NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Energy Transition Overview

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Aug 3, 2023

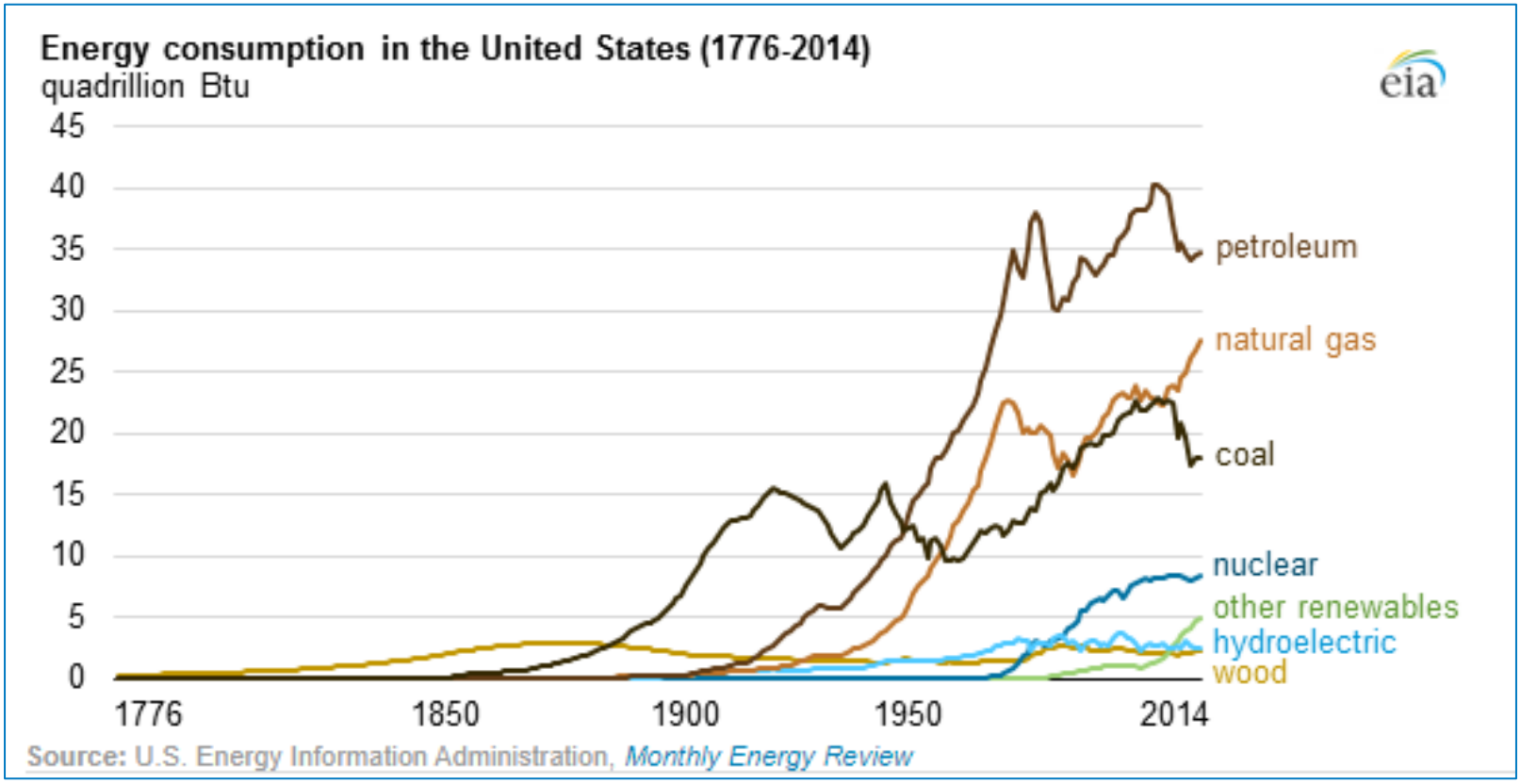
Presentation Overview

Provide a short, high-level overview of what the energy transition may look like

Where We've Been

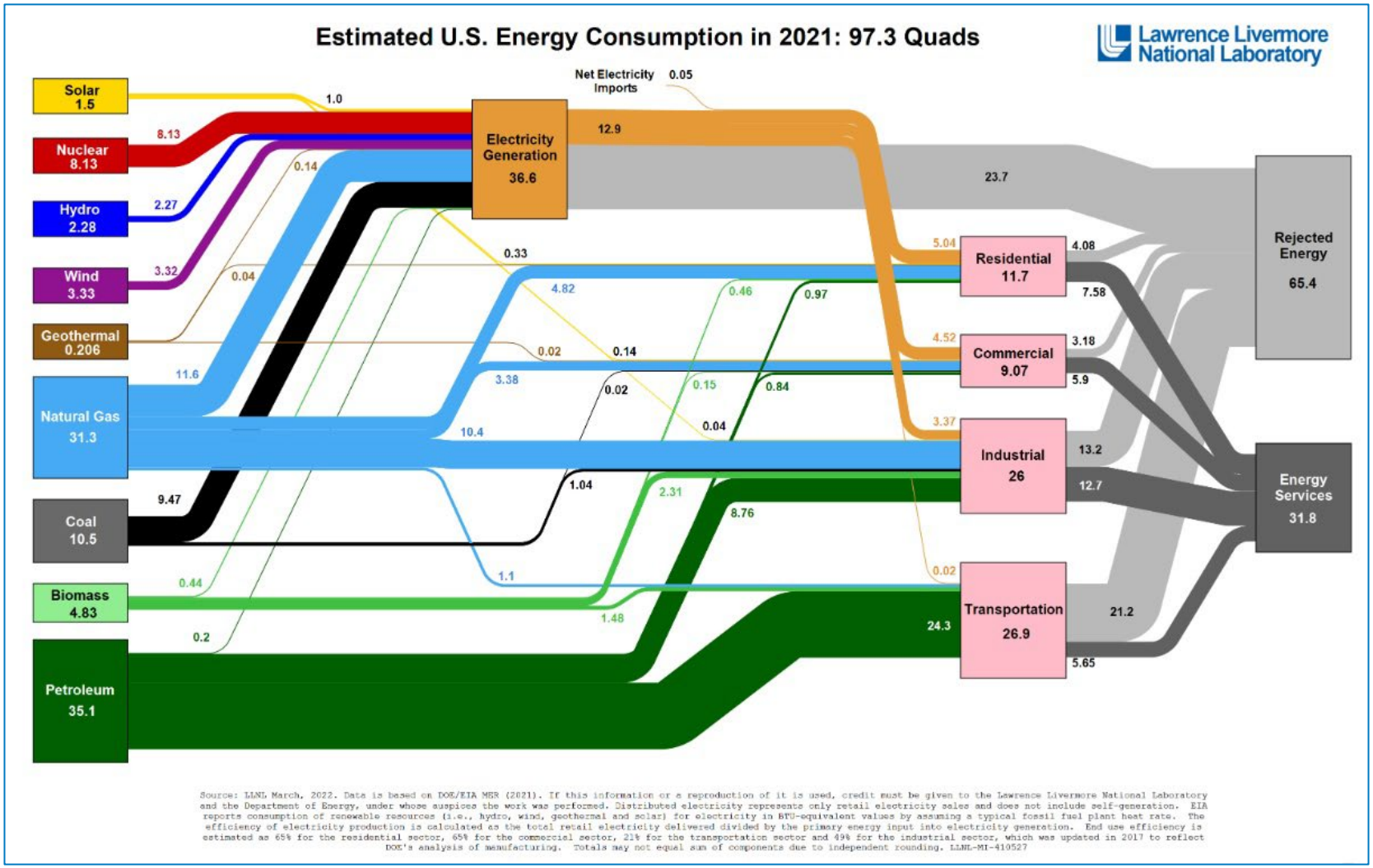
The U.S. has gone through various energy transitions in the past.

- Wood to coal (late 19th century)
- Oil & electrification (early-mid 20th century)



Source: Energy Information Administration (EIA): https://www.eia.gov/todayinenergy/detail.php?id=21912

Where We Are



Source: Lawrence Livermore National Laboratory (LBNL). Data provided by the DOE Energy Information Administration (EIA). https://flowcharts.llnl.gov/commodities/energy

Basic Goals & Drivers of the Current Energy Transition

Drivers

- Climate change
- Economics (wind and solar are cheap, battery storage costs are decreasing)

Basic Goals

- Minimize overall energy use (Energy Efficiency)
- Use less coal, petroleum, & natural gas
- Use more renewables (solar & wind in particular)

Current & Anticipated Strategies

- Energy efficiency (synergistic with other strategies)

- Decarbonize the electric grid
- Electrify as many end uses as possible
- For those end uses that can’t be electrified, use green fuels (green hydrogen, biofuels)

Decarbonize the Electric Sector

Overview

- Easiest sector to decarbonize (technically & politically)
- Already underway (although there is a long way to go)

How?

- Replace fossil fuel generation with renewable energy (mostly solar and wind).
- Enablers of large-scale renewable energy deployment
  - Large-scale deployment of storage
  - More transmission

Source: https://www.energy.gov/indianenergy/articles/seneca-nation-celebrates-commissioning-17-mw-wind-turbine-doe-support

Electrify End Uses

Space/Water Heating & Cooking

- Heat pumps (air or ground source) for space heating, water heating, & dryers
- Induction stoves for cooking

Transportation

- Cars & Light Trucks – Yes (Underway)
- Heavy Trucks – ??? May go green fuels route instead
- Marine - ??? May go green fuels route instead
- Aviation - ??? May go green fuels route instead

Industrial Processes

- Hardest sector to electrify.
- Amenability to electrification will vary by process

Green Fuels for End Uses that Can't be Electrified

Likely or possible end uses for Green Fuels

- Aviation
- Marine
- Heavy trucks
- Industrial processes

Hydrogen (H2)

- Hydrogen is not an energy source. It is a means of energy storage.
- Most hydrogen currently produced from natural gas via steam methane reformation (SMR) (process releases CO_2)
- Green hydrogen can be created via renewable powered electrolysis, but this process is currently more expensive

Biofuels

- This term encompasses a wide variety of specific fuels
- Extensive efforts underway to improve processes (often involving the breakdown and use of cellulose) and reduce costs

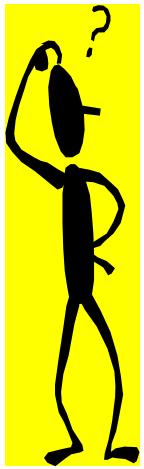
Resources & links

Lawrence Livermore National Laboratory, U.S. Energy Flow Charts, https://flowcharts.llnl.gov/commodities/energy

International Renewable Energy Agency (IRENA), World Energy Transitions Outlook 2022, https://www.irena.org/publications/2022/Mar/World-Energy-Transitions-Outlook-2022

DNV, Energy Transition Outlook 2021, https://eto.dnv.com/2021/about-energy-transition-outlook

NREL Image Library # 08058



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