

Economic Incentives to Reduce Greenhouse Gas Emissions

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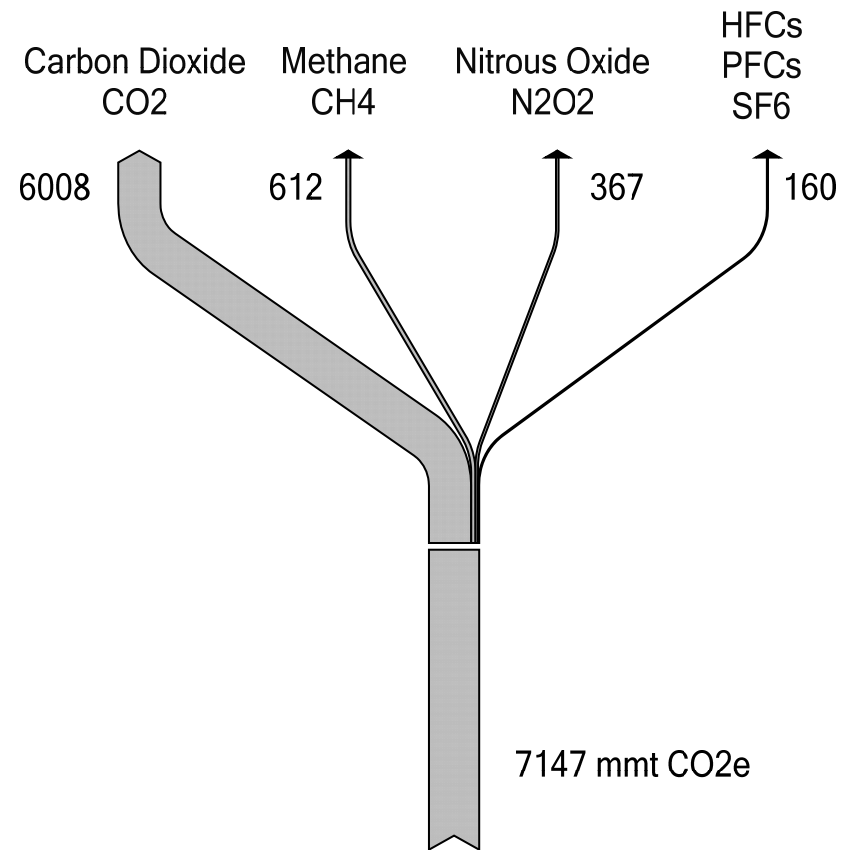
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US GHG emissions in 2005

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

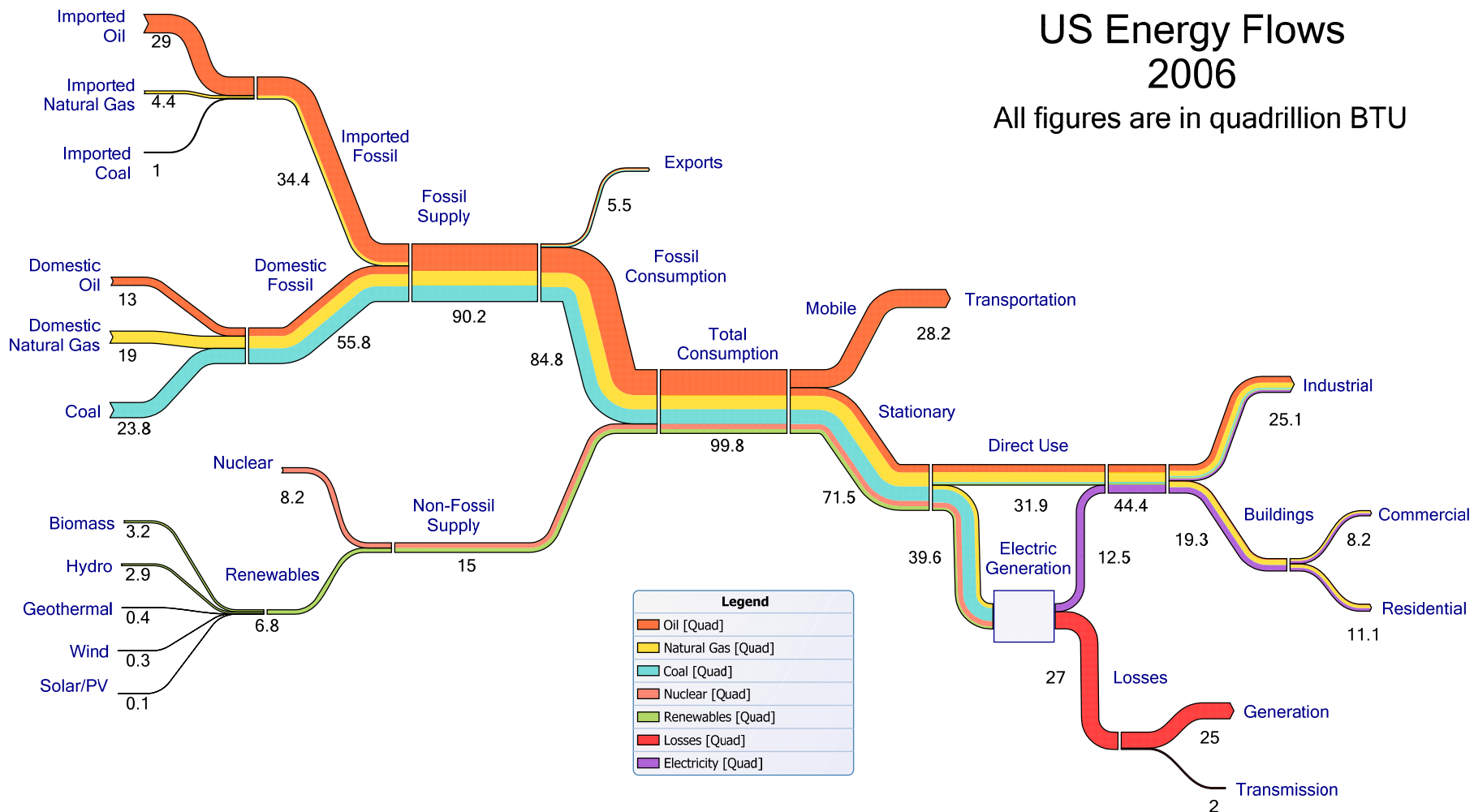


Most CO2 originates with fossil fuel use

- 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*

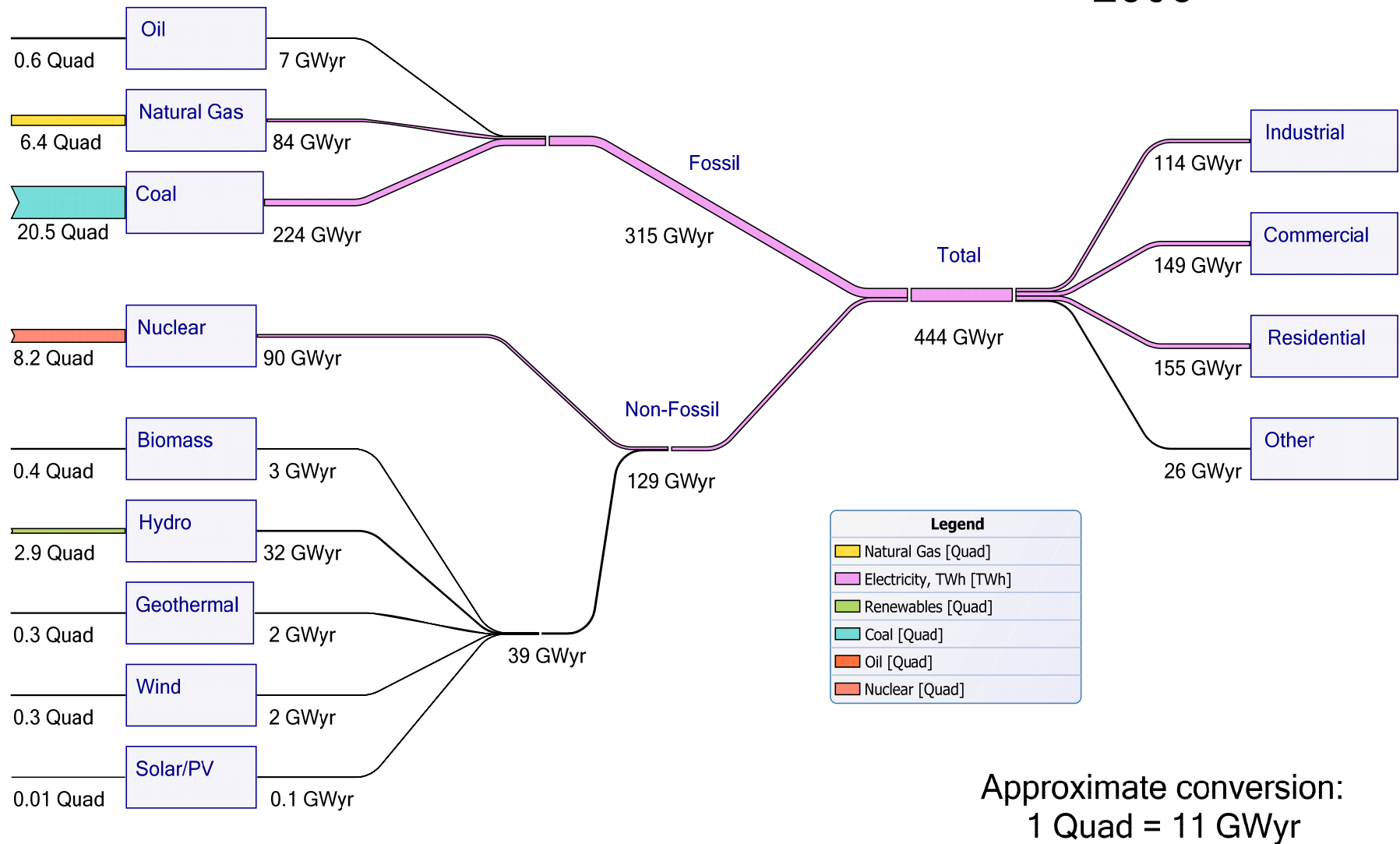
US Energy Flows 2006

All figures are in quadrillion BTU



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

US Electricity Flows 2006

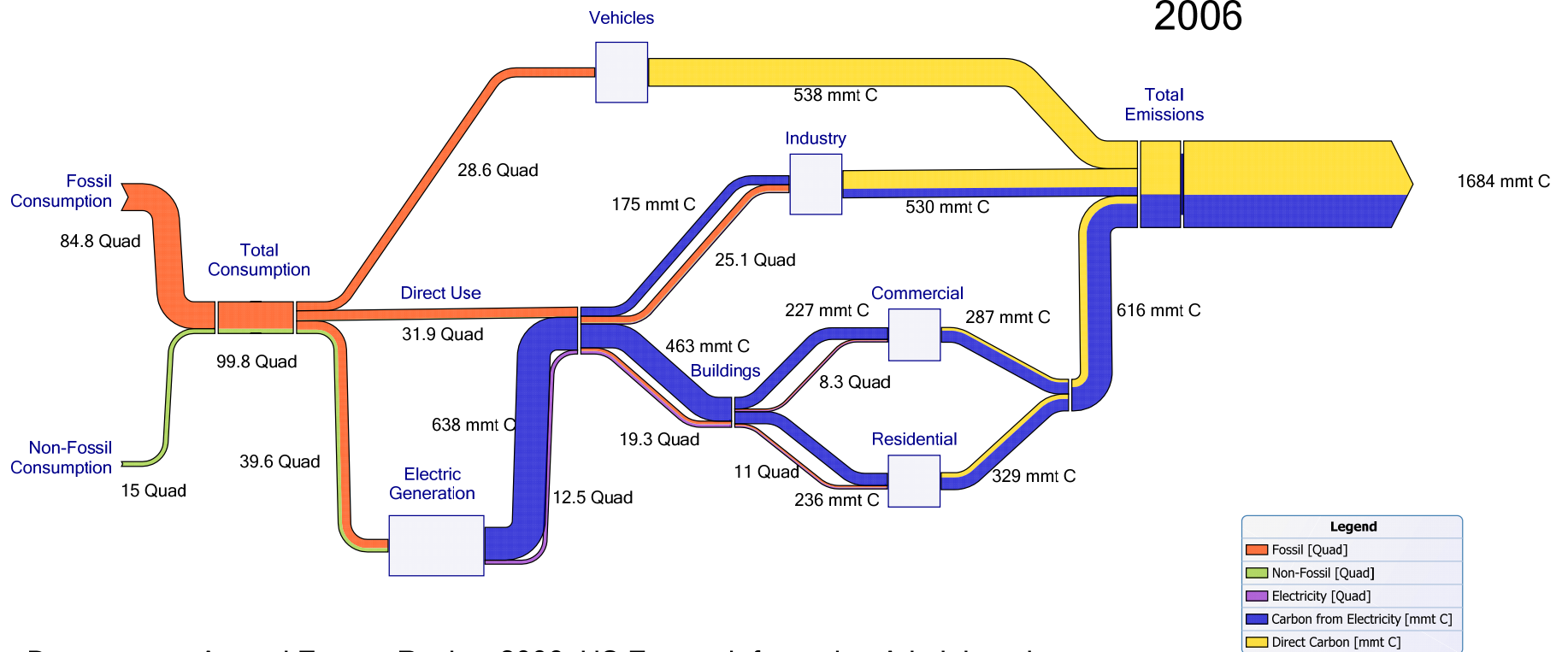


Data source: Annual Energy Review 2006, Energy Information Administration

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 CO₂*
 - *Carbon itself: 1.7 billion metric tons*
- In the long term, need to bring both down to nearly 0

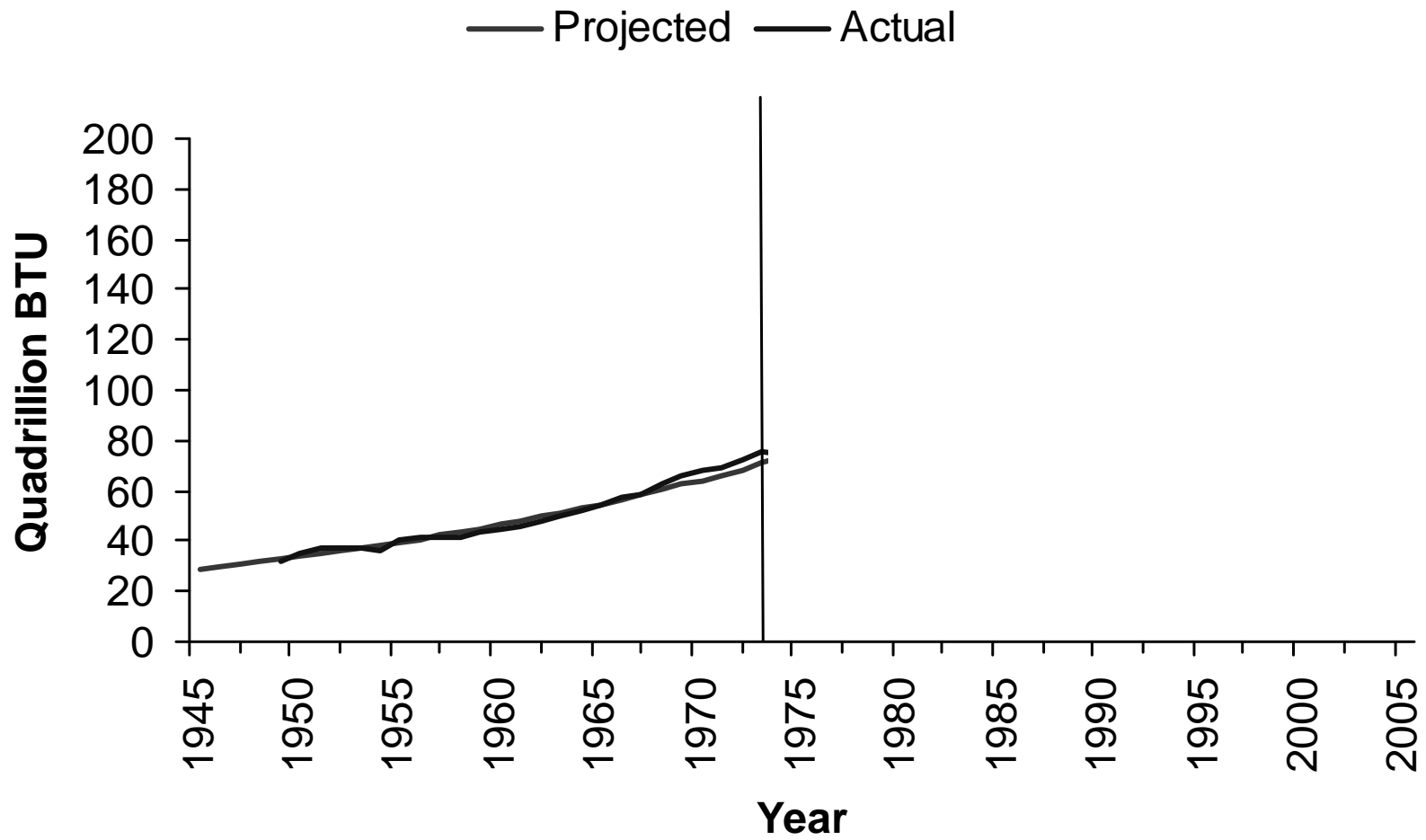
What needs to be done?

- 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*

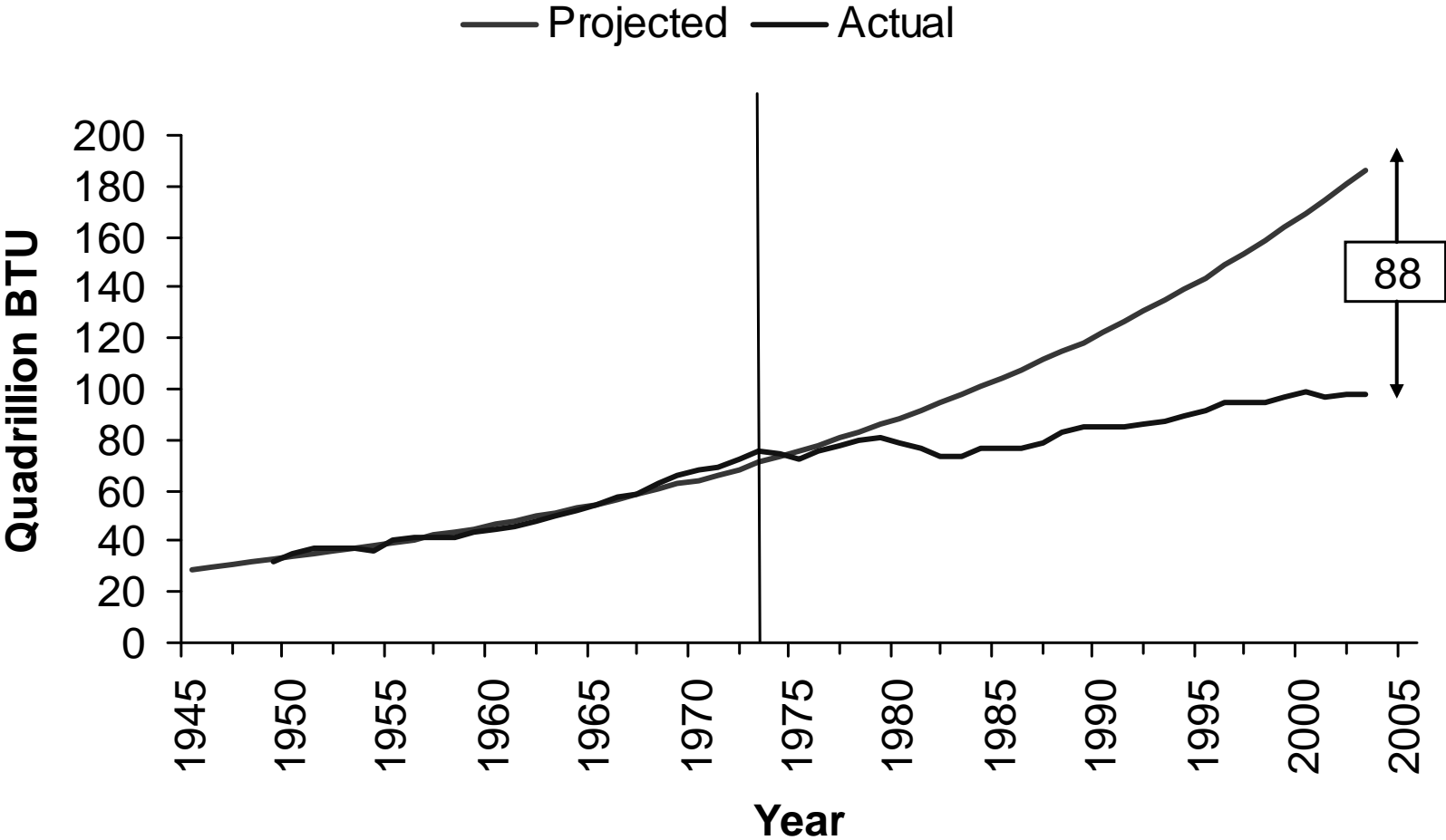
Can anything be done?

- 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*