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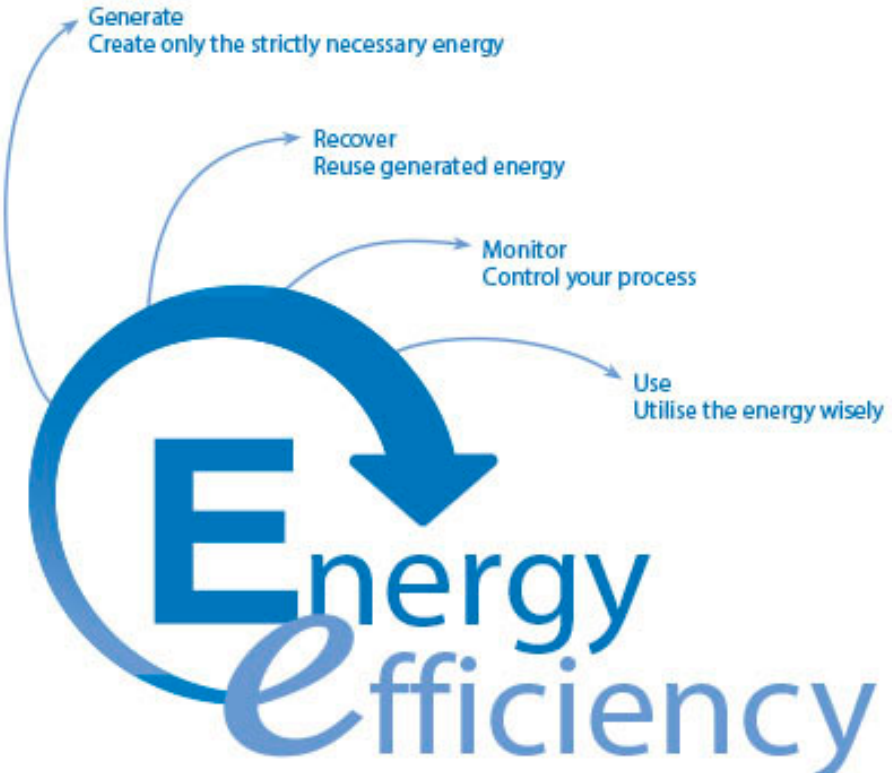
ENVS 119 - Energy & the Environment

17 - Energy Efficiency - Doing more with less

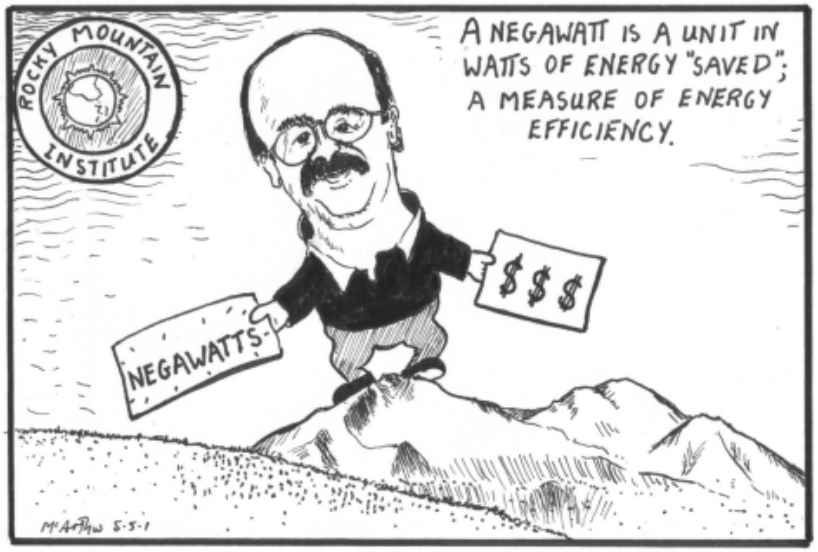
Today

- Energy efficiency?
- The "Negawatt" principle
- EPA EnergyStar program
- The refrigerator case
- Return on Investment
- Jevons Paradox
- Green buildings? ENVS137/132



Definition “Negawatts” = Kwh we don’t use

- Negawatt: Cost of Watts saved (Amory B. Lovins - Rocky Mountain institute).
- What would cost the energy efficiency upgrades on a house per kWh not used (saving)? How is it comparable to the cost of a produces kWh we would have used?
- NegaWatt are useful for measuring impact of conservation and efficiency costs.



Negawatts: LED light example

- A city decides to subsidize replacement of 100,000 incandescent lightbulbs 75W to 15W LED (60W saving)
- Cost (outreach, marketing, install) = $40 per bulb
- Q1: total cost of the program?
  100,000 LEDs x $40 = $4,000,000 (one time valid 4 years)
- Q2: How many kWh saved in 1 year (assume lights are turned On 10 hours / day?
  (75-15w)/1,000 wh per kWh x 10h x 365days x 100,000 bulbs = 21,900,000 kWh
- Q3: Cost per "nega" kWh saved the first year?
  ($4,000,000) / 21,900,000 kWh = $0.046 or 4.6cts

Negawatt v. Watt cost

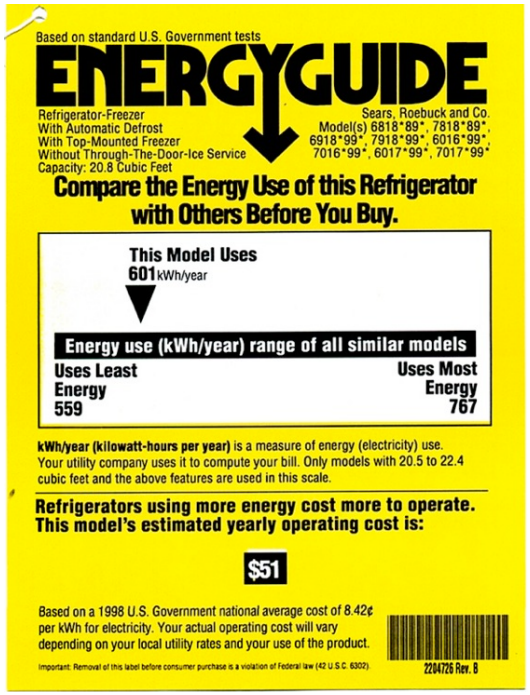
5cts/kWh
Negawatt

12cts/kWh
(market price)

LED “negawatt" at 5 cts are cheaper than Natural gas real "watt" at 12 cts on the energy market.
Everybody should do it!

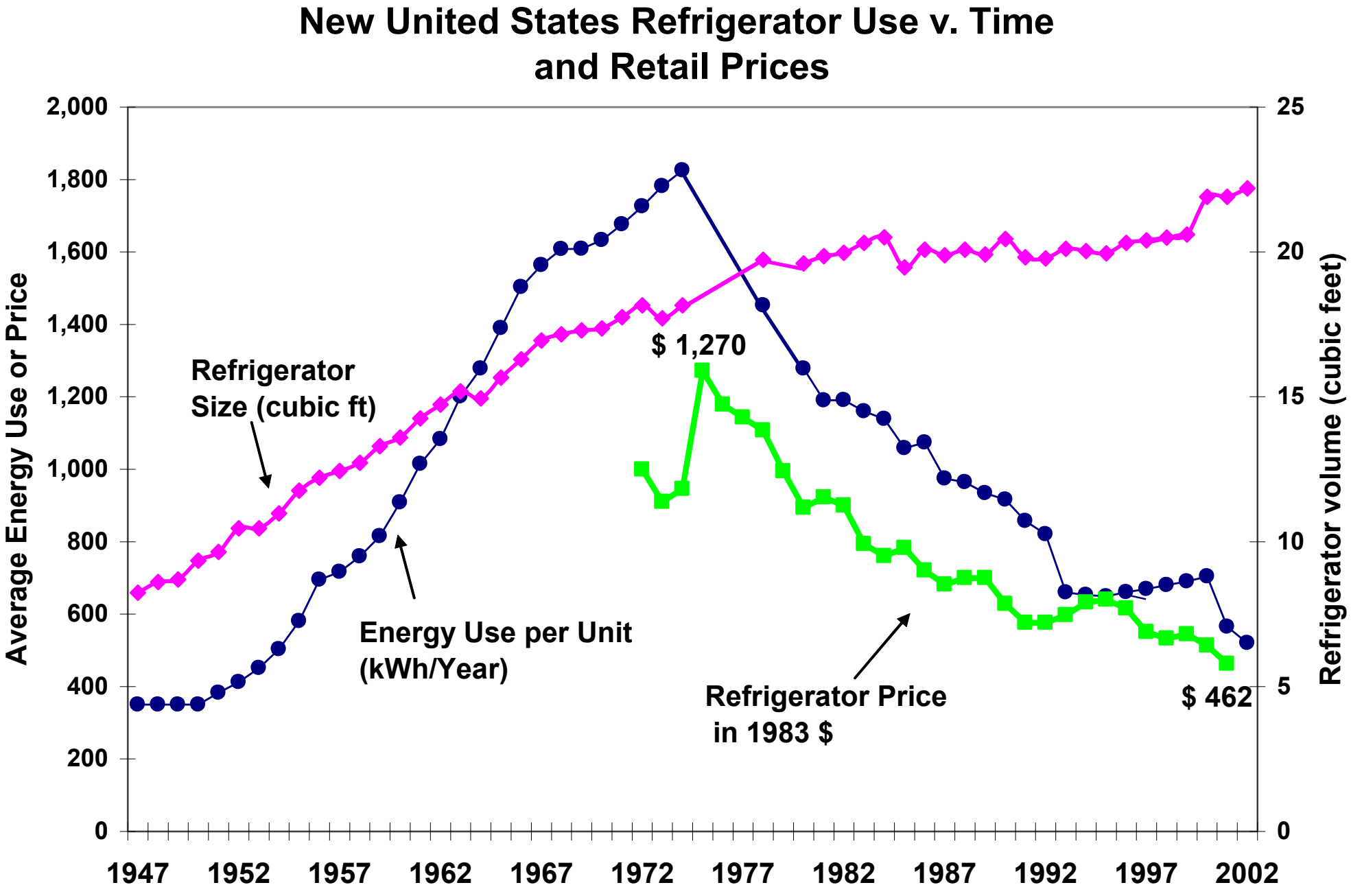
Gov. Federal EPA standards

- All appliances are tested by independent labs for energy / water efficiency.
- The top 5% “most efficient” get the **blue** Energy Star label
- All must display the **yellow** Energy Guide label



The Great Story of Refrigerator Efficiency...

Since 1975, 25% bigger, 1/3 the energy, 1/3 the cost



Source: Art Rosenfeld, David Goldstein

Return on Investment example.

- Ex: Incandescent bulb 75W, $1pc v. LED 15W, $20 (PG&E rate $0.16 kWh, lamp used 10 hours/day)
  Savings: (75-15w)/1,000 x 10h x 365days x $0.16/kWh = $30 saved per year
  ROI: ($20-$1)/$30 = 0.63 years or about 7 months!

- In less than 7 month my LED bulb will pay for itself with the savings on electricity. As it is rated for 10,000 hours of use, and is likely to last 4 more years. At the end of the bulb lifetime, I'll save 4yr x $30 = $120!
  Since the average home has about 50 lightbulbs, expected savings may be up to $6,000 for the next 4 years.

* Ave. cost per Kw in PG&E territory $0.16/kWh

Jevons paradox (1865)

- Coal-burning factories in 19th-century Manchester, UK.
- Improved technology allowed coal to fuel the Industrial Revolution, greatly increasing the consumption of coal energy compared to what was previously used in the form of wood.
- The easiest/cheapest is the technology

  =

  More will be used

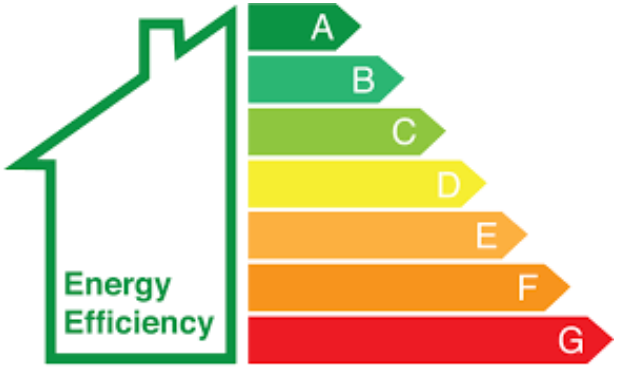
Khazzoom-Brookes postulate (1980s)

- Khazzoom studied the rebound ignored in mandatory standards for domestic appliances being set by the California Energy Commission.
- Increased energy efficiency makes the use of energy relatively cheaper
- Increased energy efficiency leads to increased economic growth

How to promote EE and conservation?

- Low-cost financing for super efficient investments
  (cars, houses, appliances, solar PV roofs…)
- Subsidy for replacing aging equipment: super efficient refrigerator program, washing machines, etc.
- Electricity peak load management (may not reduce energy, but could reduce CO2)
- PG&E energy conservation efforts:
  https://www.pge.com/en_US/residential/save-energy-money/resources/everyday-tips/energy-saving-tips/energy-saving-tips.page

END (of semester!)



If you want to learn more on
how to conserve energy in buildings (a.k.a “Green Buildings”)
sign-up for **ENVS 132** (Spring) or **ENVS 137** (Fall)