

01-Energy Flows

Text: Chapter 1-Chapter 2

ECEGR 3500

Electrical Energy Systems

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» Overview

- Energy Flows
- Electrical Energy Flows
- Changes in Energy Flow

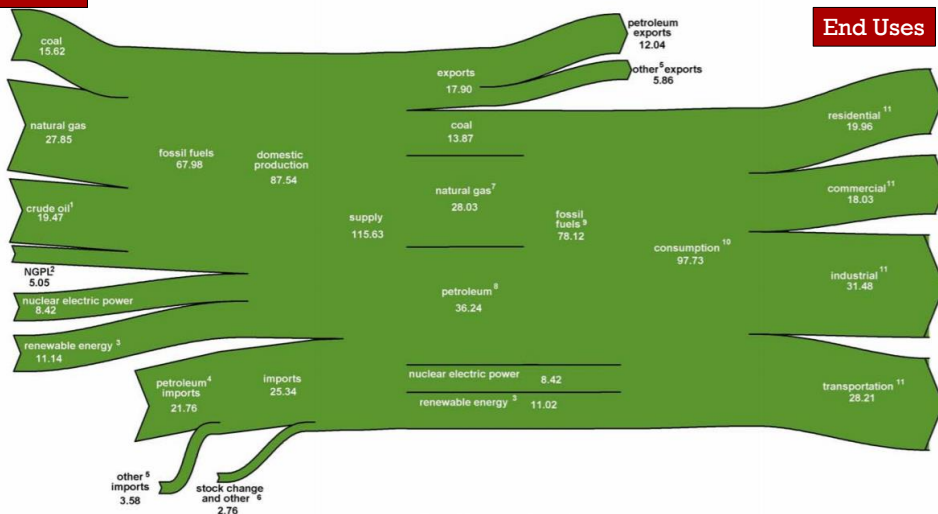
U.S. energy flow, 2017

quadrillion Btu

1 kWh = 3412 BTU

Sources

End Uses



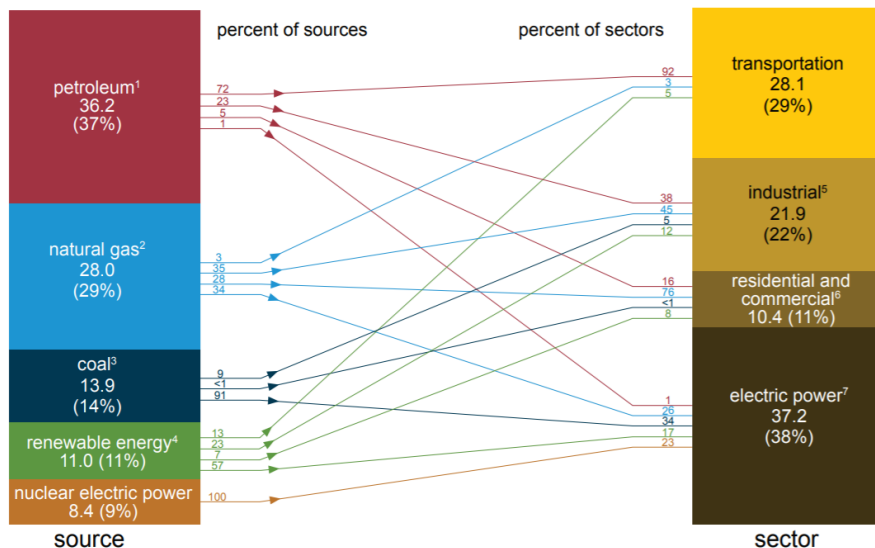
Source: www.eia.gov

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U.S. primary energy consumption by source and sector, 2017

Total=97.7 quadrillion British thermal units (Btu)



More energy is devoted to electricity generation than any other sector.

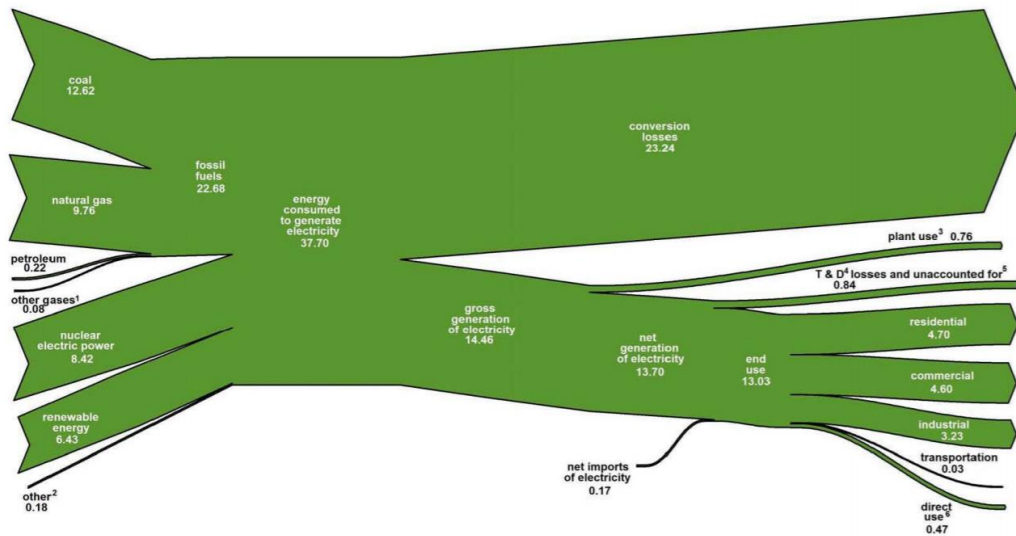
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U.S. electricity flow, 2017

quadrillion Btu



Source: www.eia.gov

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Exercise

In 2017, 37.2 Quads were used to generate electricity. Of this, 23.24 Quads were lost in the energy conversion process. What is the average efficiency of the energy conversion process?

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» Exercise

In 2017, 37.2 Quads were used to generate electricity. Of this, 23.24 Quads were lost in the energy conversion process. What is the average efficiency of the energy conversion process?

Answer: $100 \times (1 - 23.24/37.20) = 37.5$ percent

Conversion of thermal energy to electrical energy has a low efficiency (although not all electricity is generated from thermal energy, for example, in a wind turbine).

» Exercise

In 2017, 0.84 Quads were consumed by losses associated with transmission and distribution of electricity. How efficient is the transmission and distribution of electricity? (Gross electricity generation was 14.46 Quads).

Exercise

In 2017, 0.84 Quads were consumed by losses associated with transmission and distribution of electricity. How efficient is the transmission and distribution of electricity? (Gross electricity generation was 14.46 Quads).

Answer: $100 \times (1 - 0.84/14.46) = 94.2$ percent

The electrical system is highly efficient.

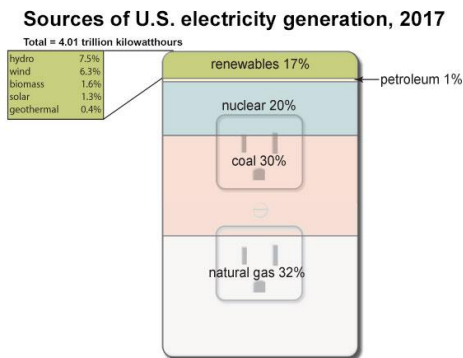
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Energy Flows (U.S.)

2017: 4,010 TWh (terawatthours) of electrical energy consumed



Note: Electricity generation from utility-scale facilities.

Source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2018, preliminary data

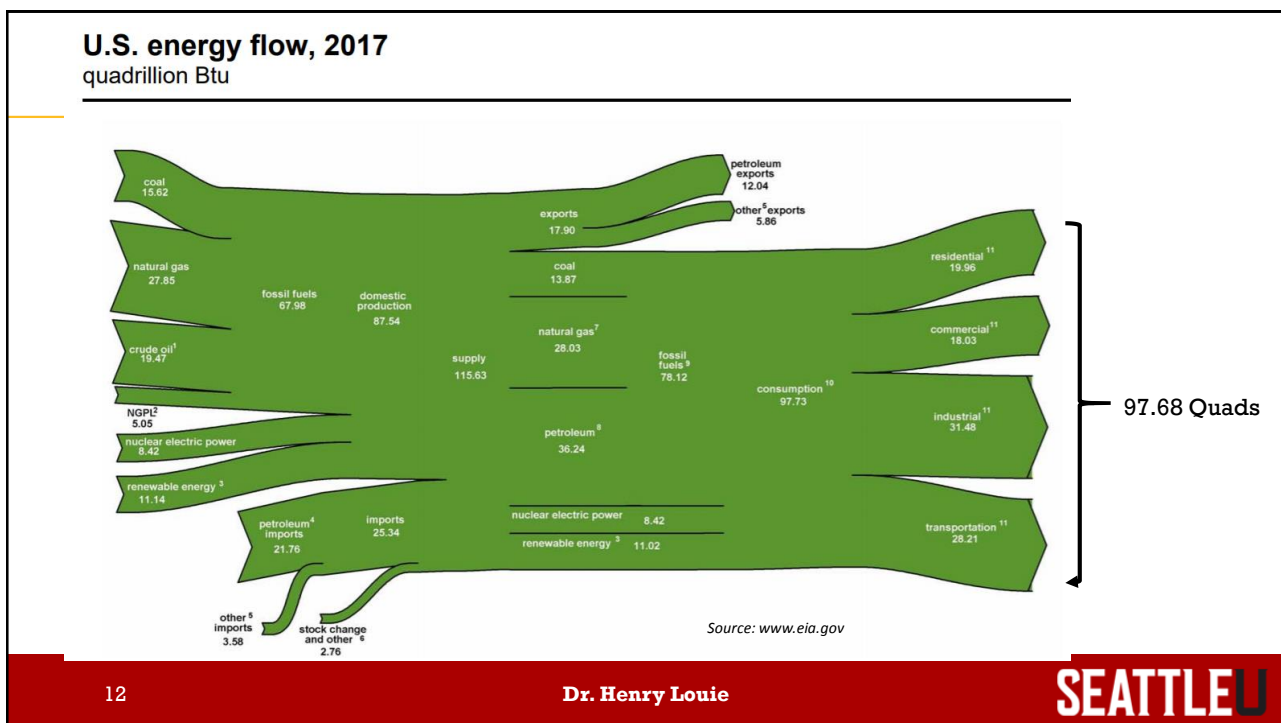
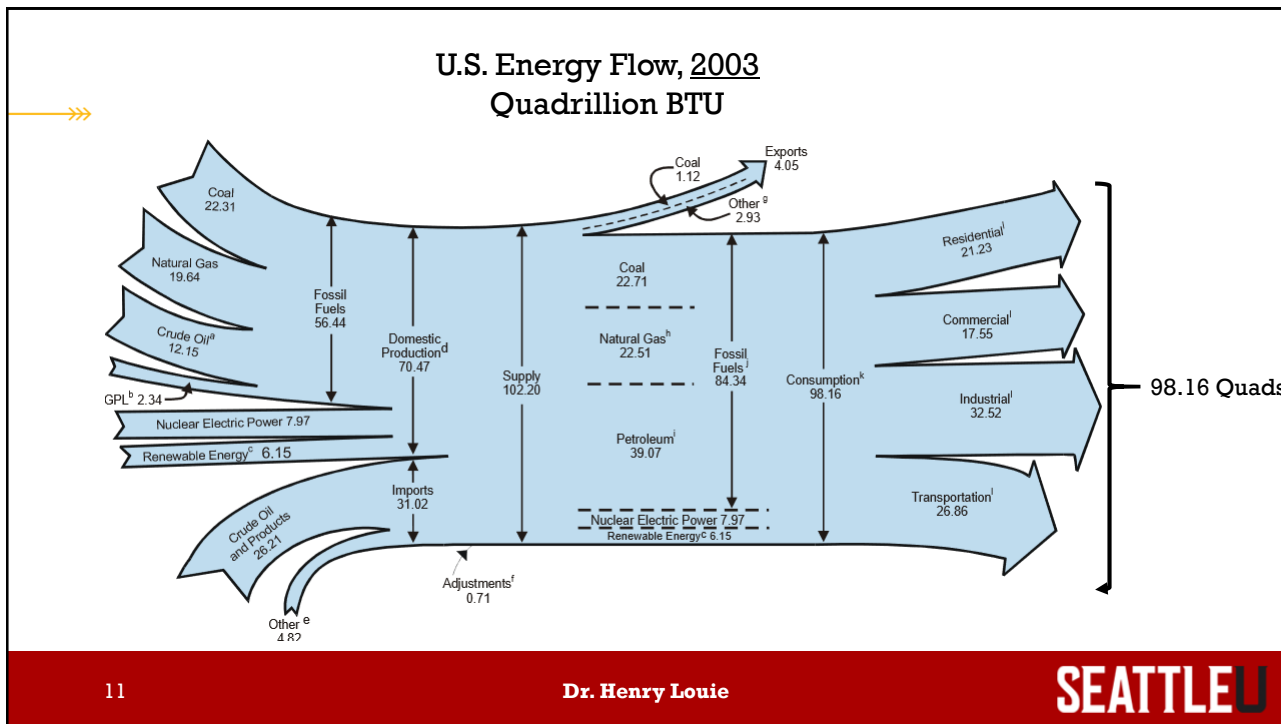


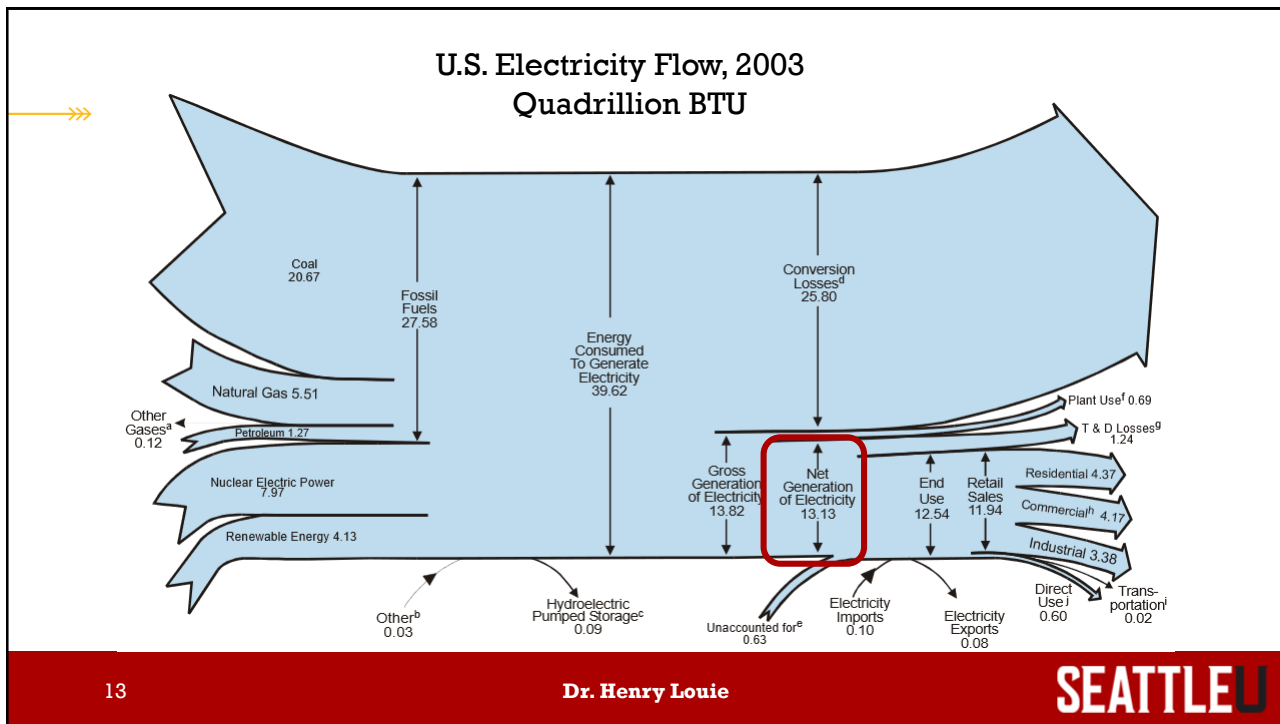
Snapshot statistic
What are the trends?

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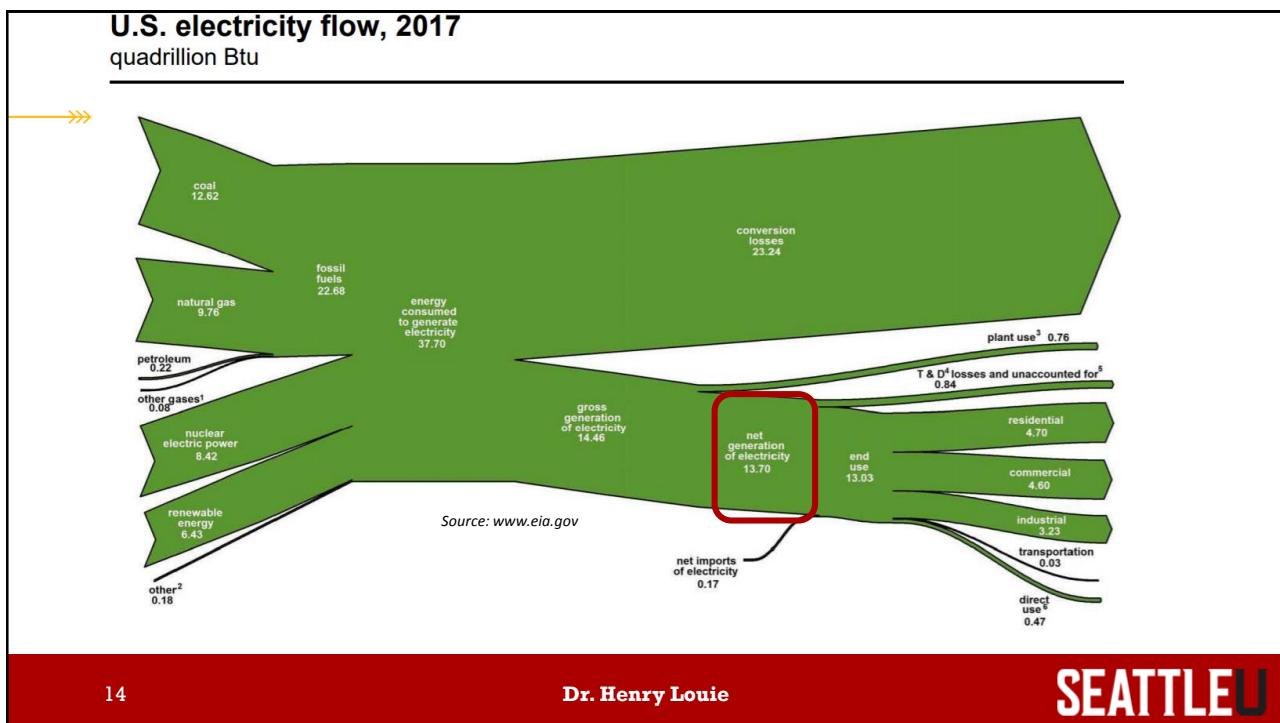




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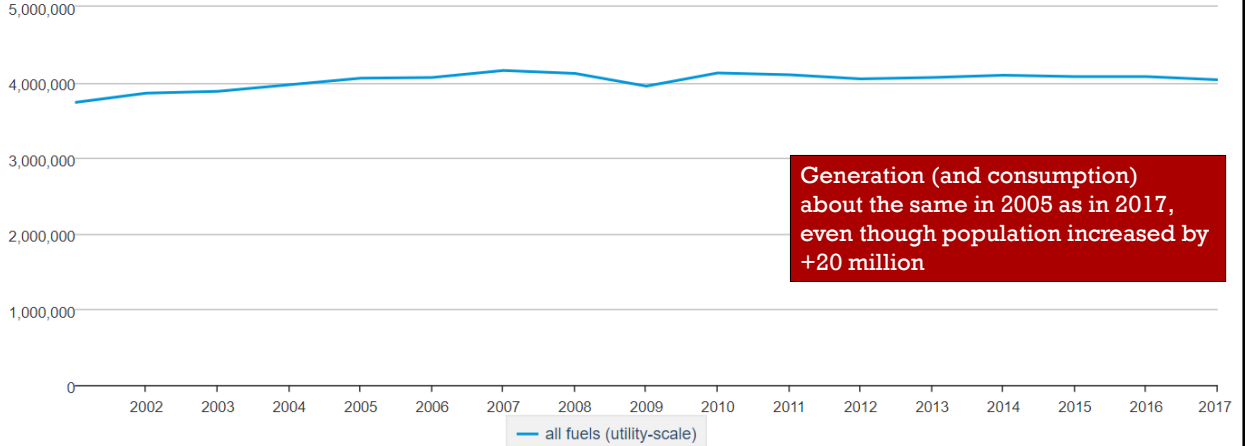
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Recent U.S. Electricity Trends

Net generation, United States, all sectors, annual

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thousand megawatthours

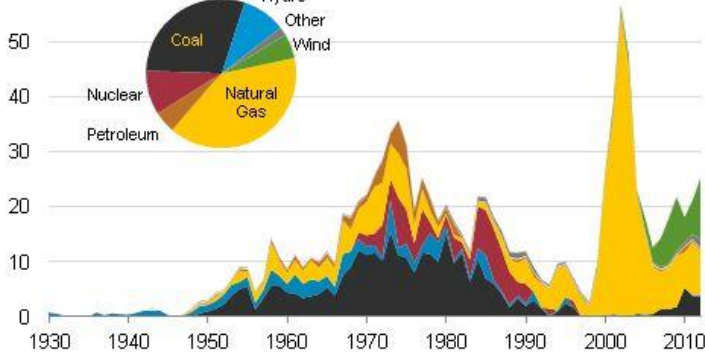


Generation (and consumption) about the same in 2005 as in 2017, even though population increased by +20 million

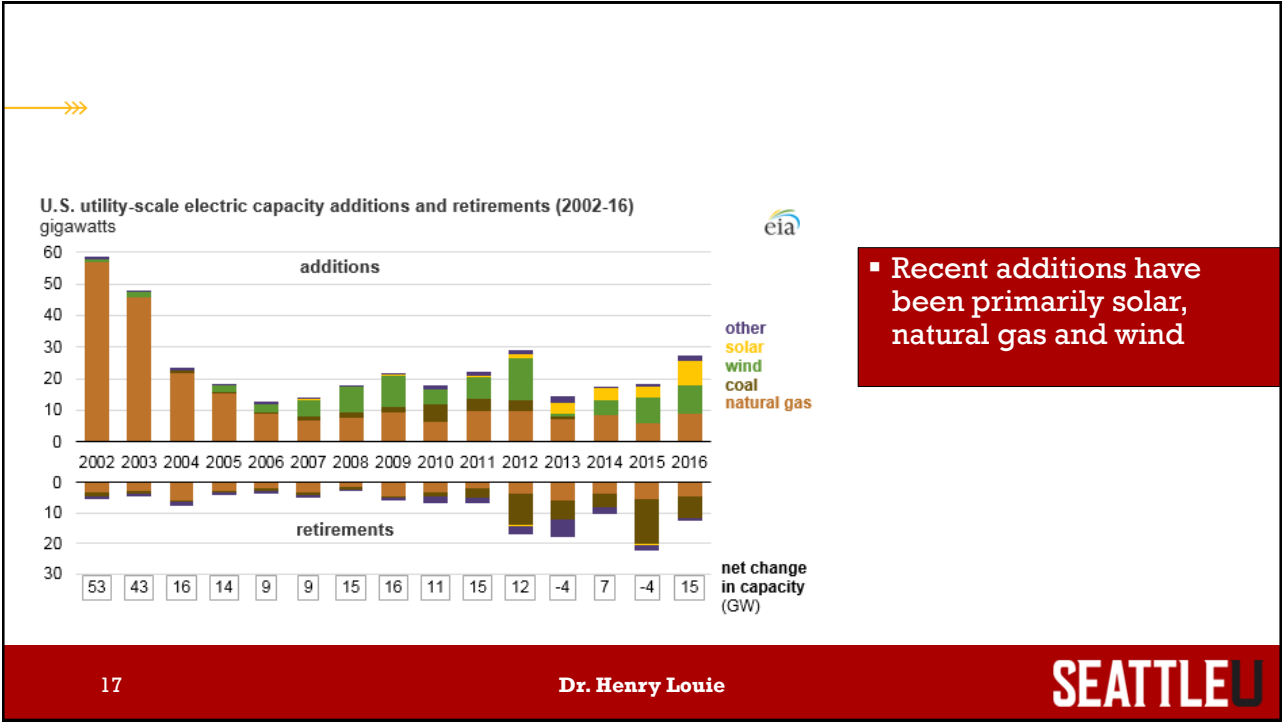
Power Plant Capacity Additions by Year

Current (2012) capacity by initial year of operation and fuel type

gigawatts



- Coal: most built before 1980
- Nuclear: built between 1960s-1990
- Wind: 2000-present
- Hydro: pre-1930 to mid 1980s
- Natural Gas: sporadic



Key Points

- Electricity is an important component of the U.S. energy mix, consuming about 40% of the energy
- Generation resource mix in the U.S. is composed of mostly coal, natural gas and nuclear power plants
- Coal-fired power plants are in decline, while natural gas, wind and solar power plants are increasing