

Energy and environmental impacts of buildings

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3rd Annual Sustainability Workshop

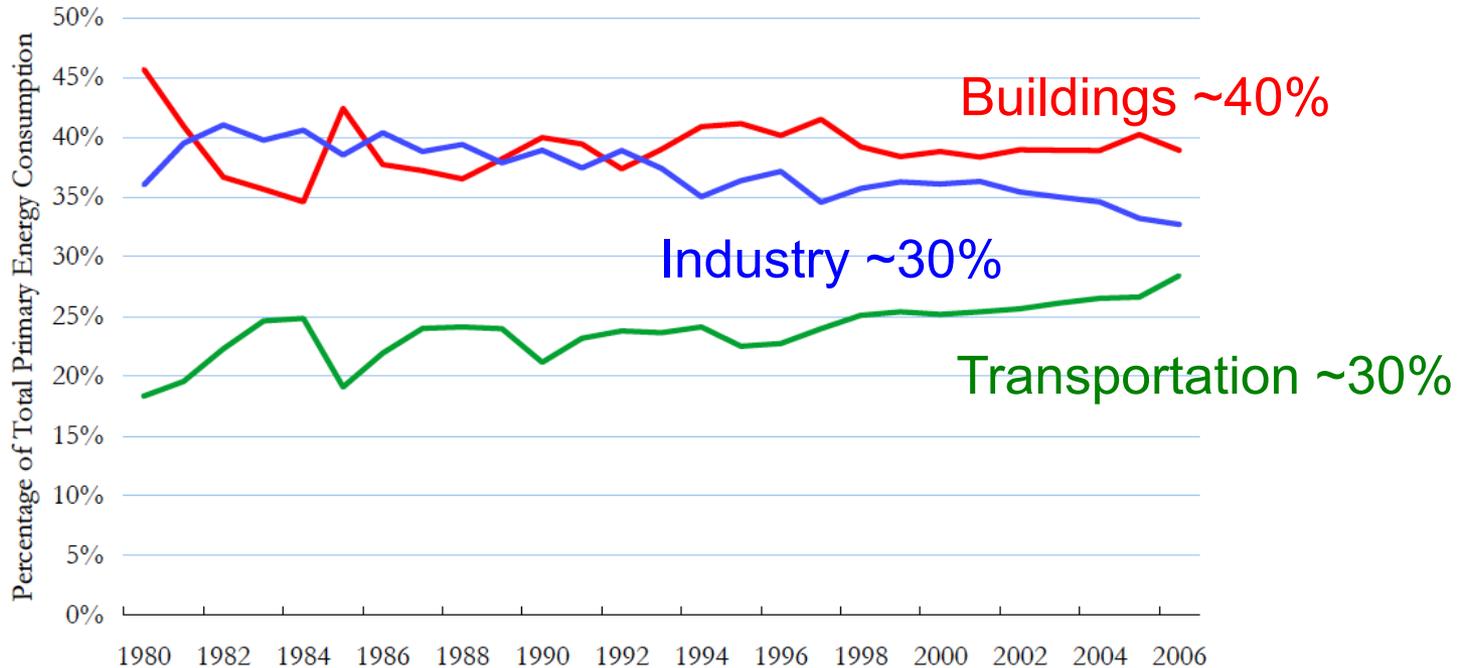


*Advancing energy, environmental, and
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Buildings use *a lot* of energy

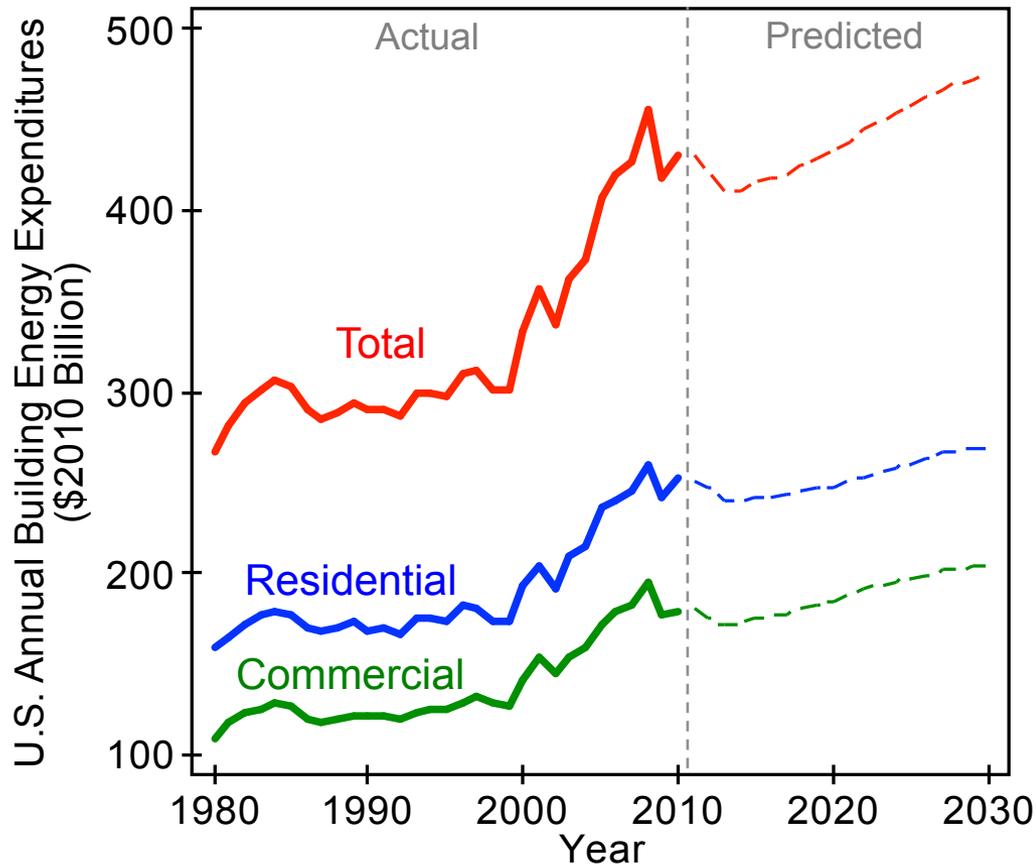


Buildings use ~40% of energy in the U.S.

And thus emit ~40% of greenhouse gases (and other pollutants)

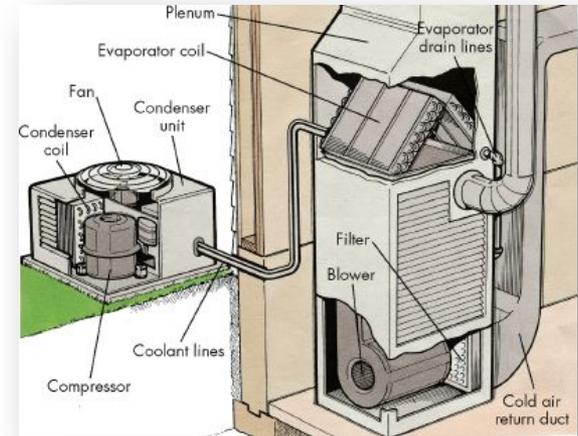
Buildings in the U.S. account for ~7% of the total amount of energy used in the world

Building energy use costs *a lot* of money



U.S. building energy expenditures totaled
~\$430 billion in 2010

Approximately 3% of our GDP



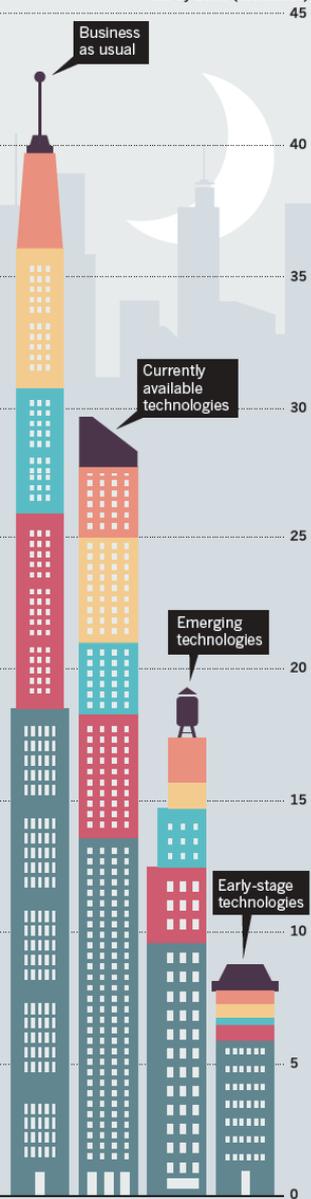
Approximately 1/3 of
building energy use is for
space conditioning
~1% of our GDP is spent on
heating and cooling
buildings

GOING DOWN

Energy demand in US buildings could be cut by up to 80% through investment and marketing.



Quads of primary energy use by 2030 (thousands)



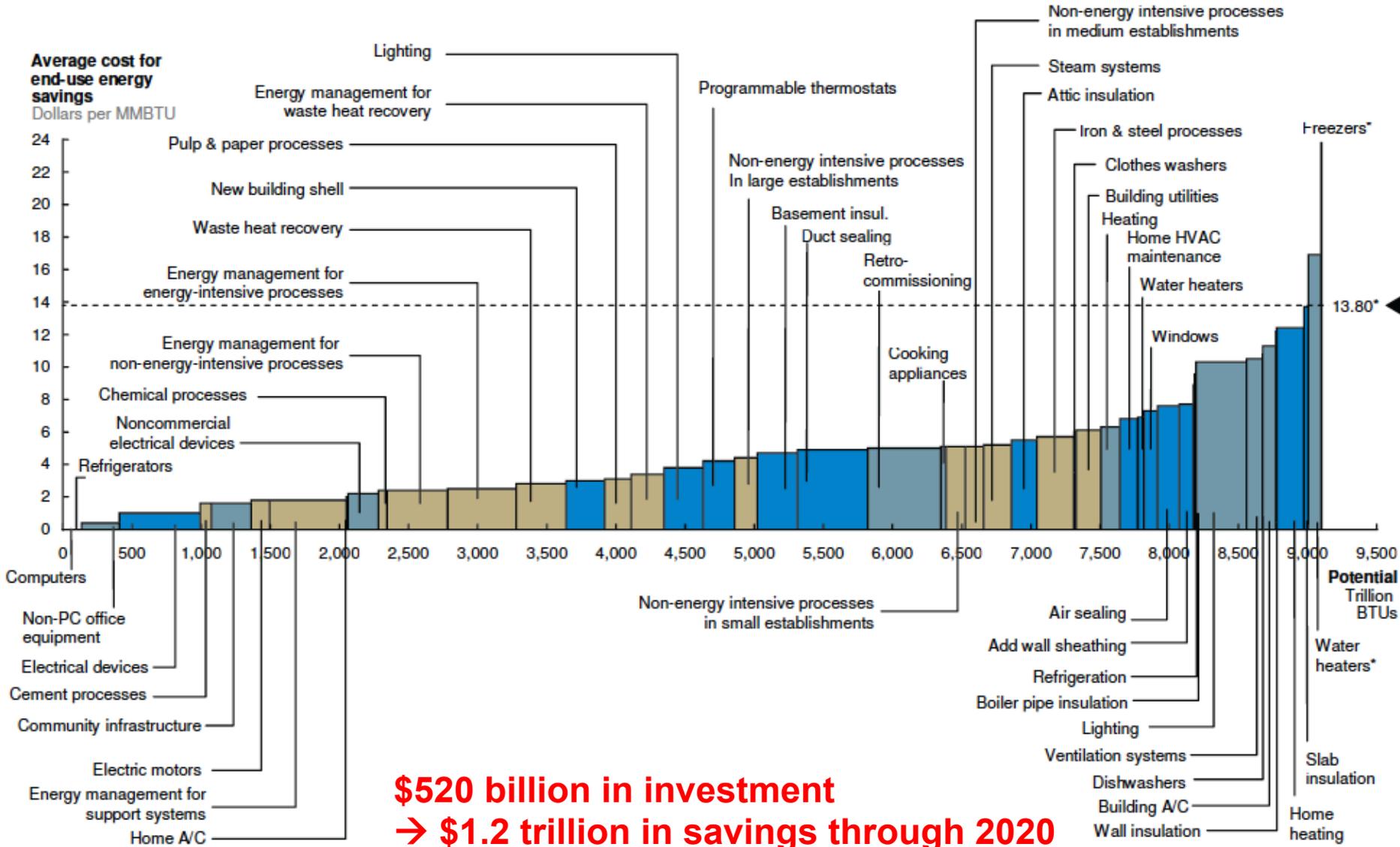
Paths toward *lower energy* buildings

- Efficient building **systems**
 - Mechanical systems
 - Mechanical driving forces
 - Gadgets and controls
- **Passive** building design
 - Natural systems
 - Natural driving forces
 - Form and materials

“Energy demand in U.S. buildings could be cut by up to 80% through investment and marketing”

Energy efficiency is actually *inexpensive*

Residential Commercial Industrial



Moving forward with *lower energy* buildings

- We can achieve major reductions in costs and environmental impacts associated with building energy use... TODAY
 - Requires political will and proper economic incentives
- Ongoing challenges and areas of research:
 - Politics and psychology
 - Balancing energy use, indoor air quality, and health
 - We spend most of our time in buildings (~90%)
 - Much of our exposure to airborne pollutants of both indoor and outdoor origin occurs inside buildings

Challenges to achieving *lower energy* buildings

Political ideology affects energy-efficiency attitudes and choices

Dena M. Gromet^{a,1}, Howard Kunreuther^a, and Richard P. Larrick^b

“...promoting the environment can negatively affect adoption of energy efficiency in the United States because of the political polarization surrounding environmental issues.”

“...more politically conservative individuals were less in favor of investment in energy- efficient technology than were those who were more politically liberal.”

“more conservative individuals were less likely to purchase a more expensive energy-efficient light bulb when it was labeled with an environmental message than when it was unlabeled.”

Gromet et al., 2013, *PNAS* 110(23):9314-9319

Connections between energy, IAQ, and health

Association of classroom ventilation with reduced illness absence: a prospective study in California elementary schools

M. J. Mendell, E. A. Eliseeva,
M. M. Davies, M. Spears,
A. Lobscheid, W. J. Fisk,
M. G. Apte

Elementary school student **absences** were shown to be **lower** in classrooms with **higher outdoor air ventilation rates** in a recent study in California

Increasing outdoor air ventilation will increase costs in most climates

However, in California, increasing classroom ventilation rates to the State standard is estimated to decrease student absences for illness by 3.4% (increasing state funding to schools by \$33 million annually) at a cost of only \$4 million

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