

# Economic Incentives to Reduce Greenhouse Gas Emissions

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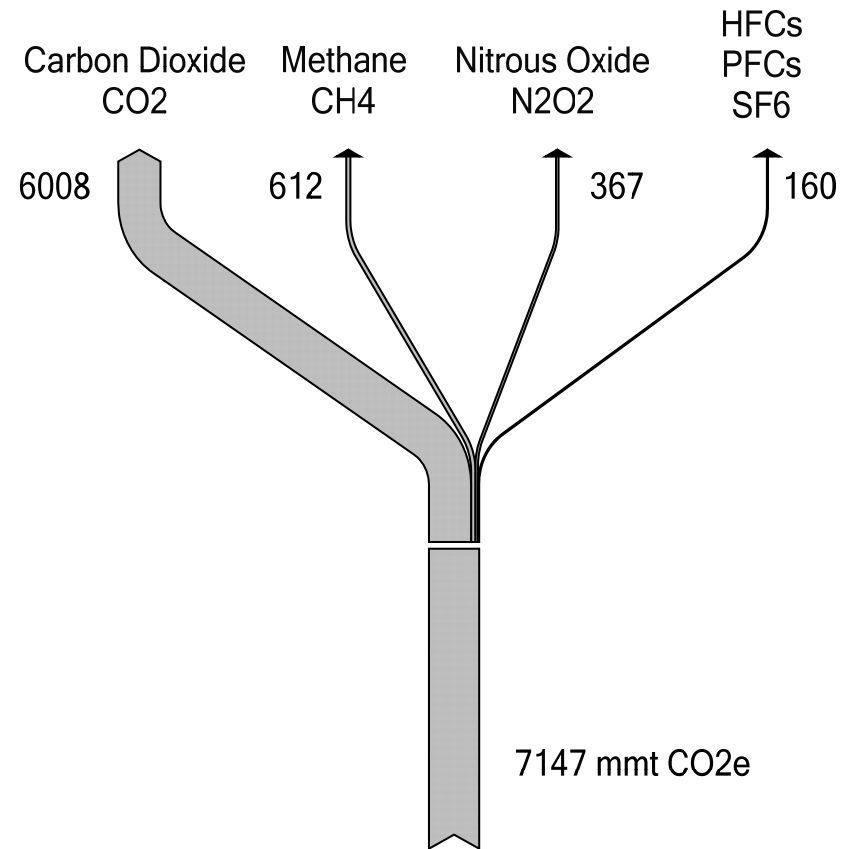
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# US GHG emissions in 2005

Gas	Mmt	Mmt CO2e
Carbon Dioxide	6008	6008
Methane	27	612
Nitrous Oxide	1.2	367
Halocarbons	--	160

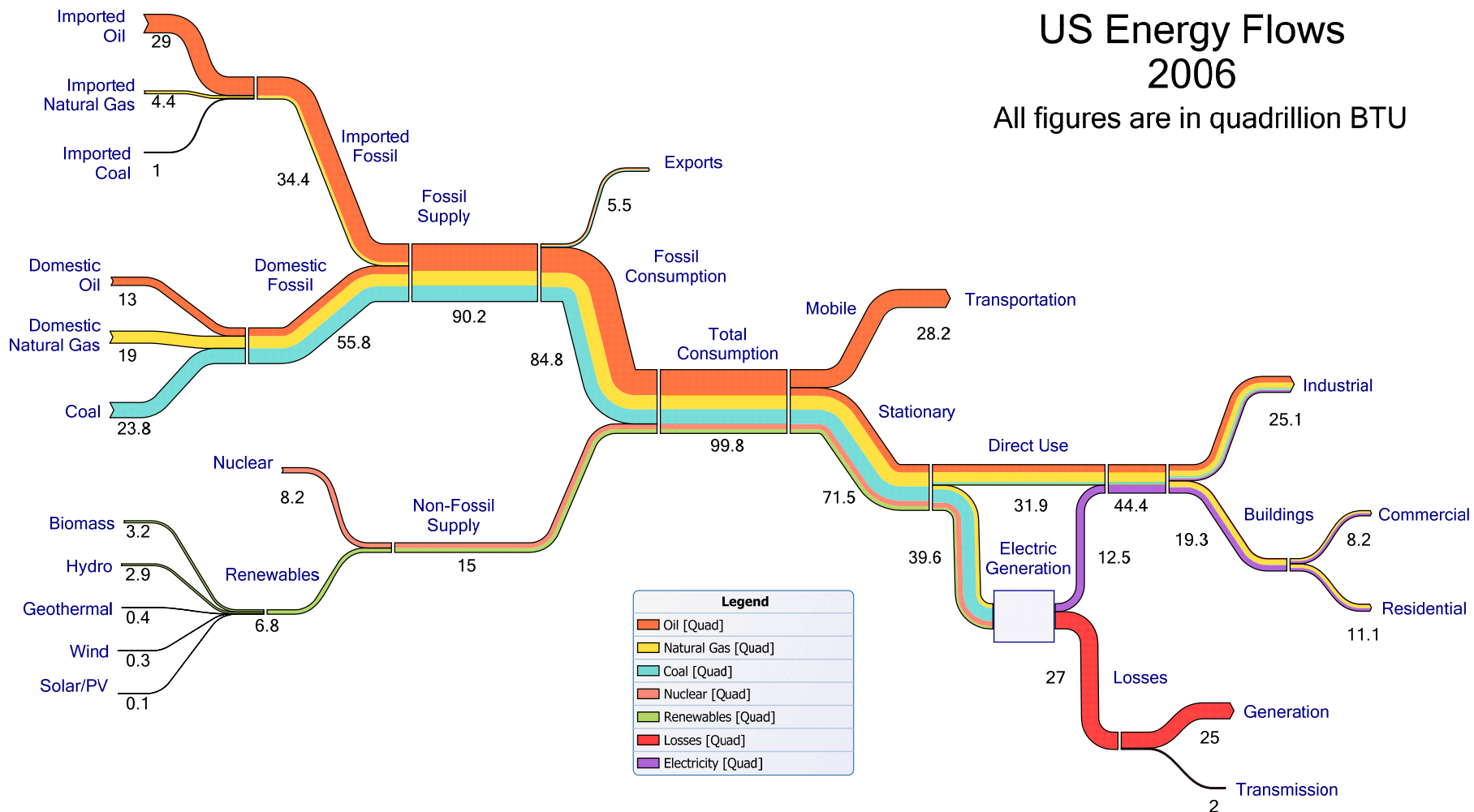


# Most CO2 originates with fossil fuel use

- Reducing CO2 will mean reducing fossil fuel consumption
  - *Sequestration also possible*
- National energy use
  - *Measured in quadrillions of BTUs or "quads"*
  - *1 quad =  $10^{15}$  BTU = 1,000,000,000,000,000 BTU*
- How big is that?
  - *Energy in 45 million tons of coal*
  - *1 trillion cubic feet of natural gas*
  - *170 million barrels of crude oil*

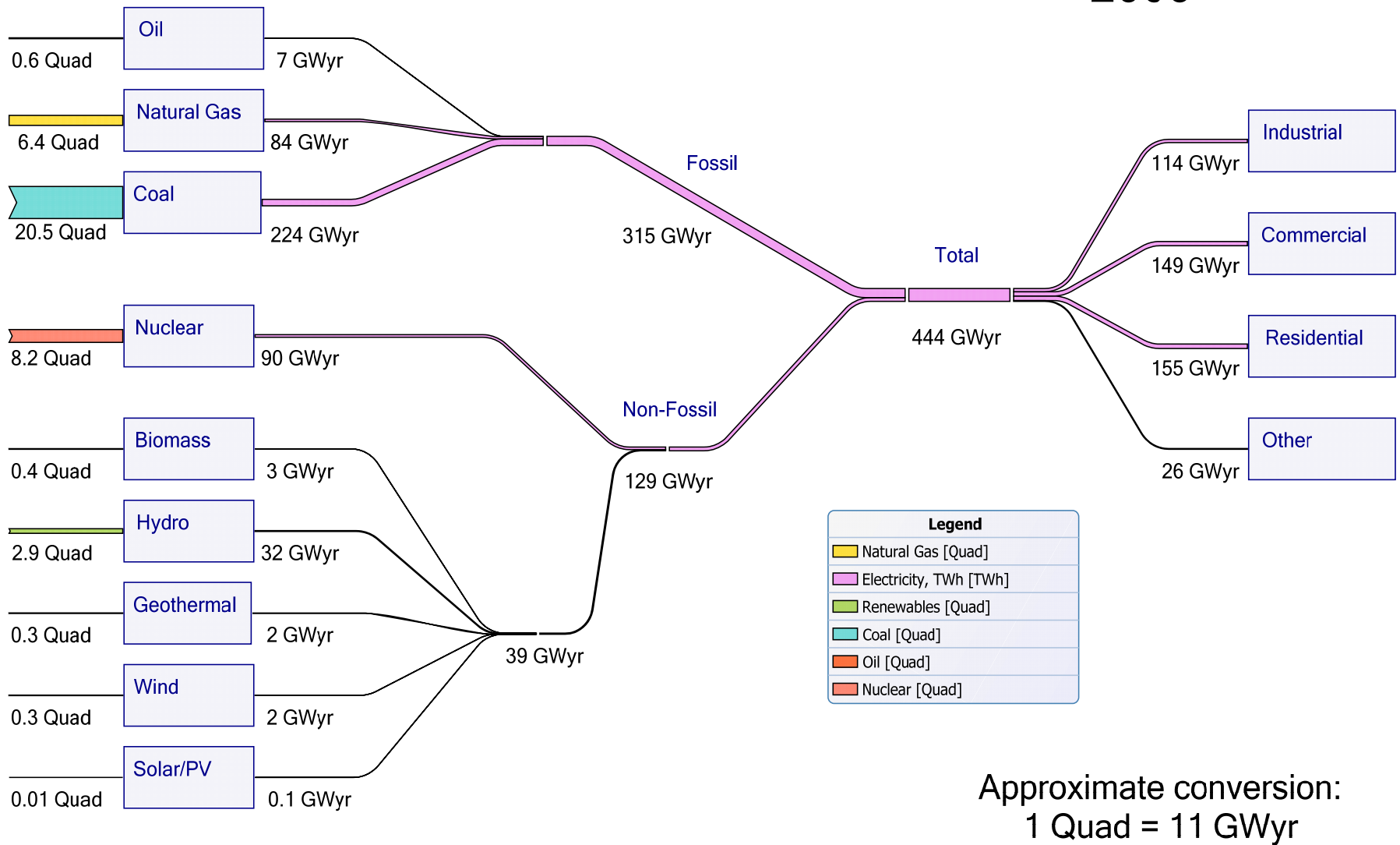
# US Energy Flows 2006

All figures are in quadrillion BTU



Data source: Annual Energy Review 2006, US Energy Information Administration

# US Electricity Flows 2006

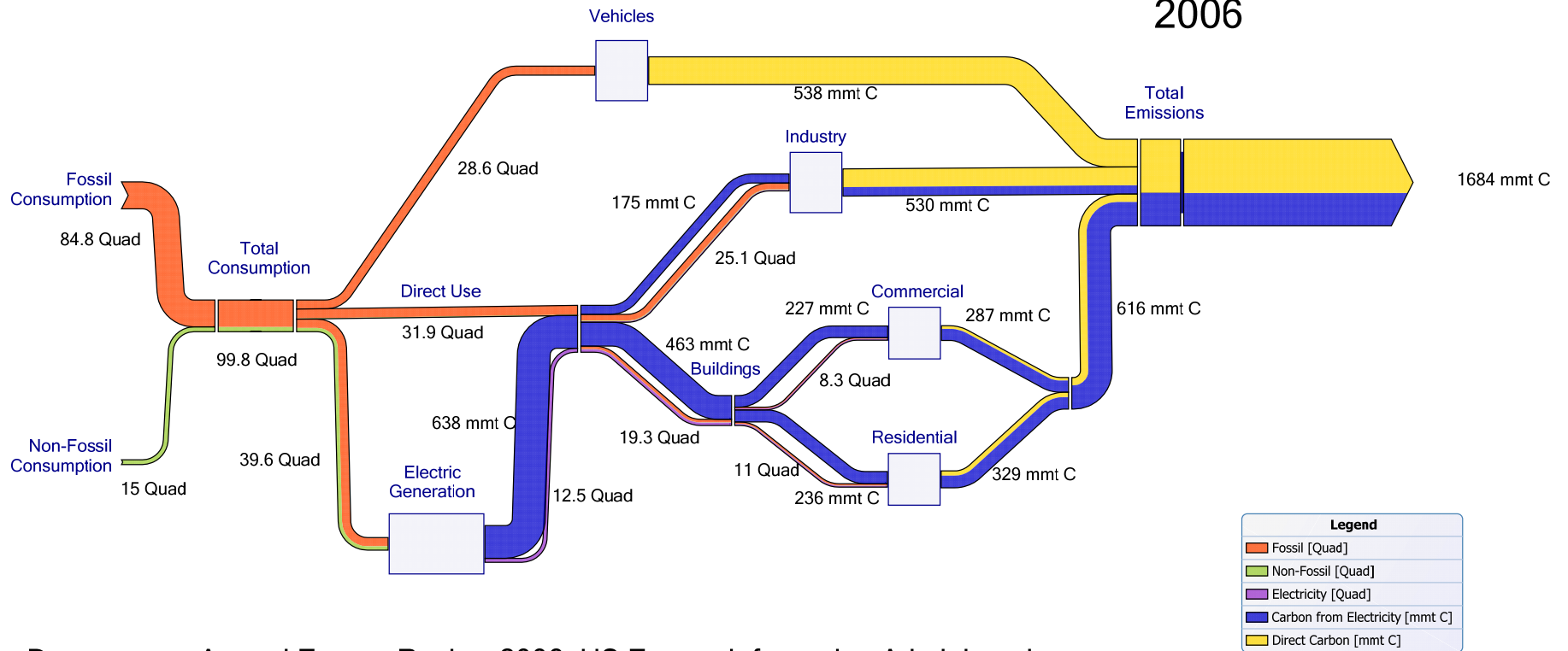


Data source: Annual Energy Review 2006, Energy Information Administration

# Translating energy into CO2

- Natural gas
  - *14.5 mmt C per quad*
  - *Lowest carbon per quad of fossil fuels*
- Oil
  - *About 20 mmt C per quad*
  - *38% more carbon than gas*
- Coal
  - *26 mmt C per quad*
  - *80% more carbon than gas*

# US Energy and Carbon Flows 2006



Data source: Annual Energy Review 2006, US Energy Information Administration

# A very large problem ...

- US fossil energy
  - *86 quads*
- US emissions
  - *6 billion tons of CO<sub>2</sub>*
  - *Carbon itself: 1.7 billion metric tons*
- In the long term, need to bring both down to nearly 0



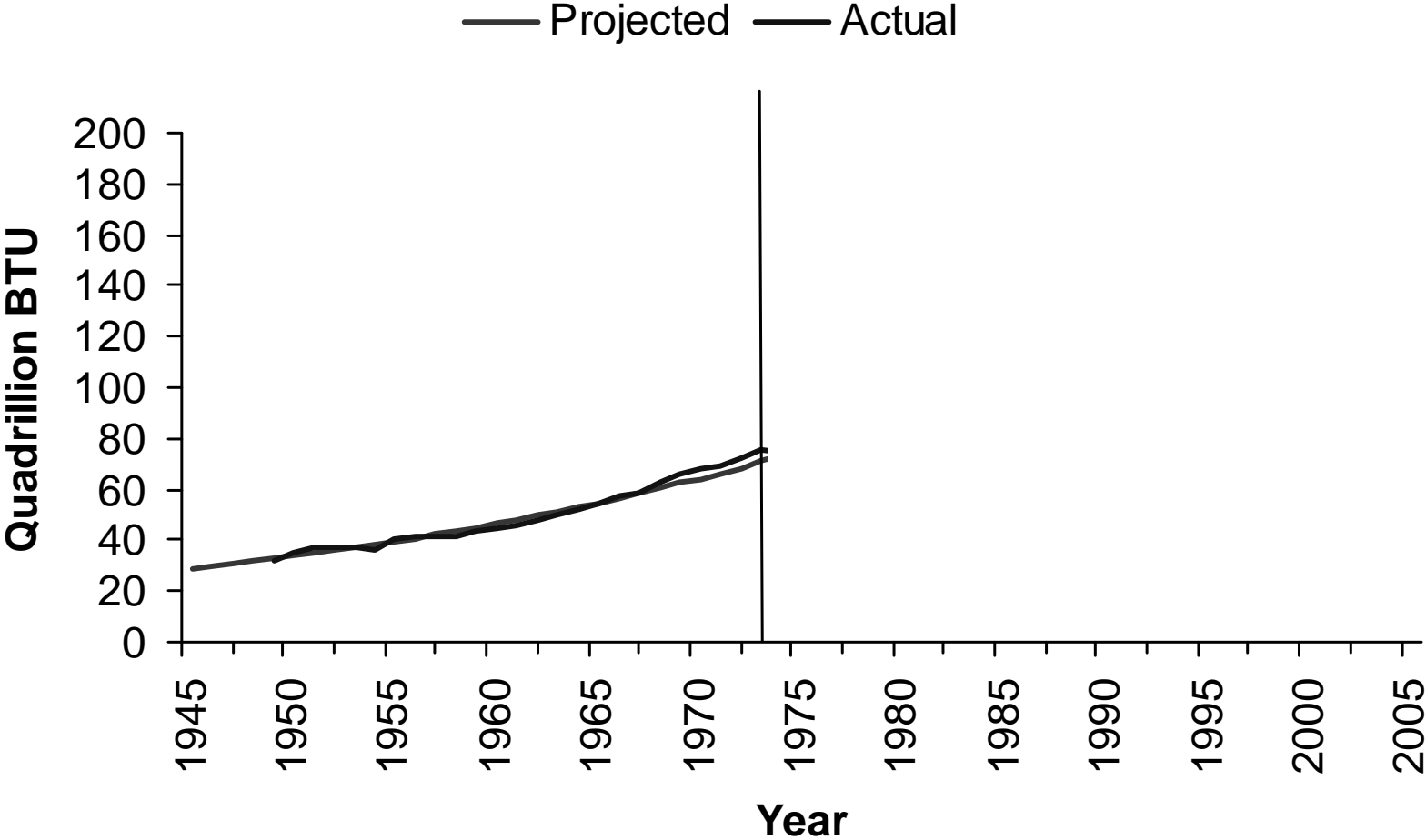
# What needs to be done?

- Shift toward non-fossil sources
  - *Nuclear, renewables*
- Improve efficiency of energy consumption
  - *Less energy for any given thermostat setting*
  - *Less energy for any given mile driven*
- Reduce demand for energy-intensive activities
  - *Less driving, less air conditioning, etc.*
- Capture and sequester carbon
  - *Principally at power plants*

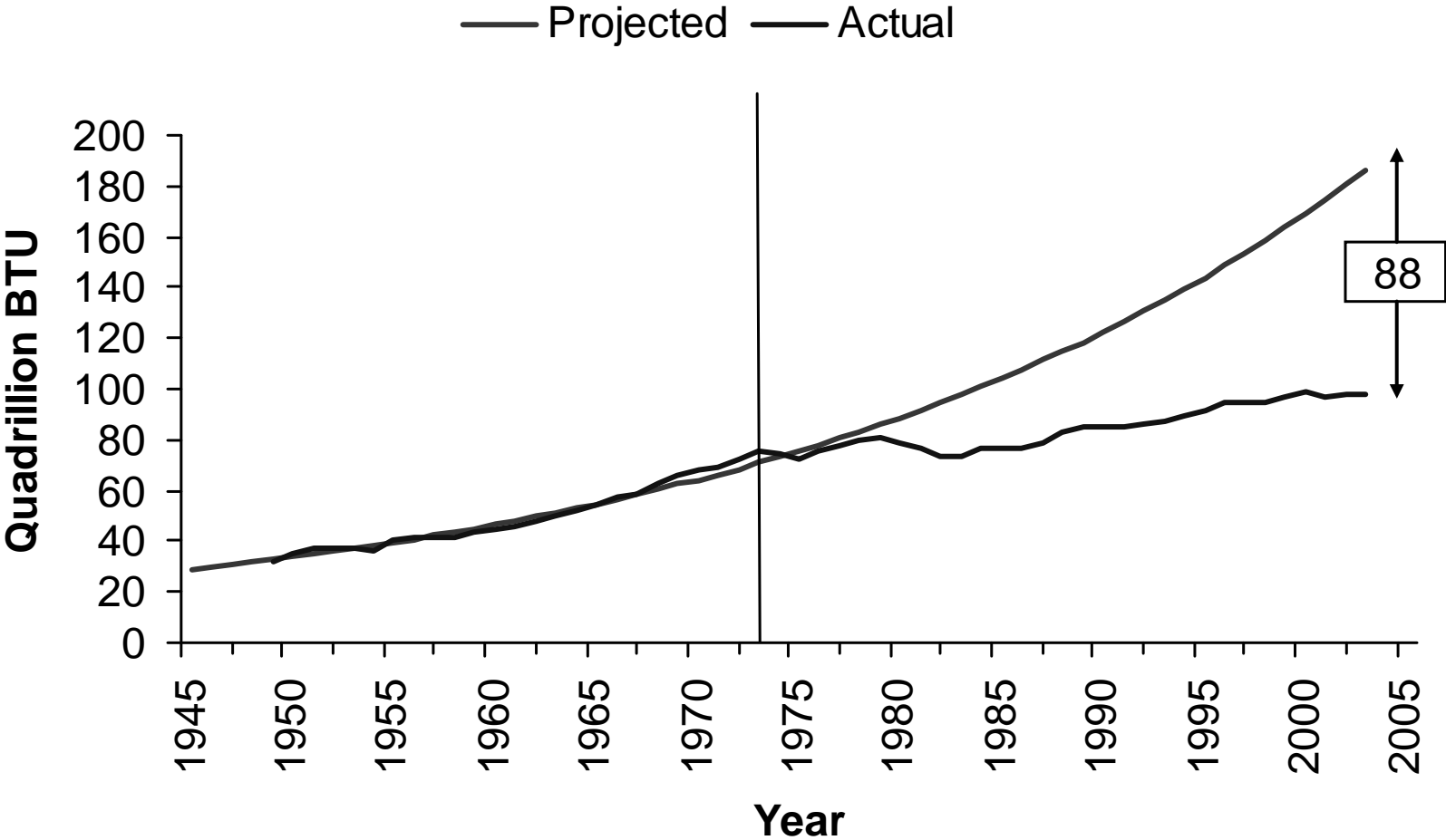
# Can anything be done?

- Does fuel use rise inexorably no matter what?
- What do we know from history about fuel use?

# US Energy Consumption, 1949-2003



# US Energy Consumption, 1949-2003



# Energy prices matter!

- Price spikes stabilized US energy consumption for about 20 years
- GDP growth was a little slower: about 0.2% per year

# Fundamental economic policy

- Impose a large carbon tax on fossil fuels
  - *Proportional to carbon content*
- Would reduce emissions substantially:
  - *Powerful incentive to reduce fuel use*
  - *Incentive to adopt alternative technologies*
  - *Incentive for R&D on alternative technologies*
  - *Consistent with historical evidence on energy prices*

# What political problems arise?

- Large energy taxes may not be politically viable
  - *Not possible to discuss seriously?*
  - *Pressure to repeal every year*
- Main policy question becomes
  - *Can we get similar incentives with a different policy?*

# Alternatives to a tax

- Tradable emissions permits
  - *Issue a limited number of permits to burn fossil fuels*
  - *Allow owners to buy and sell*
  - *Would raise fuel prices*
  - *Costs may be very high*
- Hybrid policy
  - *Some tradable permits*
  - *Tax provision for exceeding permits*
  - *Raises fuel prices with fewer political problems*



# Other policies

- Regulations
  - *Appliance standards*
  - *Building codes*
  - *CAFE standards*
- Technology-oriented policies
  - *Subsidies for hybrid cars*
  - *Subsidies for alternative fuels*
  - *Subsidies for R&D*
  - *Carbon sequestration*

## Will need fossil fuel prices to rise

- Fossil fuels are currently very cheap
- Technology policies alone won't be enough
  - *Unlikely to produce a "silver bullet" technology that would be cheaper than fossil fuels and also carbon-free*