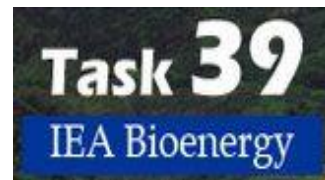




**IEA Bioenergy**  
Technology Collaboration Programme



# United States of America Country Update

IEA Bioenergy Task 39 business meeting

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Virtual, April 20, 2021

*The IEA Bioenergy Technology Collaboration Programme (TCP) is organised under the auspices of the International Energy Agency (IEA) but is functionally and legally autonomous. Views, findings and publications of the IEA Bioenergy TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.*

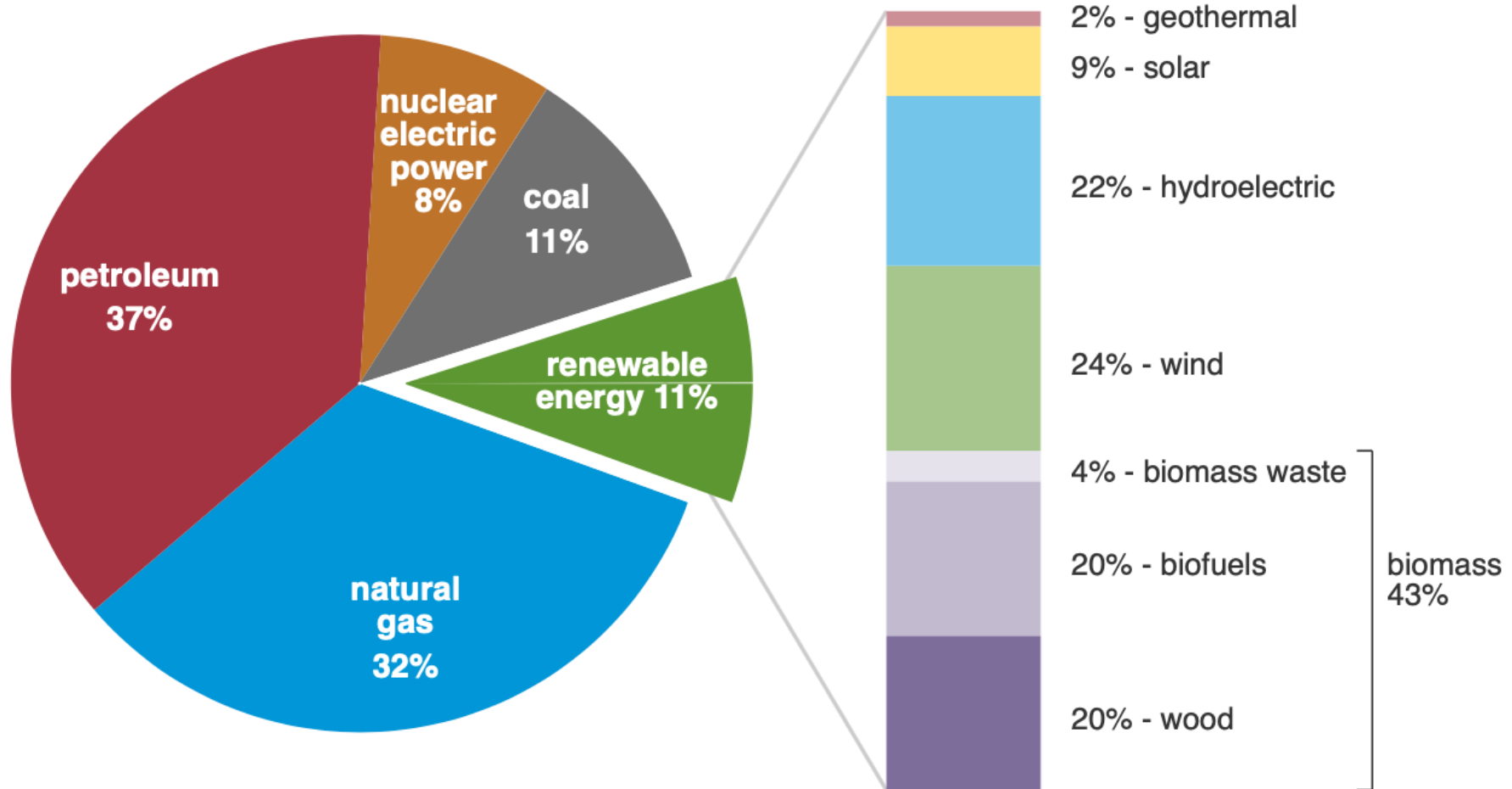
**Technology Collaboration Programme**

by **iea**

# US Primary Energy Use by Source in 2019

total = 100.2 quadrillion  
British thermal units (Btu)

total = 11.4 quadrillion Btu

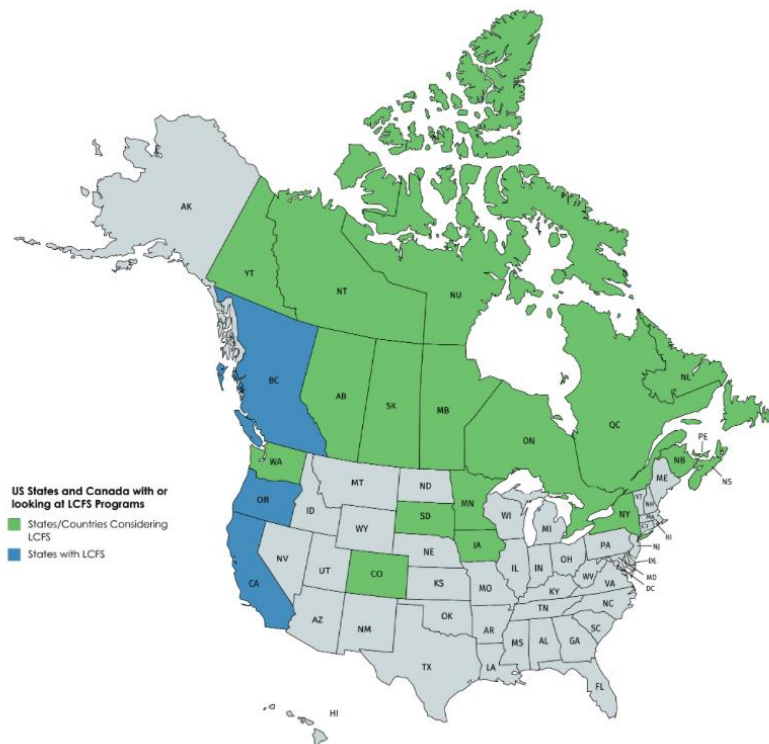


Sources: US EIA. 2021. Monthly Energy Review, Table 1.3 and 10.1, April 2020, preliminary data.

<https://www.eia.gov/energyexplained/us-energy-facts/>

# Overview of Transport Biofuels Situation

- The main policies fostering advanced biofuels in the US are the federal level Renewable Fuel Standard (RFS) and the state of California's Low Carbon Fuel Standard (LCFS); Oregon now also has established an LCFS
- The major transport biofuels remain ethanol (E10, E15) and blended diesel biofuels (FAME and HEFA); some renewable methane is also being used in transport
- Federal level policy is in flux - the new administration is re-committing to fighting climate change and decarbonizing society. Increasingly emphasizing biofuels for hardest sectors (freight and aviation)
- The US Department of Energy continues to support a broad and deep RD&D agenda.



US States and Canada with LCFS Programs or looking at Establishing LCFS Programs

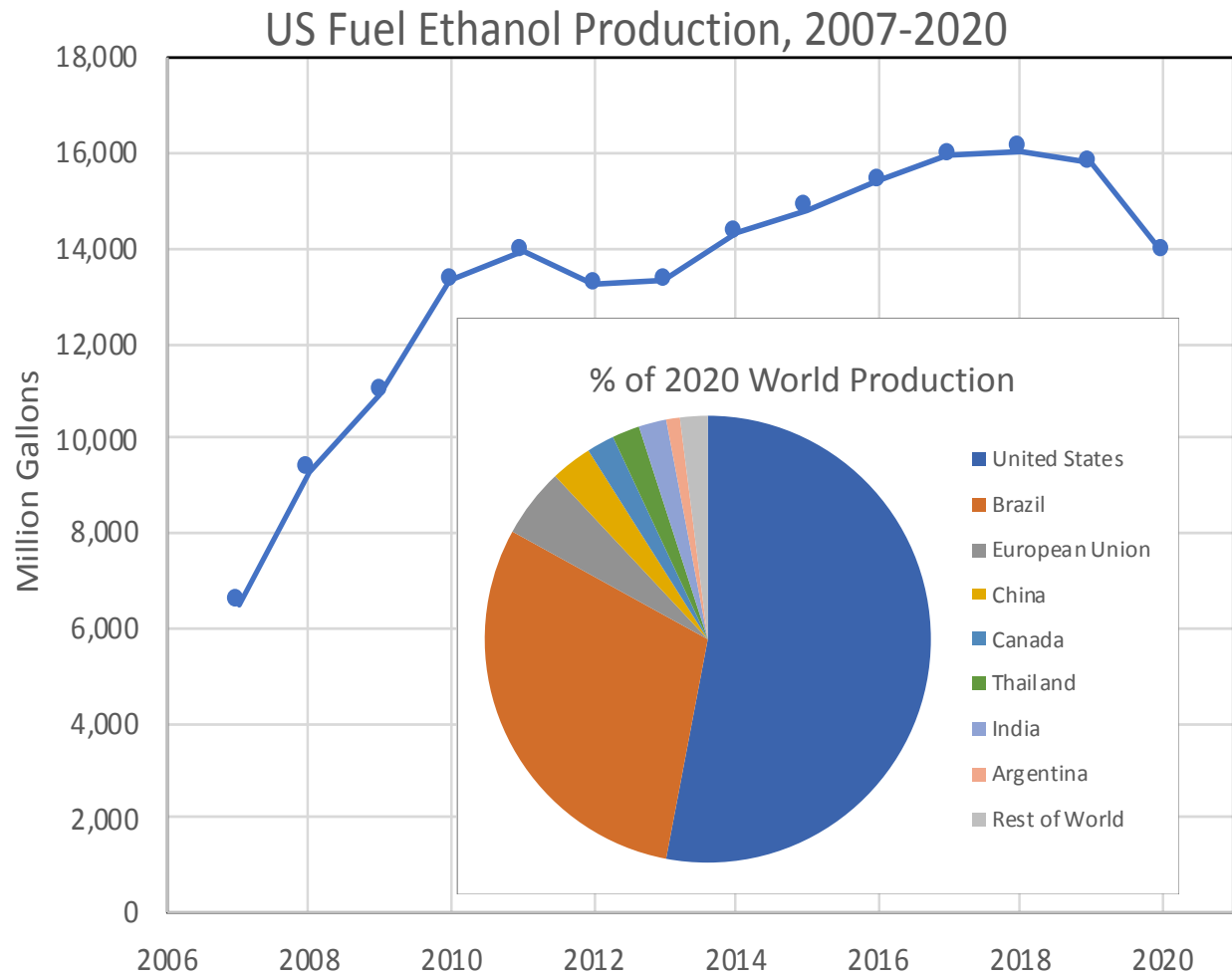
# US DOE Bioenergy Program - 2021 Peer Review

- Held virtually during March 2021 (March 8-12, 15-16 and 22-26)
- Broad program-wide technical scope: Advanced Algal Systems; Biochemical Conversion and Lignin Utilization; Metabolic Engineering (Agile BioFoundry Consortium); Catalytic Upgrading; CO<sub>2</sub> Utilization; Co-Optimization of Fuels and Engines; Data, Modeling, and Analysis; Feedstock Technologies (including Feedstock-Conversion Interface Consortium); Organic Wastes; Performance-Advantaged Bioproducts; Bioprocessing Separations; and Plastics; Systems Development and Integration
- Agenda, overview and soon (in May?) also presentations available at: <https://www.energy.gov/eere/bioenergy/2021-project-peer-review>
- The 2019 Peer Review (report and presentations) are available at: <https://www.energy.gov/eere/bioenergy/2019-project-peer-review>



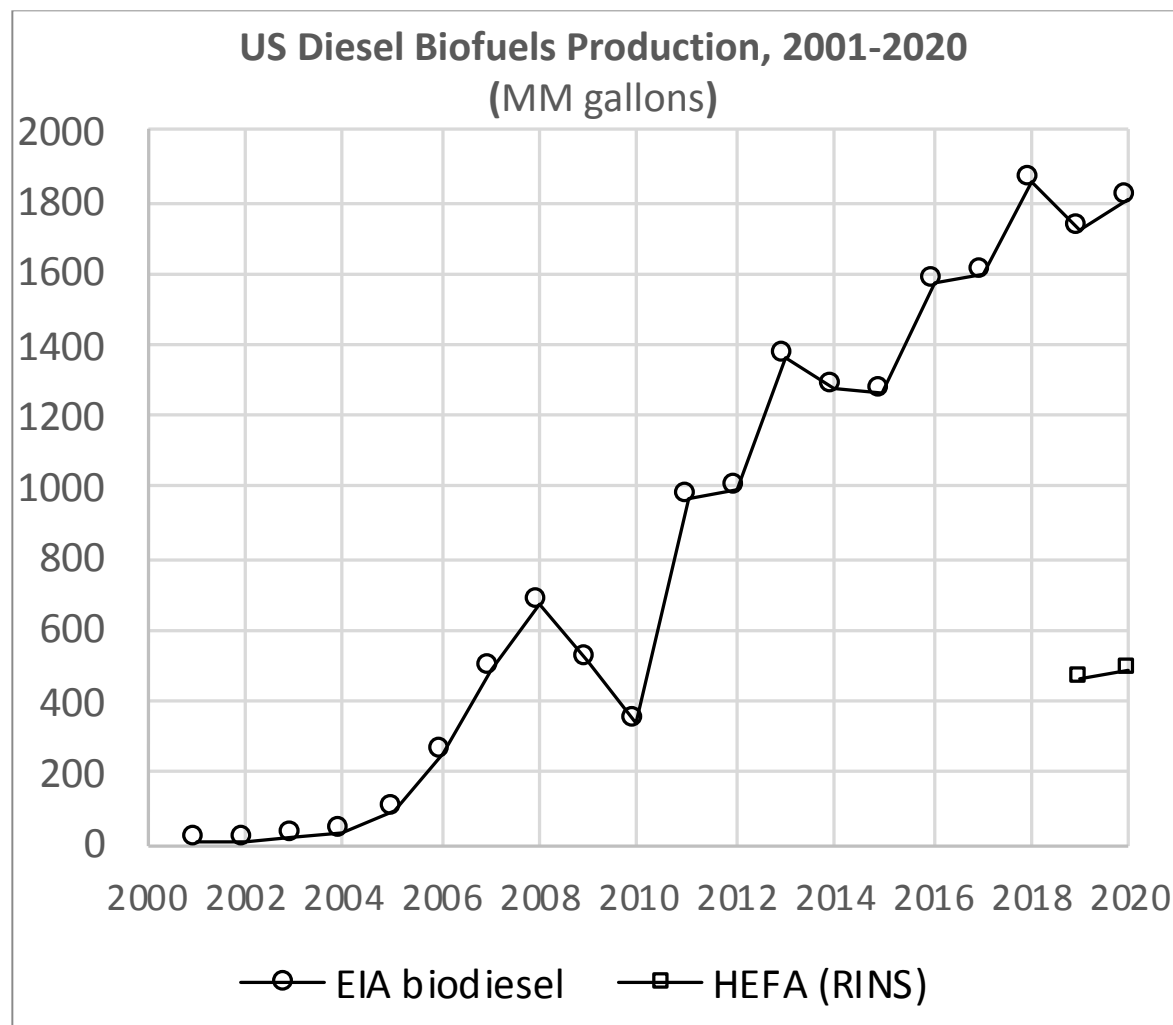
# Historical US Ethanol Production

- 13.9 billion gallons (52.7 billion liters) produced in 2020, from ~200 plants, mostly from corn (starch); down ~12% from 2019
- Primary being used as E10 and E15 fuels for light duty mobility; Alcohol-to-Jet (ATJ) production advancing as a future market
- Cellulosic production going backwards – annual production has fallen since 2017 when 10 MM gallons produced; only 2 MM gal produced in 2020 and 2021 levels remain low (~0.25 MM gal/month based on RIN data)
- Anticipate post-Covid production increases however how fast cellulosic ramps up depends on future oil prices and carbon policy



# US Diesel Biofuels Production, 2001-2020

- Biodiesel production continues to grow, now roughly 1.8-2.2 billion gallons (6.8 – 8.5 billion liters); HEFA and FAME inconsistently separated
- Production volumes remain limited by available oleaginous feedstocks – soybean oil remains largest single feedstock used; use of waste feedstocks continues to increase
- More fungible HEFA fuels (aka RD or Renewable Diesel) compared to traditional FAME biodiesel increasingly taking the available feedstock



Source: EIA March 2021 Monthly Energy Review,

<https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf>



# 2019-2020 US Biofuels Summary

Federal RFS2 continues; uncertainty re: extension beyond 2022  
CA's LCFS remains biggest driver for advanced biofuels development

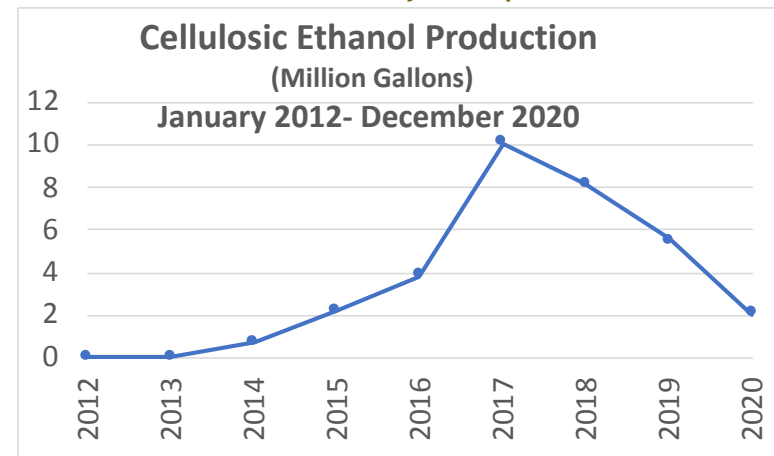
## Positive

- Federal-level RFS2 and state of CA's LCFS remain in force, together providing strong drivers for advanced biofuels development; future of RFS beyond 2022 remains highly uncertain
- LCFS expansion: Oregon has also established an LCFS; many other states evaluating LCFS policies
- New administration recommitting federal government to Paris agreement; lots of related policy still to be developed / implemented
- Production: US remains largest producer; 2019 production was ~ 52.7 B L ethanol, mostly from corn grain, and ~ 7 - 8.5 B L diesel biofuels, both FAME biodiesel and HEFA renewable diesel (RD), from oleaginous feedstocks
- Production efficiencies for many routes keep improving, and more waste feedstocks now used
- Commercialization of advanced routes continues to slowly progress, e.g., commercial demonstration projects by LanzaTech/LanzaJet and Gevo for alcohol to jet (ATJ) routes, and Fulcrum and Red Rocks for CO/syngas to FT fuels

RFS2 = Renewable Fuel Standard

## Negative

- Mauna Loa recorded 420 ppm CO<sub>2</sub> earlier this year - while policy to price carbon remains ever elusive!
- Biofuels demand reduced due to Covid-19 pandemic travel restrictions, especially for light duty mobility
- Petroleum prices remain too low for most advanced biofuels to be economically competitive



- Political polarization and policy uncertainty remain high; difficult to realize coherent progressive policy
- New administration embracing electrification of light duty transport, deemphasizing cellulosic ethanol and increasingly redirecting RD&D funding for advanced biofuels to target heavy duty transport (aviation, marine, road freight)

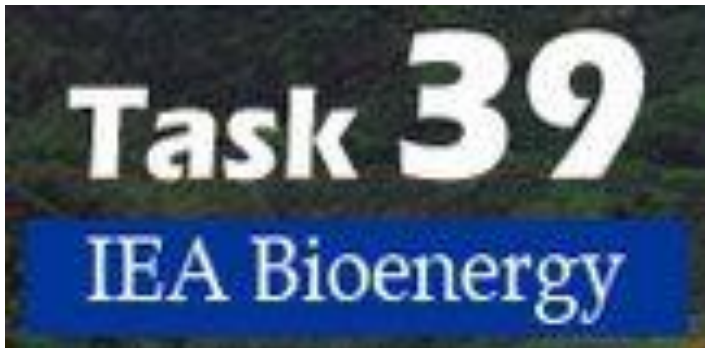
LCFS = Low Carbon Fuel Standard

Thank you!  
Any questions?

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[www.nrel.gov](http://www.nrel.gov)



[www.task39.ieabioenergy.com](http://www.task39.ieabioenergy.com)



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# Additional Slides (EIA ethanol data)

# US DOE Program - Recent Funding Announcements

- **Bioenergy Technologies Office Scale-Up and Conversion FOA** to reduce transportation emissions (April 2021)

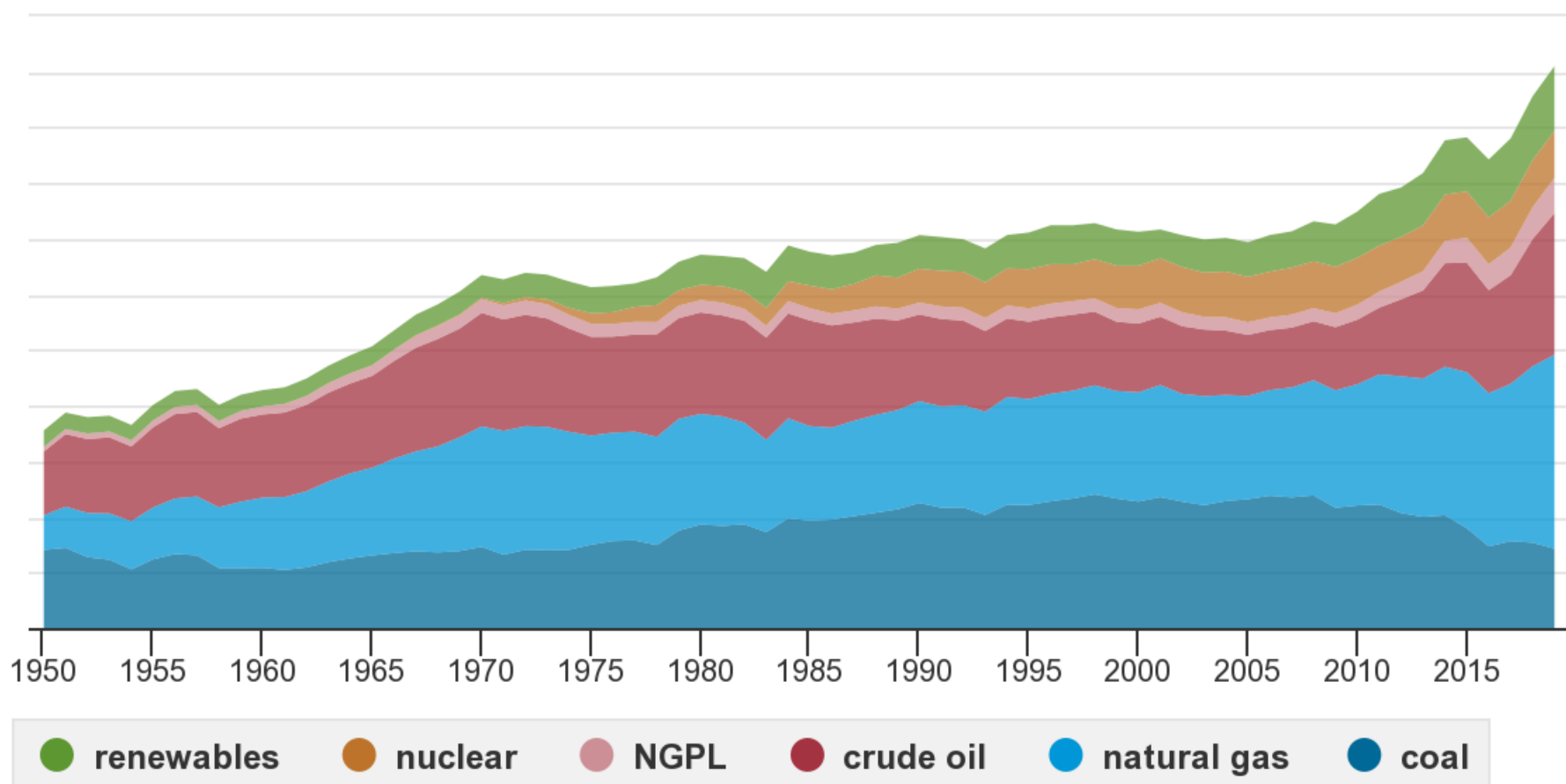
## Topic Areas (\$61 MM):

- Scale-up of Biotechnologies (up to \$30.3 M) [for aviation, marine]
  - Cellulosic Sugars for High Yield Conversion (up to \$8.5 M)
  - Separations to Enable Biomass Conversion (up to \$8.0 M)
  - Residential Wood Heaters (up to \$5.0 M)
  - Renewable Natural Gas (up to \$9.6 M)
  - <https://www.energy.gov/eere/bioenergy/articles/us-department-energy-announces-61-million-biofuels-research-reduce>
- **Vehicle Technologies Office Supertruck FOA** to enable medium- and heavy-duty equipment manufacturers (OEMs), suppliers, and fleet partners to develop higher efficiency trucks and freight systems (April 2021)



# US Primary Energy Production, 1950-2019

Quadrillion BTU (Quad)

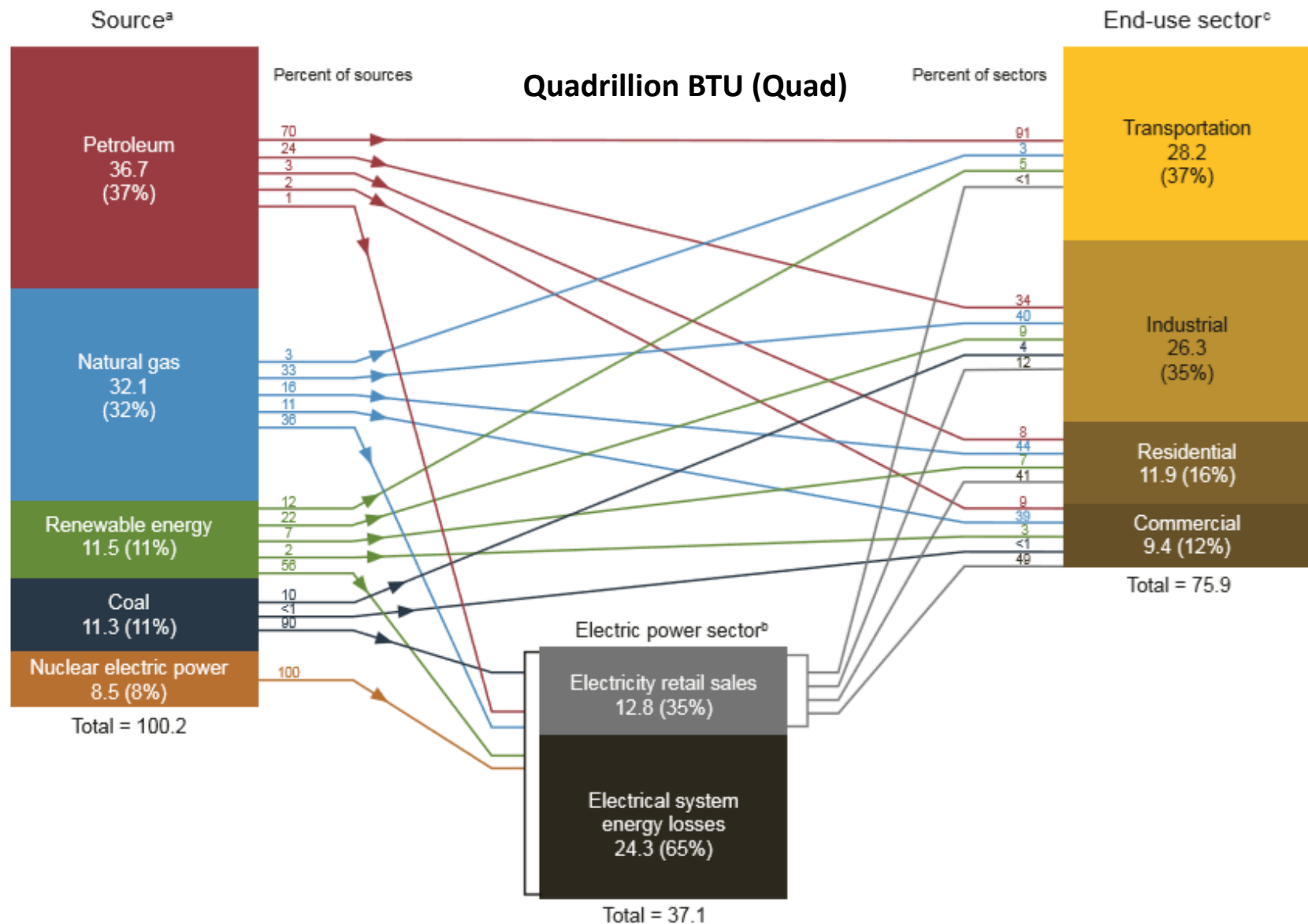


Note: NGPL is natural gas plant liquids.

Source: US EIA. 2021. Monthly Energy Review, Table 1.2, April 2020, preliminary data for 2019.

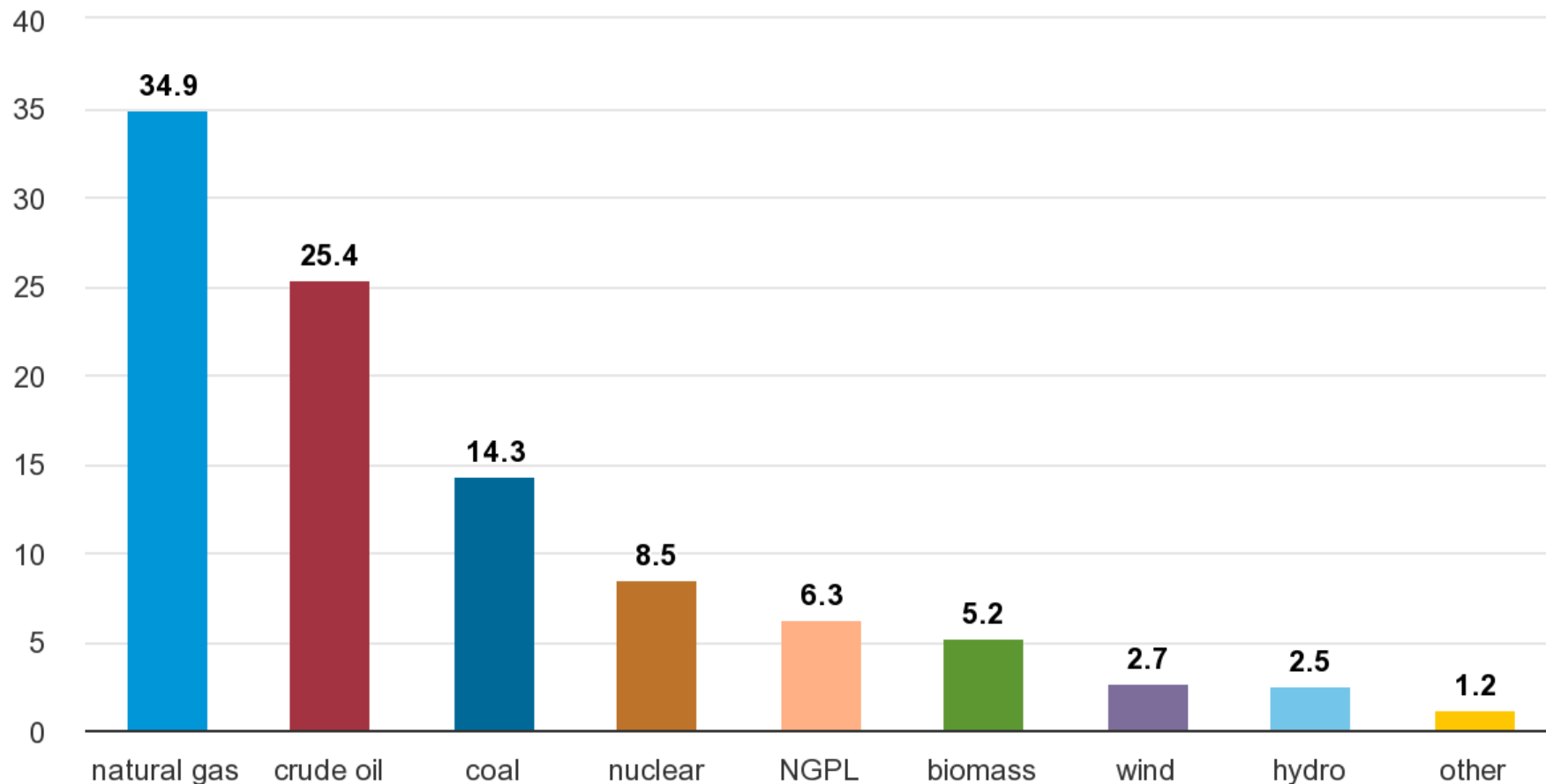
<https://www.eia.gov/energyexplained/us-energy-facts/>

# USA Primary Energy Use in 2019



# US Primary Energy Production by Source, 2019

Quadrillion BTU (Quad)



Note: NGPL is natural gas plant liquids; other is geothermal and solar; hydro is conventional hydroelectric.

Source: US EIA.2021.Monthly Energy Review, April 2020, preliminary data.

<https://www.eia.gov/energyexplained/us-energy-facts/>