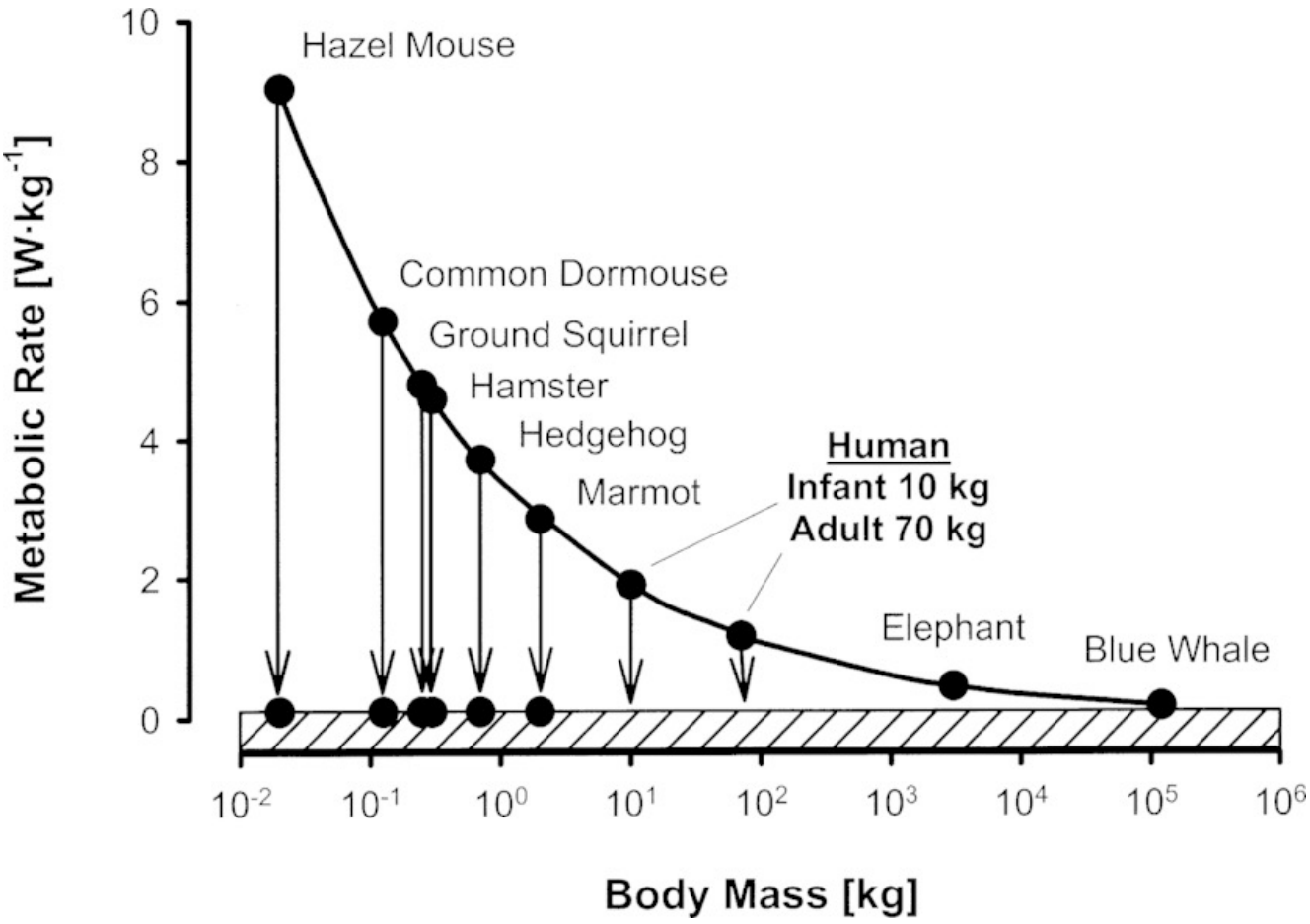
Kleiber's Curve:

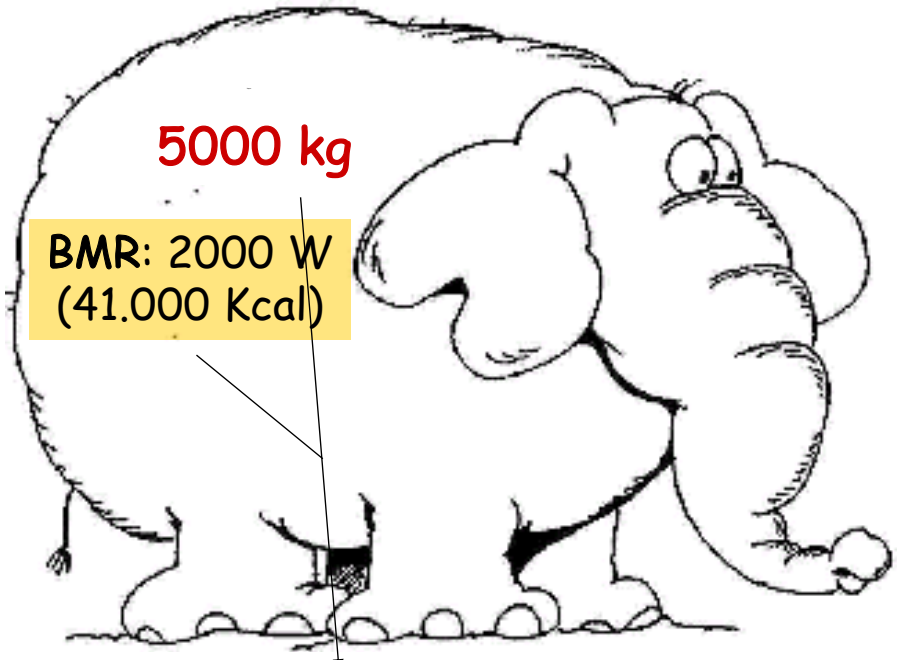
Miller A. T., 1986, *Energy Metabolism*, F.A. Davis Company Philadelphia, PA.

Blaxter K. 1989, *Energy metabolism in animals and man*, Cambridge University Press, Cambridge, UK.

Kleiber M. 1975, *The Fire of Life: An Introduction to Animal Energetics*, Robert E. Krieger Publishing Company Huntington, NY.







BMR: 0,2-0,3 W
(4-6 Kcal)

20-40 gr

8-10 W/kg

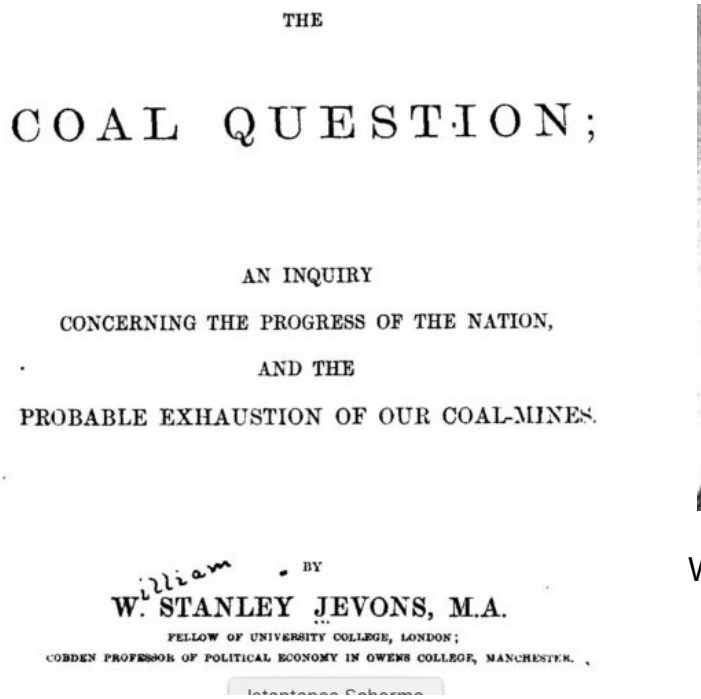
Elephant efficiency:
20-25 times > than mouse

Basal metabolism rate

Humans: 75 W(1600 Kcal) → 1,2 W/kg

Jevons Paradox

Technological progress that increases the efficiency with which a resource is used
tends to increase (rather than decrease) the rate of consumption of that resource.



THE

COAL QUESTION;

AN INQUIRY

CONCERNING THE PROGRESS OF THE NATION,

AND THE

PROBABLE EXHAUSTION OF OUR COAL-MINES.

BY

W. STANLEY JEVONS, M.A.

FELLOW OF UNIVERSITY COLLEGE, LONDON;

COBDEN PROFESSOR OF POLITICAL ECONOMY IN OWENS COLLEGE, MANCHESTER.

1865

William Stanley Jevons

(1835-1882)

English economist

«Coal will finish soon!»

Why? Chapt 7 "Of the Economy of Fuel"

↑ efficiency in the natural resource use → ↑ productive scale → ↑ demand of the nat res

"It is wholly a confusion of ideas to suppose that the economic use of fuel is equivalent to a diminished consumption.

The very contrary is the truth.

As a rule, the new modes of economy will lead to an increase of consumption according to a principle recognized in many parallel instances…. "

"It is the very economy of its (coal) use which leads to its extensive consumption…"

↑ efficiency → ↑profits
→ ↑ investments & firms → ↓ P→ ↑demand
→ ↑ use of coal
perhaps non in all industries (systemic effect!!!!)
but ↑ in some → ↑ other industries

In the history of steam engine
"Every such improvement of the engine," he observed, "when effected, does but accelerate anew the consumption of coal. Every branch of manufacture receives a fresh impulse-hand labor is still further replaced by mechanical labor …" (152-153).

"It is the very economy of the use of coal that makes our industry what it is (142)"

* See M. Giampietro and K. Mayumi, "Another View of Development, Ecological Degradation, and North-South Trade," Review of Social Economy, vol. 56, no. 1, 1998.
J B Foster, 2000, "Capitalism's Environmental Crisis- Is Technology the Answer?" Monthly Review, 52 (7) http://www.monthlyreview.org/1200jbf.htm

Does building new roads solve the traffic problem?
NO:
Encourages use of personal vehicles (Newman 1991)
(which reduces public transport)

↑ Oil price → ↑ energy-efficient cars → ↑ leisure driving
(Cherfas 1991)

The number of miles driven increased and car performance improved,

bigger and more sophisticated vehicles

REBOUND EFFECT

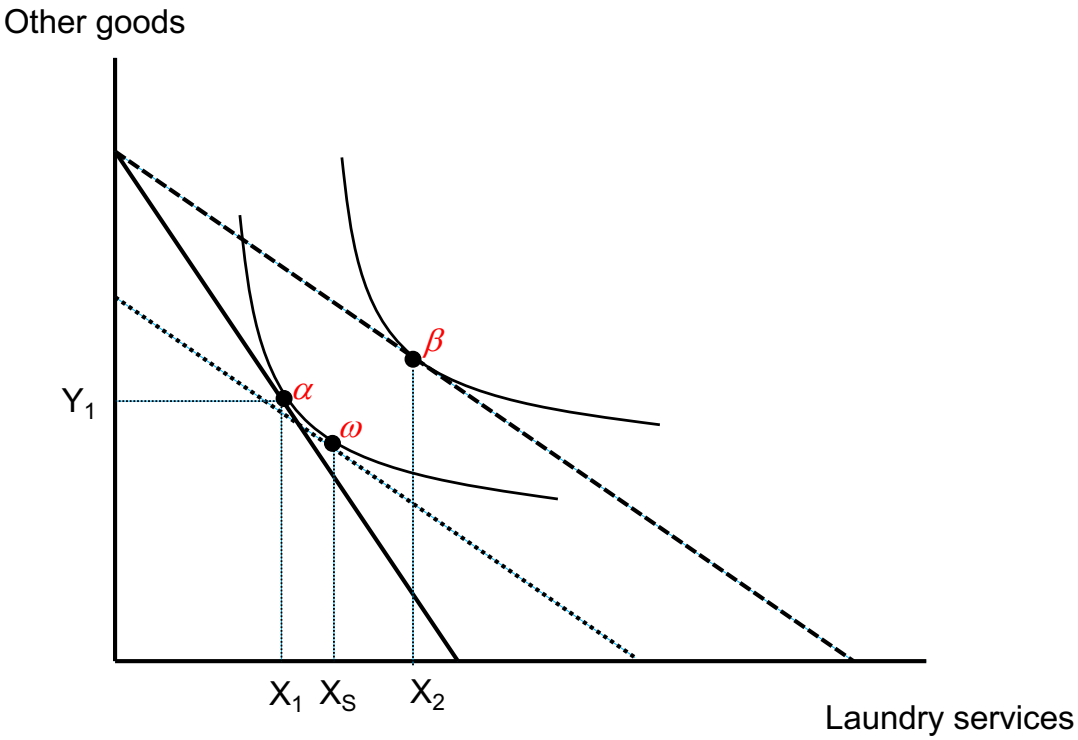
Partial rebound (take-back) (0% < RE < 100%):
0 < actual resource savings < potential savings
most common result of empirical studies on individual markets

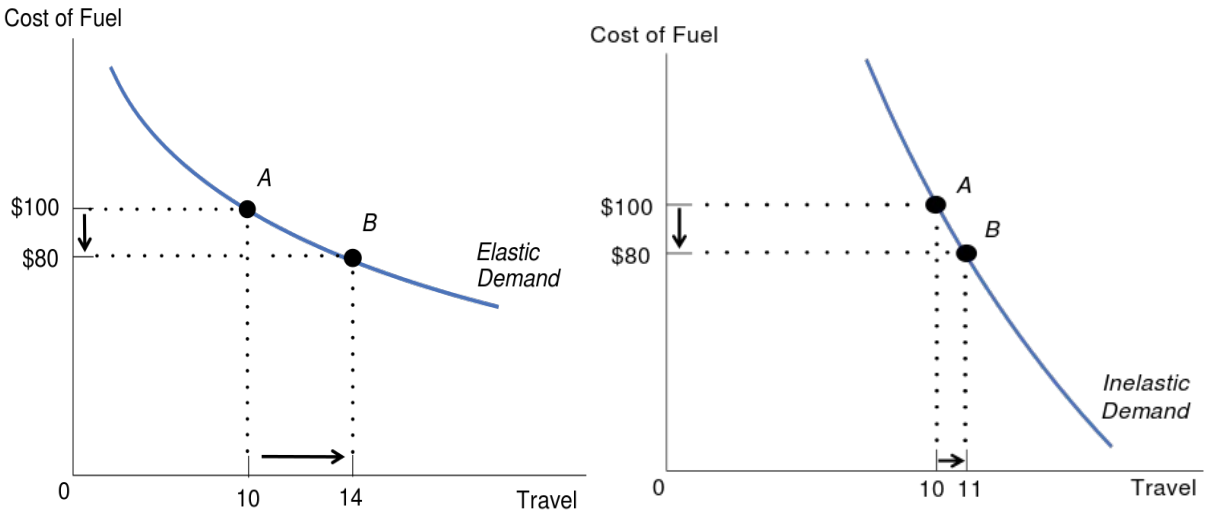
Backfire (RE > 100%):
0 > actual resource savings

usage increased beyond potential savings

Backfire = Jevons' paradox

Somehow similar to INCOME EFFECT due to lower prices





https://www.frontiersin.org/articles/10.3389/fenrg.2018.00026/full

Giampietro, M., & Mayumi, K. (2018). Unraveling the complexity of the Jevons paradox: the link between innovation, efficiency, and sustainability. *Frontiers in Energy Research*, *6*, 26.