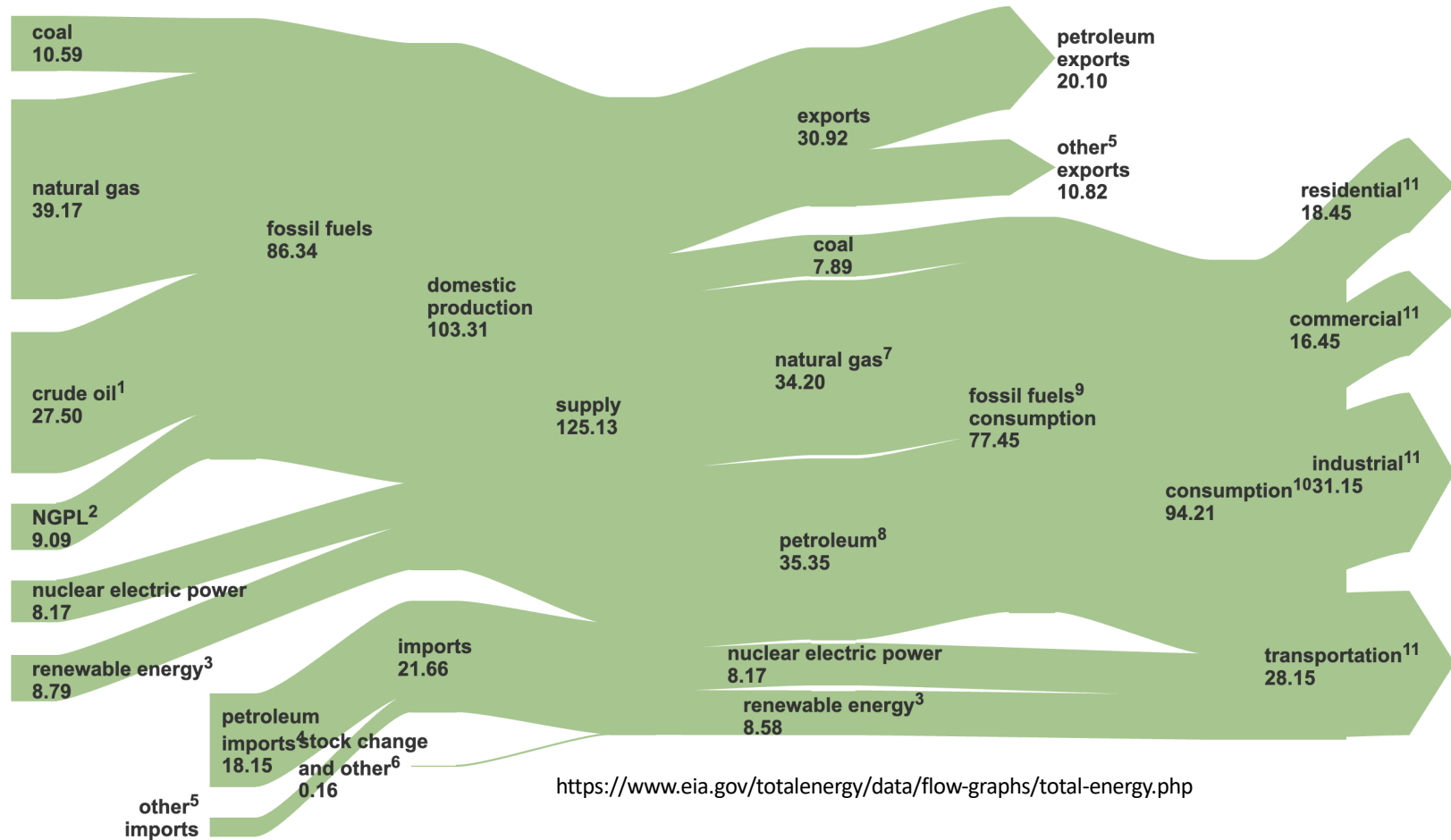


# U.S. Energy Use

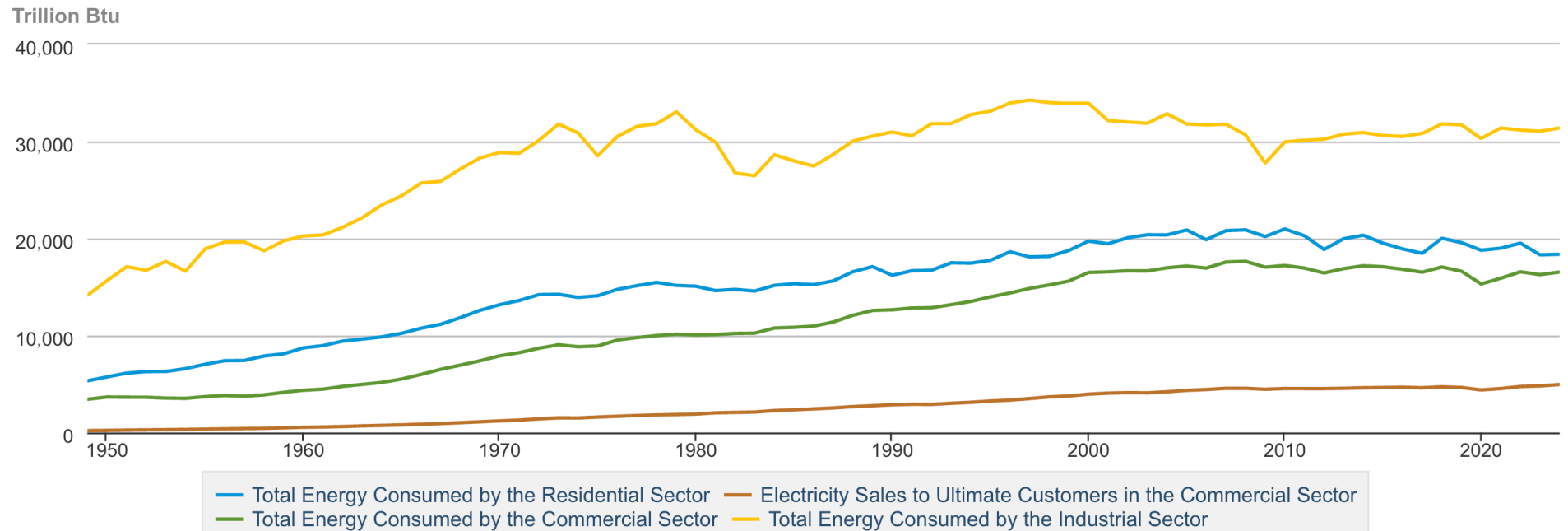


Quadrillion BTU

# U.S. Energy Use

**Table 2.1a Energy Consumption: Residential, Commercial, and Industrial Sectors**

 [DOWNLOAD](#)



Data source: U.S. Energy Information Administration

# US Energy Sectors

Note the factors: 1/3 (roughly)

## ***Sources***

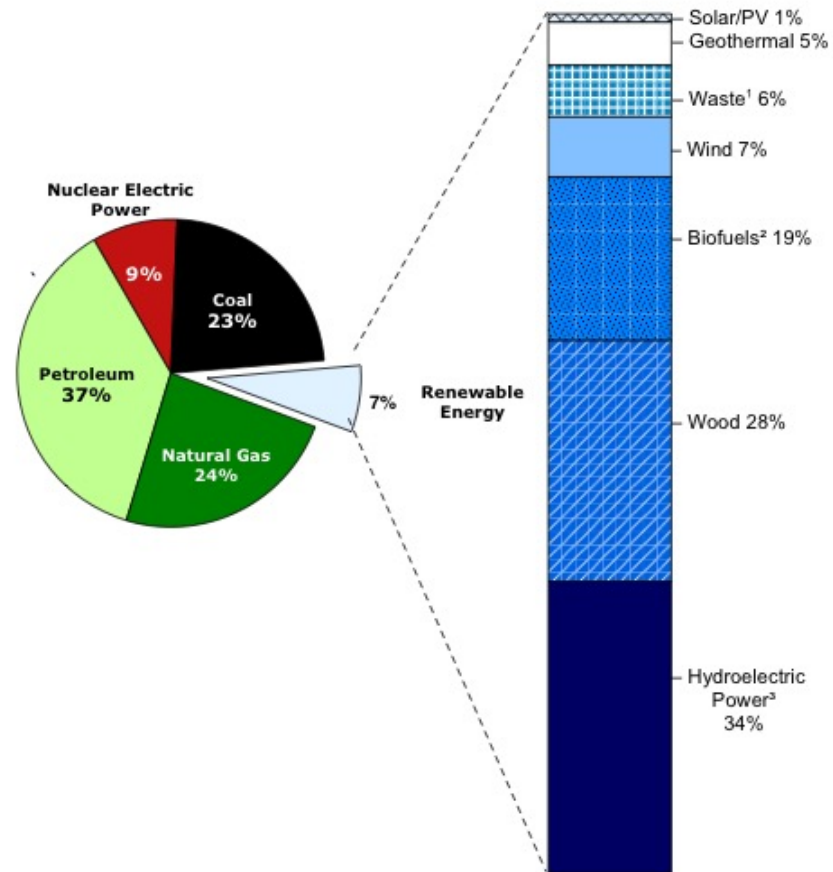
- Petroleum: 1/3
- Natural Gas: 1/3
- Other: 1/3
  - Renewable
  - Coal
  - Nuclear

## ***End Uses***

- Transportation: 1/3
- Industrial: 1/3
- Other: 1/3
  - Residential
  - Commercial

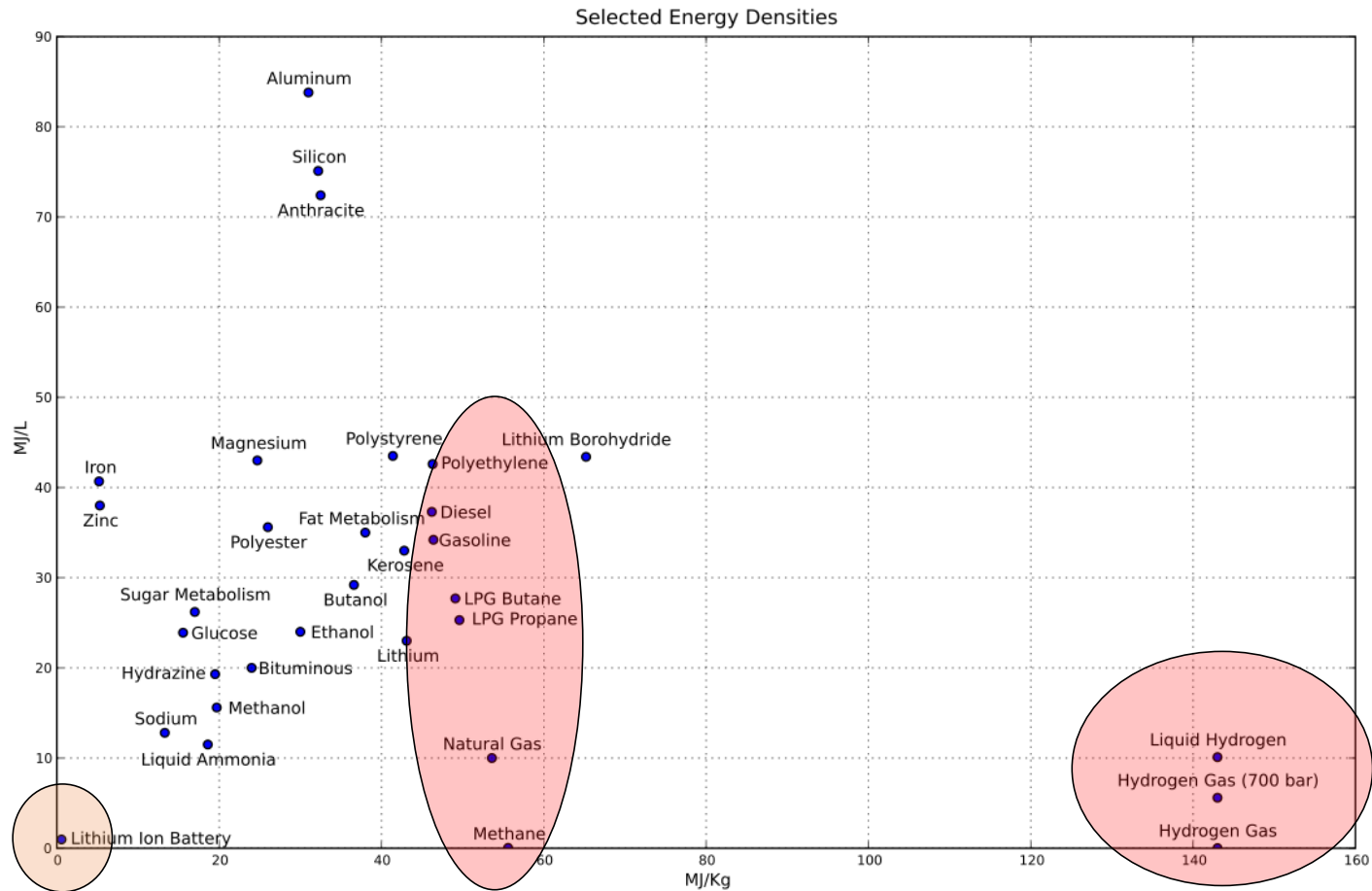
# Non-combustion energy sources

- Non-combustion
  - Nuclear: 9%
  - Hydro: 2.4%
  - Wind: 0.5%
  - Solar: 0.1%
- Non-combustion sources will continue to increase, even substantially.
- Combustion will remain dominant in the foreseeable future.



<http://www.eia.doe.gov/emeu/aer/>

# Energy Density



[http://upload.wikimedia.org/wikipedia/commons/c/c6/Energy\\_density.svg](http://upload.wikimedia.org/wikipedia/commons/c/c6/Energy_density.svg)

# Combustion Issues



## The High Cost of Cheap Coal

Coal is plentiful—and polluting. Can an energy-hungry world afford to wait for this fuel to clean up?



# Combustion Issues



<https://olsonfarlow.com/portfolios/mountaintop-removal>

# Emissions

- Emissions:
  - Pollutants
    - NO<sub>x</sub>
    - SO<sub>x</sub>
    - PM
    - Metals
  - Greenhouse Gases

Figure 3-2. Trend in CARBON MONOXIDE Emissions, 1940 to 1998

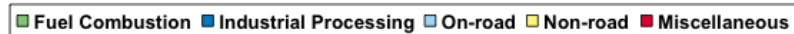
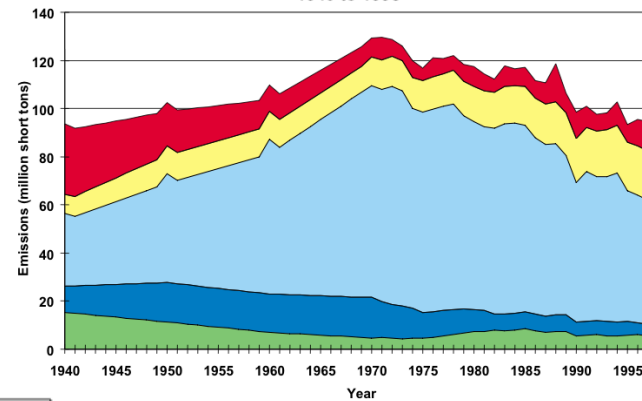


Figure 3-3. Trend in NITROGEN OXIDE Emissions, 1940 to 1998

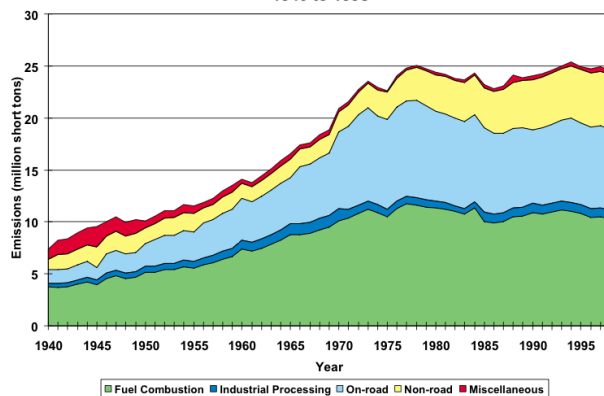
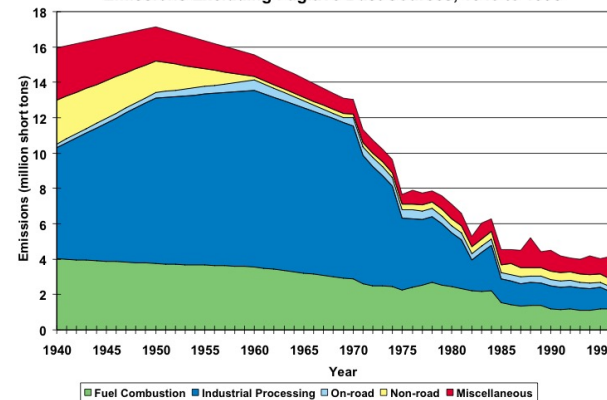


Figure 3-6. Trend in PARTICULATE MATTER (PM<sub>10</sub>) Emissions Excluding Fugitive Dust Sources, 1940 to 1998





# SO2 Emissions

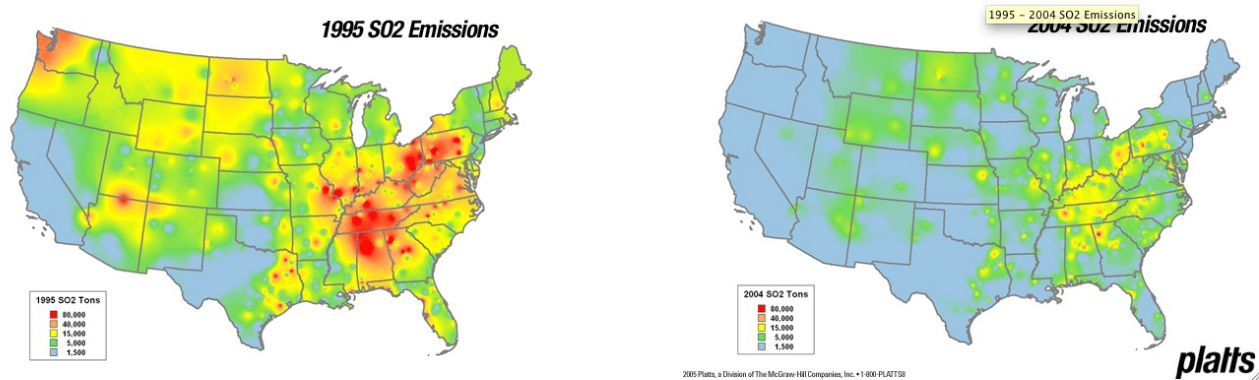
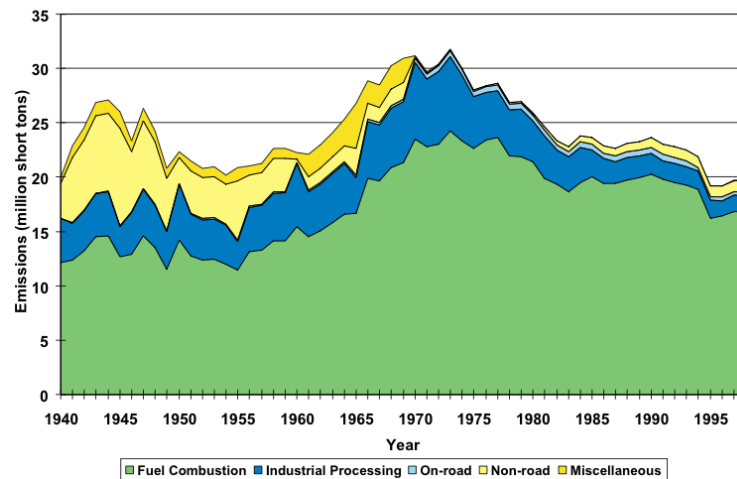


Figure 3-5. Trend in SULFUR DIOXIDE Emissions, 1940 to 1998



# SO2 Emissions

## U.S. coal-fired power plants invested more than \$30bn on scrubbers in four years

Mar 25, 2013

<http://www.power-eng.com/articles/2013/03/us-coal-fired-power-plants-invested-more-than-30bn-on-scrubbers-.html>



Owners of coal-fired power plants invested more than \$30 billion in **flue gas desulfurization systems**, also known as scrubbers, between 2007 and 2011, according to a report from the U.S. Energy Information Administration.



According to the report, scrubbers were installed at around 110 coal-fired power plants in 34 states during that time, raising the amount of scrubbed generating capacity in the U.S. from 115 GW to just more than 191 GW. That number represents a little less than 60 percent of coal-fired, steam electric generation capacity in the U.S.

According to the EIA, utilities made the investments in scrubbers in response to several regulatory initiatives, including the U.S. Environmental Protection Agency's Clean Air Interstate Rule.

The increase in installed scrubbers has helped create a reduction of SO<sub>2</sub> emissions, which were 68 percent lower in 2011 than the 1990 level and 46 percent lower than the 2007 level. Other factors in that reduction include coal-fired plants burning less coal and switching to a lower sulfur coal.

Plant operators in Ohio, Pennsylvania, West Virginia, Maryland and Georgia made 43 percent of the total national investment in scrubbers, spending a total of \$13 billion between 2007 and 2011, according to the EIA. Ohio plants spent more than any other state, making a \$3.6 billion investment in scrubbers over that time period.



<http://www.panoramio.com/photo/7780554>