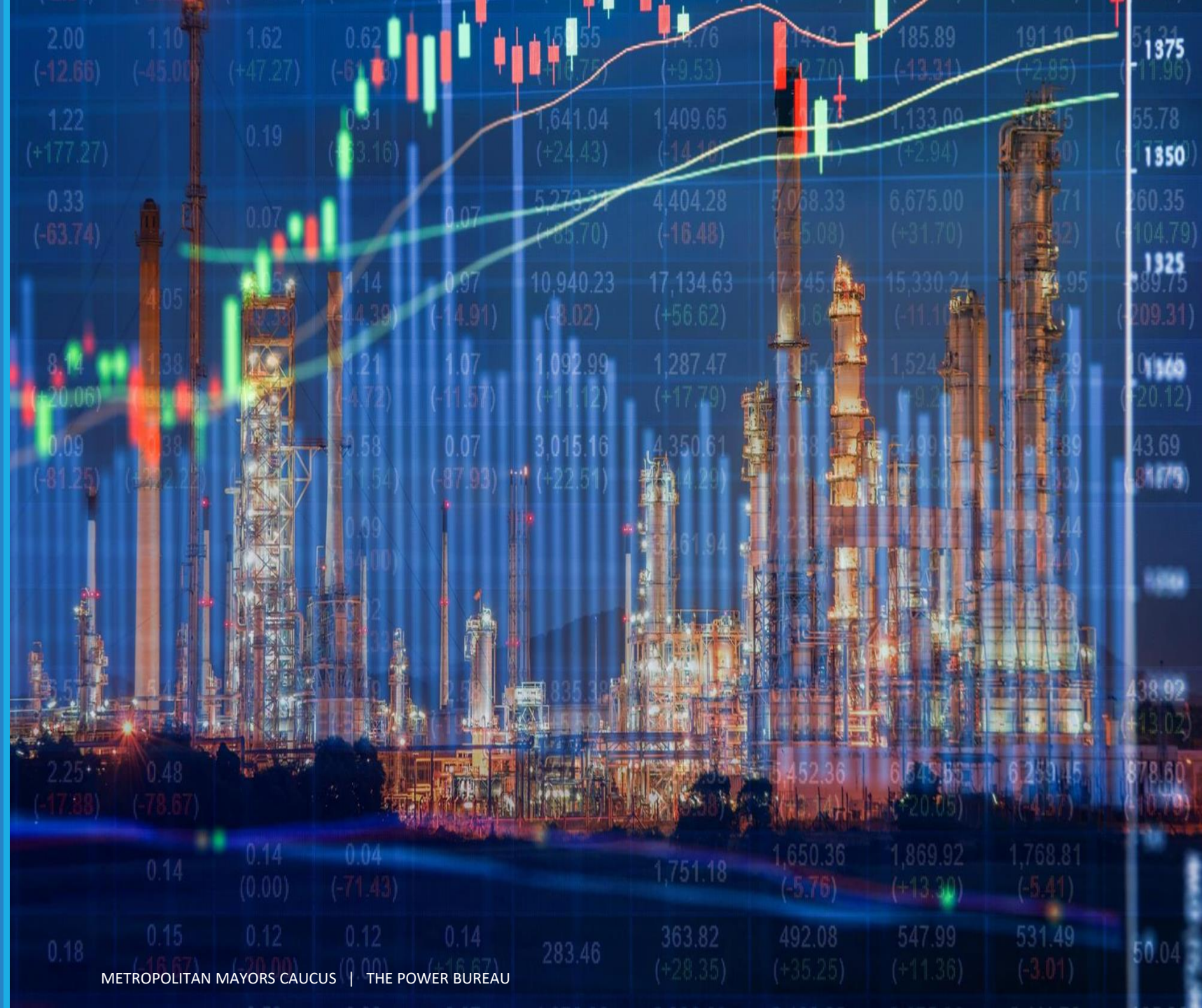


Energy Academy

Session #1: Introduction

Metropolitan Mayors Caucus |
The Power Bureau

January 18, 2023



AGENDA

OVERVIEW	<ul style="list-style-type: none">▪ Participants▪ Course Description
ENERGY SOURCES & USES	<ul style="list-style-type: none">▪ Energy▪ CO2 Emissions
THE ELECTRIC GRID	<ul style="list-style-type: none">▪ Generation▪ Transmission▪ Distribution
ENERGY & EMISSIONS PATTERNS	<ul style="list-style-type: none">▪ National▪ Illinois
DISCUSSION	<ul style="list-style-type: none">▪ Open



OVERVIEW

OVERVIEW

INTRODUCTIONS

- Mark Pruitt
Principal | The Power Bureau
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(219) 921-3828

Current Work

Power Bureau. Advisor on energy policy, planning, and procurement.

Illinois Community Choice Aggregation Network. Municipal aggregation and energy purchasing for municipalities

Past Work

Illinois Power Agency. Director of state utility regulator responsible for wholesale electricity planning and purchasing for investor-owned utilities, Renewable Portfolio Standard, Clean Coal Portfolio Standard.

University of Illinois. Managed electricity and natural gas purchasing, hedging, billing for state executive agencies.

Nicor Solutions. Cogeneration and energy efficiency project developer for federal facilities.

Other Activities

Teaching. Northwestern University, University of Illinois

Argonne National Laboratory. Energy Transition Consultant for Net Zero World (Indonesia)

Communities participating in the Energy Academy Program

OVERVIEW

INTRODUCTIONS

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(219) 921-3828
- 44 municipalities represented by 74 individual attendees

City of Batavia	Village of Fox Lake	Village of River Forest
City of Chicago	Village of Franklin Park	Village of Riverside
City of Elgin	Village of Glenview	Village of Romeoville
City of Geneva	Village of Grayslake	Village of Schaumburg
City of Harvey	Village of Hanover Park	Village of South Barrington
City of Naperville	Village of Hazel Crest	Village of University Park
City of Rockford	Village of Hillside	Village of Villa Park
Village of Bannockburn	Village of La Grange	Village of Westchester
Village of Barrington	Village of Lincolnshire	Village of Western Springs
Village of Broadview	Village of Mount Prospect	Village of Westmont
Village of Brookfield	Village of Northbrook	Village of Winnetka
Village of Bull Valley	Village of Oak Park	DuPage County
Village of Darien	Village of Park Forest	Kane County
Village of Deerfield	Village of Richmond	Will County
Village of Forest View	Village of Richton Park	

OVERVIEW

COURSE DESCRIPTION

- Topics

WEEKLY CLASSES AND TOPICS	
Energy Sector: Background	<ul style="list-style-type: none">▪ Energy sources and uses▪ Physical System: Generation, Transmission, Distribution▪ Emissions sources and trends
Energy Markets: Supply, Demand and Prices	<ul style="list-style-type: none">▪ Wholesale markets: Energy, Capacity & Ancillaries▪ Wholesale operations: Auctions and rates▪ Retail Markets: Energy Supply, Delivery and Taxes▪ Retail Pricing Options: Default, Fixed Price, Variable Price
Energy Business: Production and Utilities	<ul style="list-style-type: none">▪ Early Days of Industry: Edison, Tesla, Westinghouse▪ Public Power: Municipal utilities and electric cooperatives▪ Birth of the Modern Utilities: Insull, cost-of-service regulation▪ The Regulatory Compact: Trading monopoly for oversight
Energy Policy: Context and Outlook	<ul style="list-style-type: none">▪ Drivers: Consumers, Business, Environment, Climate, Equity▪ Legislative Primer: Review of the policymaking process▪ State of Illinois Policies: PUA, Choice Law, IPA, EIMA, FEJA, CEJA▪ Federal Policies: IJJA, IRA
Energy Transition: Goals and Constraints	<ul style="list-style-type: none">▪ Decarbonization▪ Adoption and Impacts of electrification▪ Constraints: Policy, Regulatory, and Markets Interactions
Energy Transition: Renewable Energy	<ul style="list-style-type: none">▪ Technology review: Wind, solar, geothermal, landfill gas▪ Past deployments and the outlook▪ Renewable Options in Illinois
Energy Transition: Energy Efficiency	<ul style="list-style-type: none">▪ Technology review: Lighting, controls, microgrids, Smart Cities▪ Past deployments and the outlook▪ Energy Efficiency Programs in Illinois

OVERVIEW

COURSE DESCRIPTION

- Topics
- Post course assistance

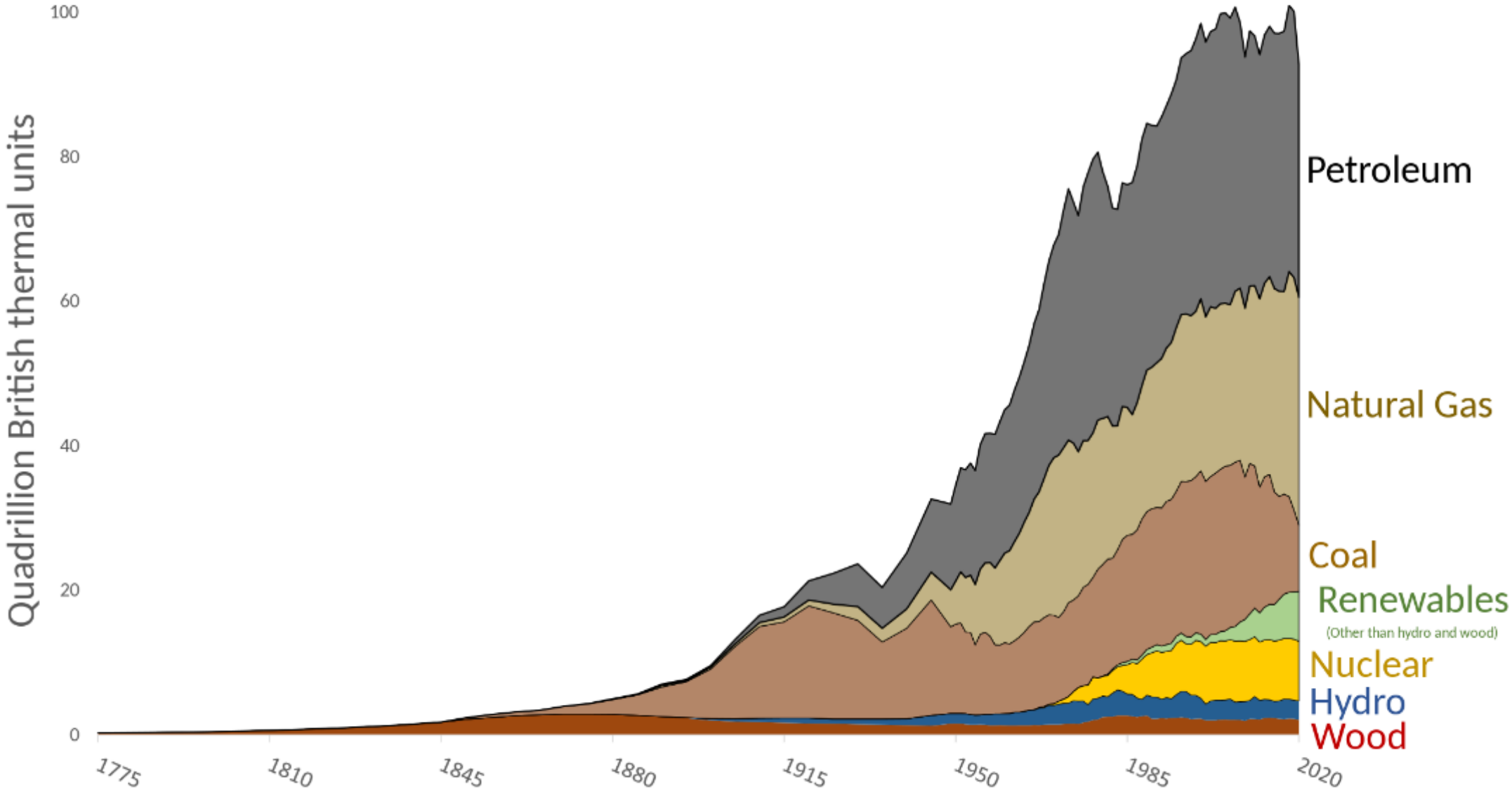
SOME POTENTIAL TOPICS BASED ON INTERESTS OF ATTENDEES	
Renewable Energy Purchasing	<ul style="list-style-type: none">▪ Negotiating Virtual Power Purchase Agreements▪ Leveraging CCA program purchases
Promoting Local Solar Development	<ul style="list-style-type: none">▪ Group Buy programs▪ Community Driven Community Solar
Attracting/Capturing funding for local initiatives	<ul style="list-style-type: none">▪ Federal: IJJA, IRA, QOZ▪ State: FEJA, CEJA▪ Local: PACE
Energy Policy Planning & Development	<ul style="list-style-type: none">▪ Local: Permits, Zoning, Purchasing, Codes▪ State: Community solar, Joint Action Agencies



ENERGY SOURCES & USES

Source: U.S. Energy Information Administration
Made by: Kaj Tallungs

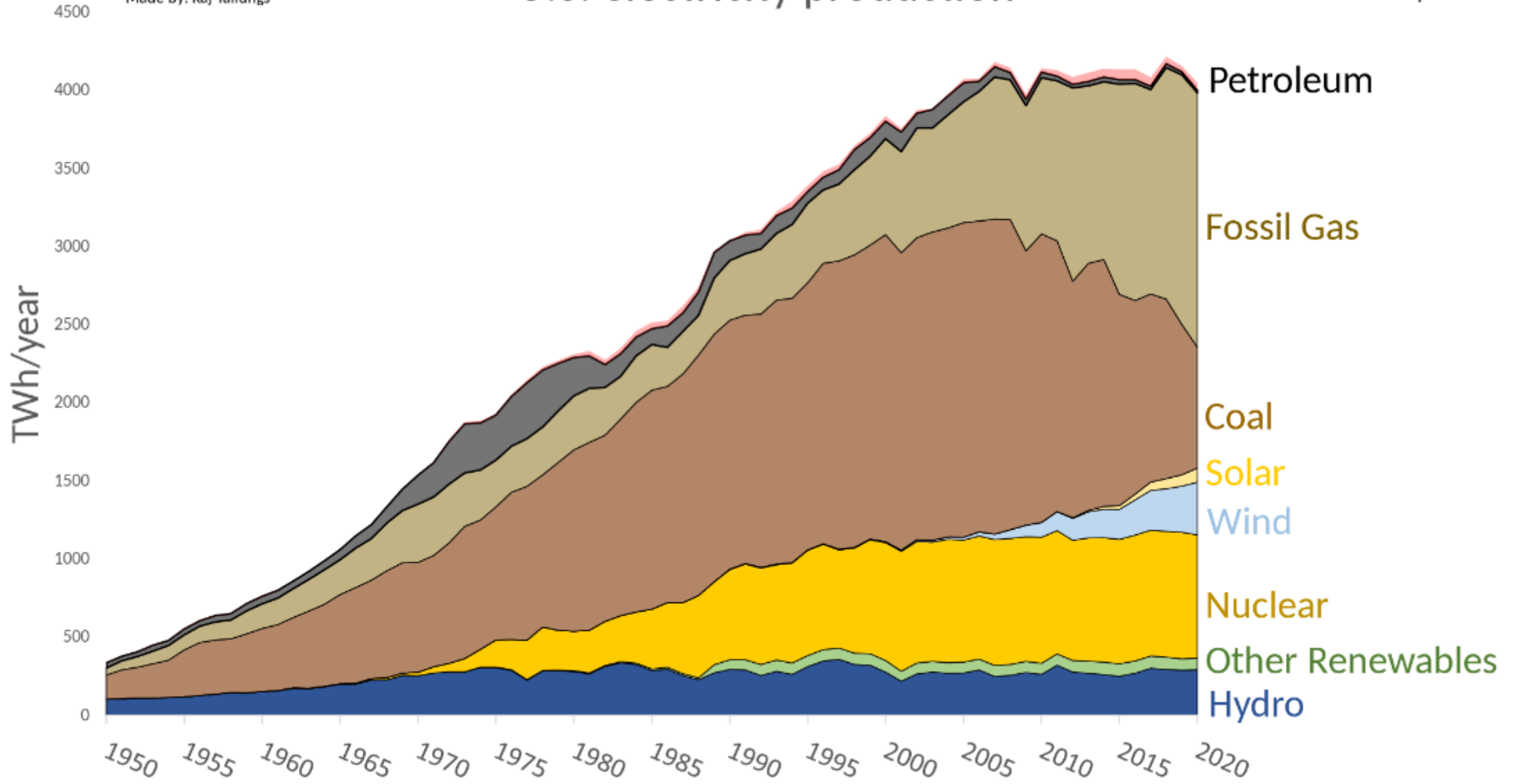
U.S. primary energy consumption



Source: U.S. Energy Information Administration
Made by: Kaj Tallungs

U.S. electricity production

Net imports



Estimated U.S. Energy Consumption in 2021: 97.3 Quads

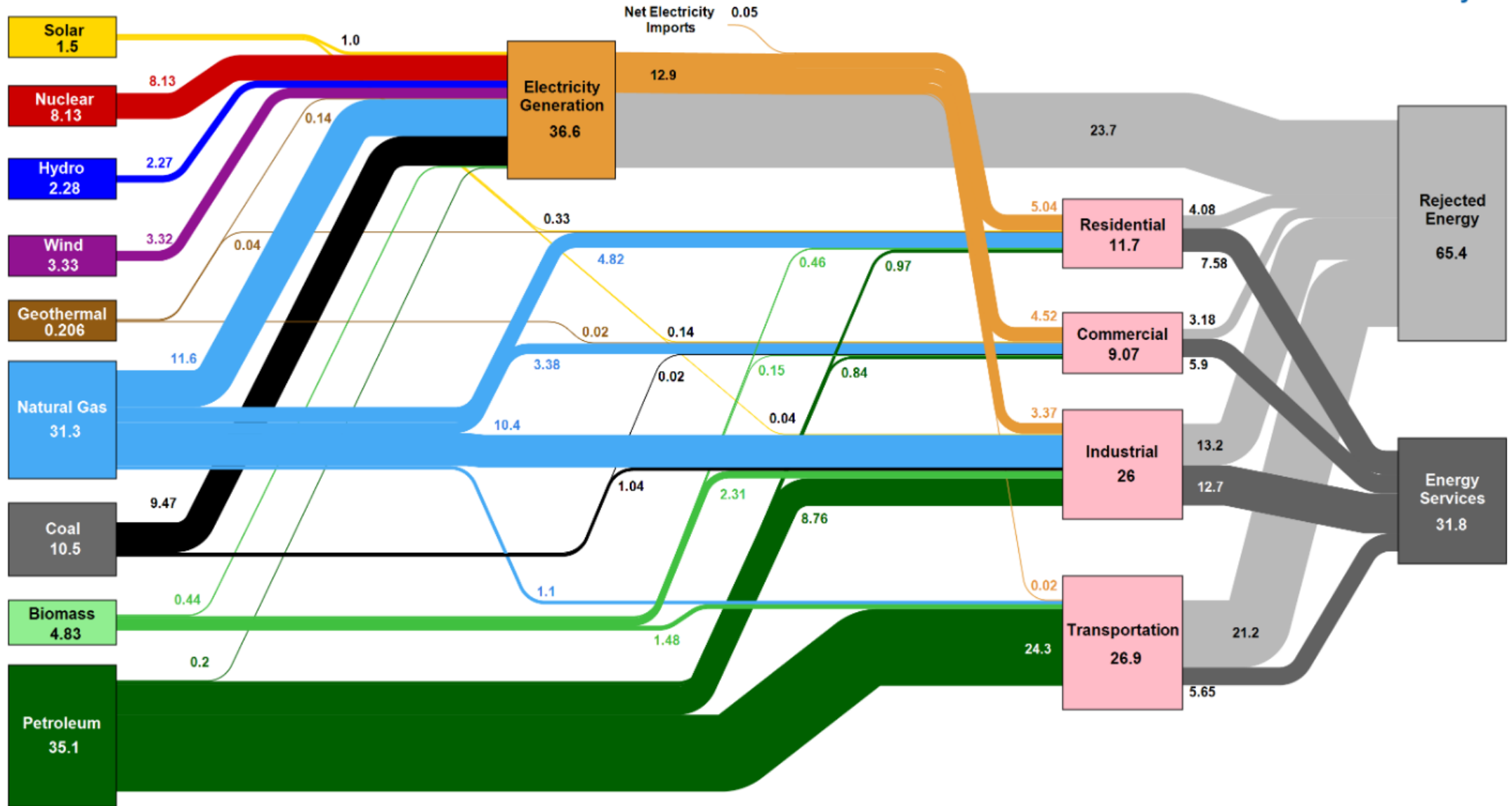


Image Credit: [Department of Energy](#)

United States Energy-related Carbon Dioxide Emissions in 2021: 4,863 million metric tons

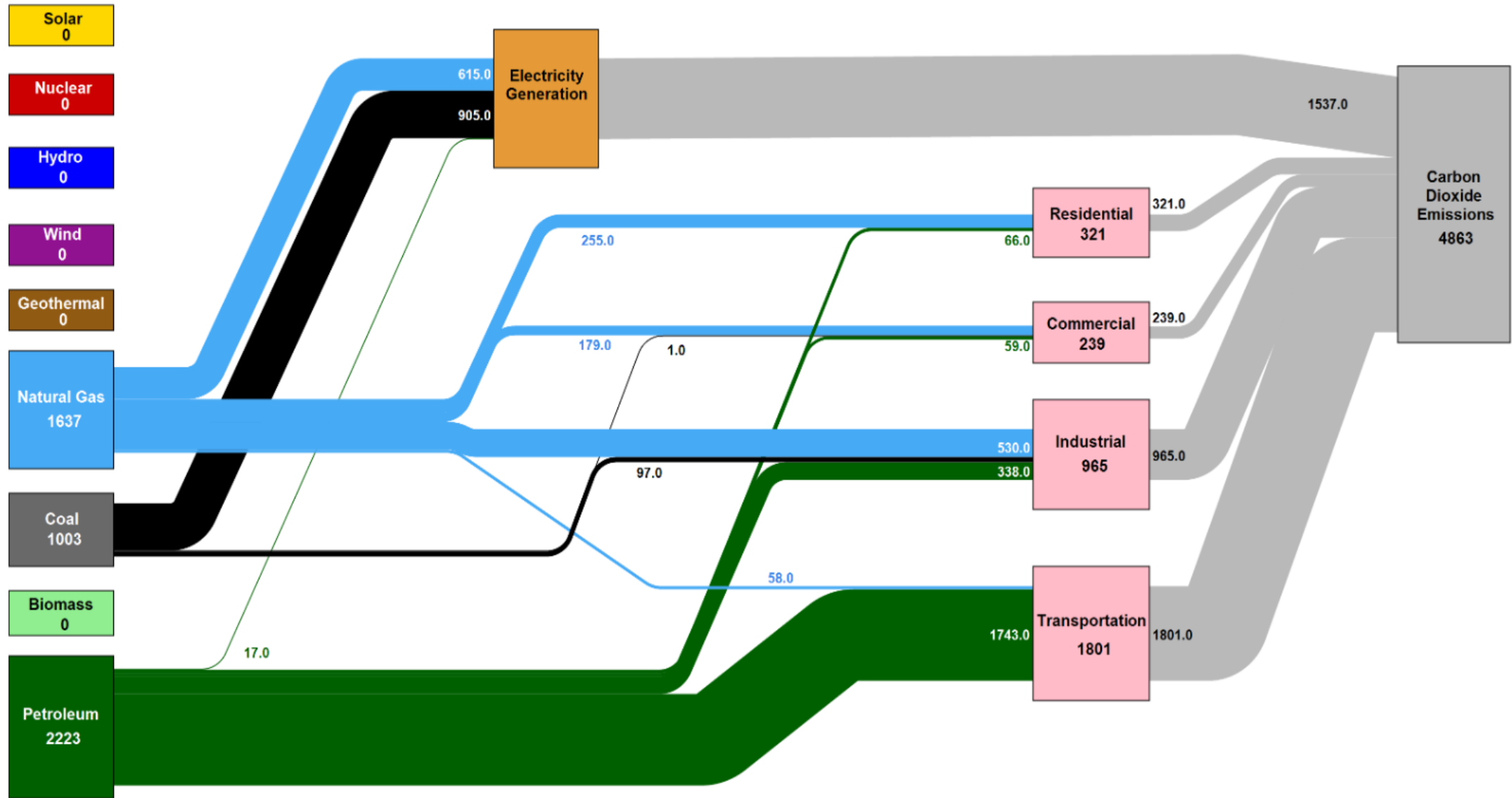


Image Credit: [Department of Energy](#)



THE ELECTRIC GRID

Key Elements of the US Grid

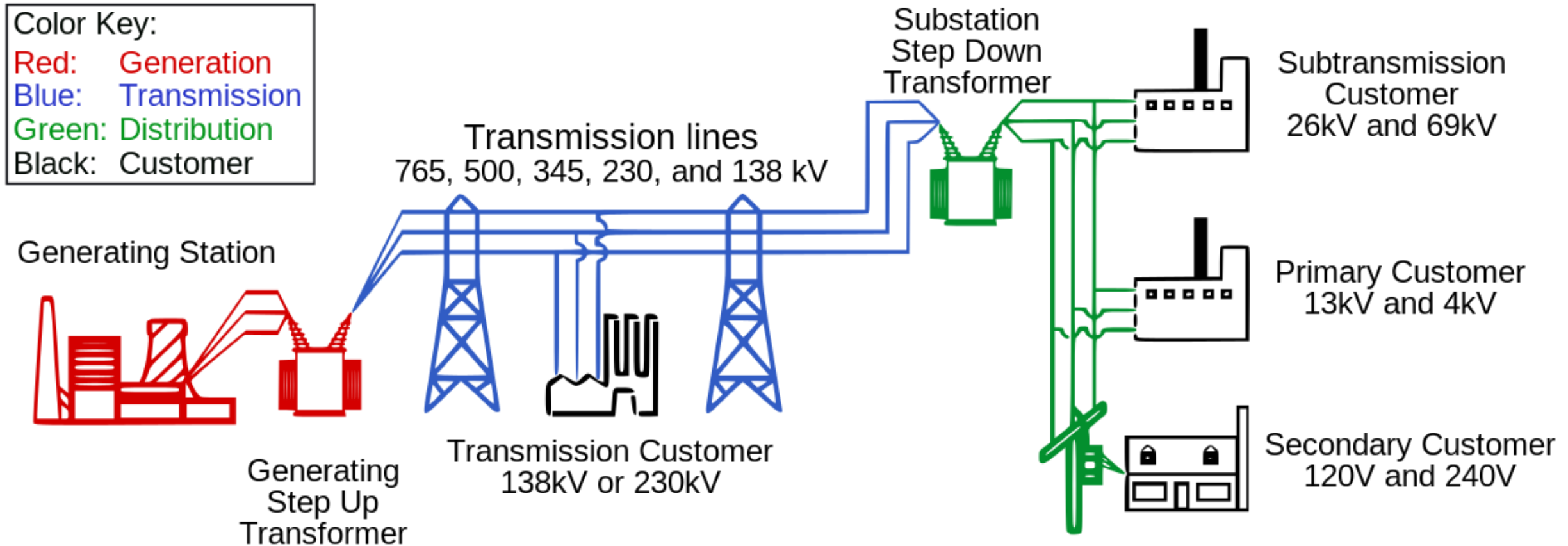


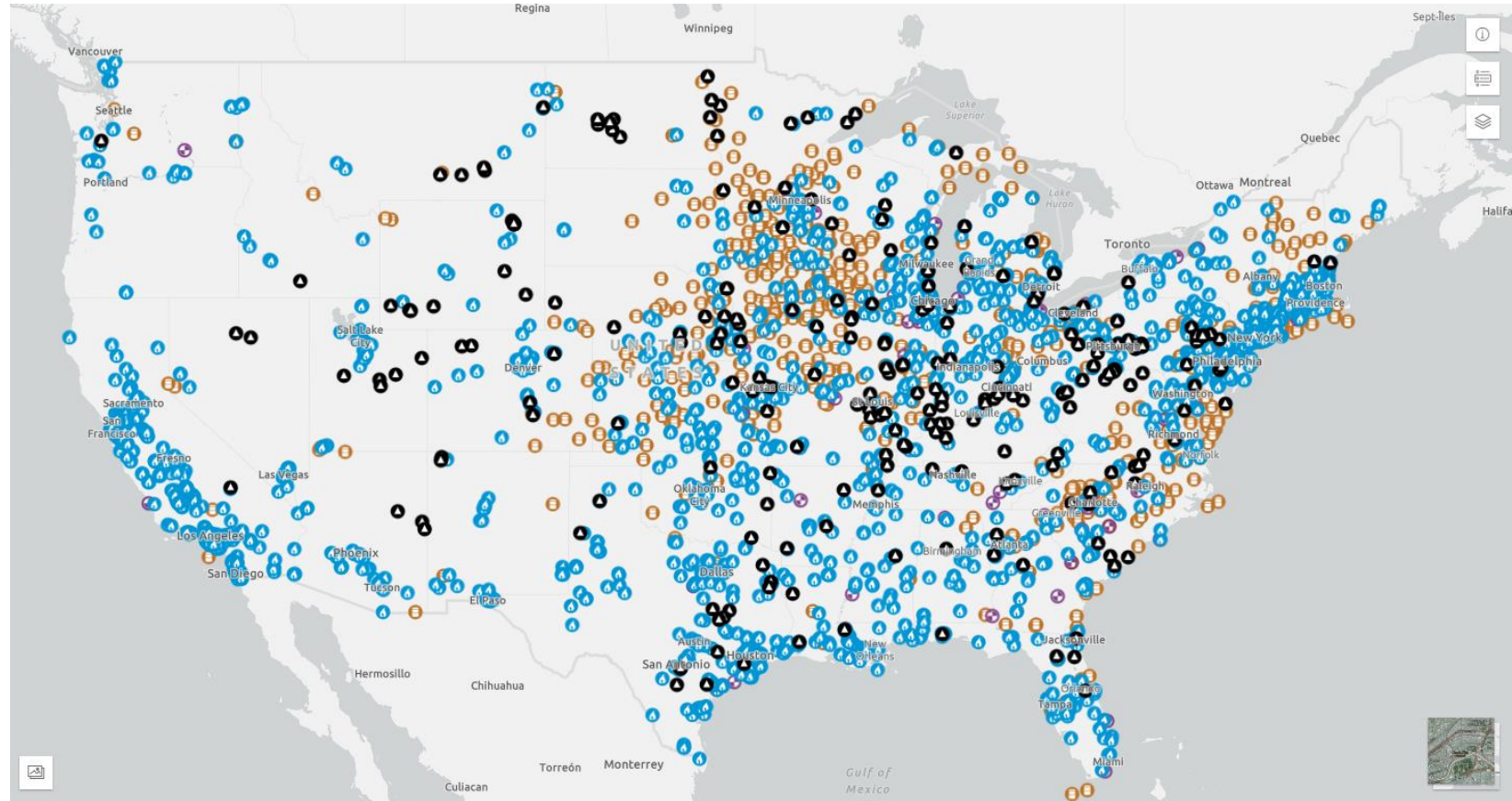
Image Credit: Ballotopedia.org

Traditional Power Assets are (generally) located near population centers

GENERATION

POWER PLANTS

- Natural Gas (blue)
- Coal (black)
- Petroleum (brown)
- Nuclear (purple)



Renewable Power Assets are (generally) proximate to the renewable resource

GENERATION

GENERATING CAPACITY

- Solar (yellow)
- Wind (gray)
- Hydroelectric (blue)
- Biomass (green)
- Geothermal (magenta)

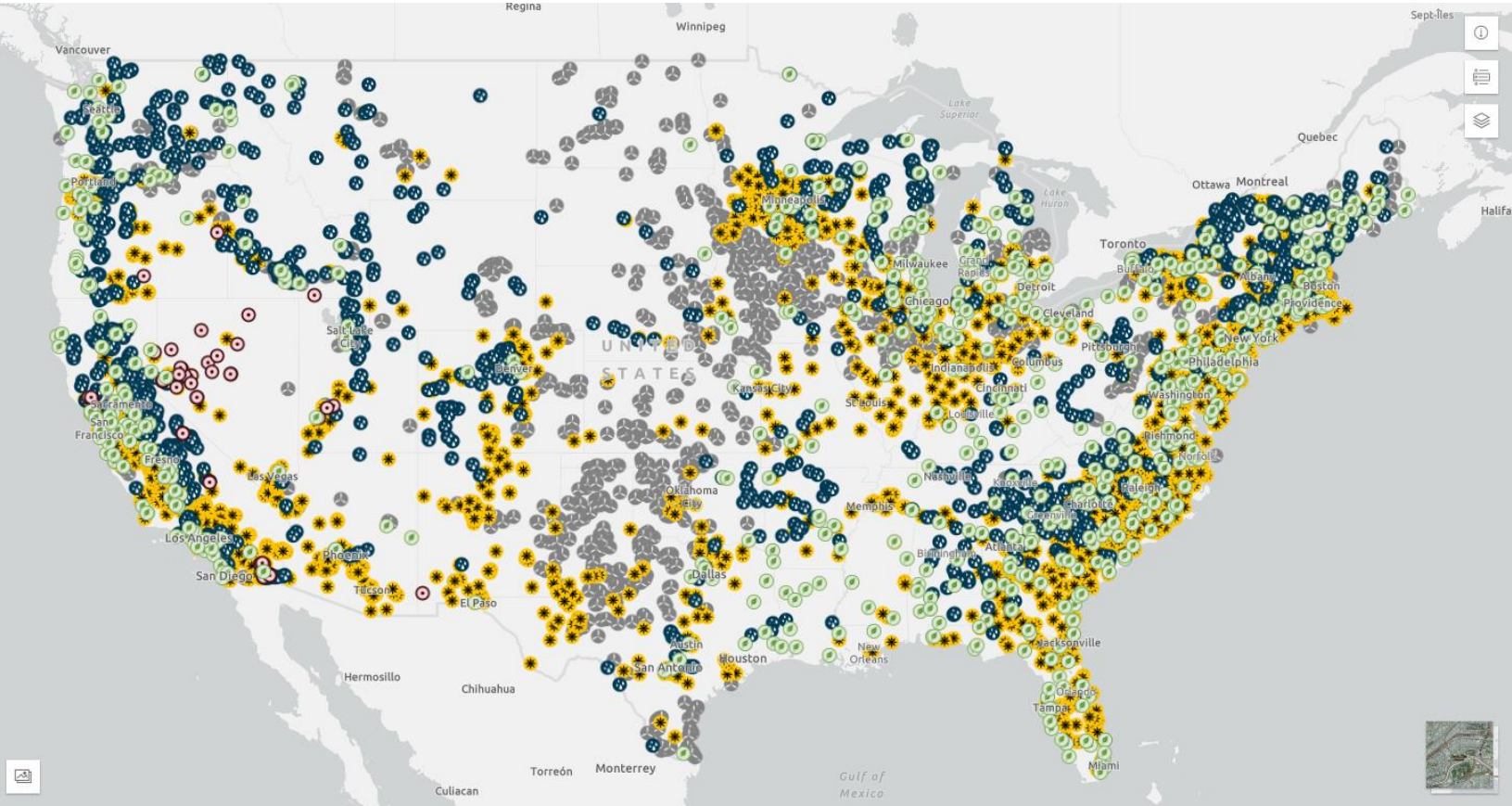


Image Credit: [Energy Information Administration](#)

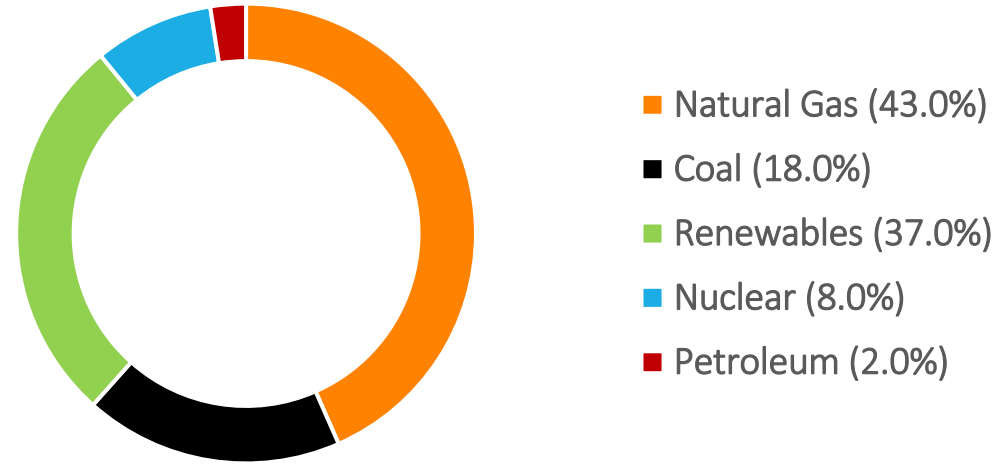
GENERATION

GENERATING CAPACITY (1,143,757 MW)

- The maximum generating potential from a power asset

Fossil Fuel and Nuclear Generating Capacity and Generation still Dominate

Generating Capacity by Fuel Type (1.14 million MW)
(US, 2021, EIA)



Fossil Fuel and Nuclear Generating Capacity and Generation still Dominate

GENERATION

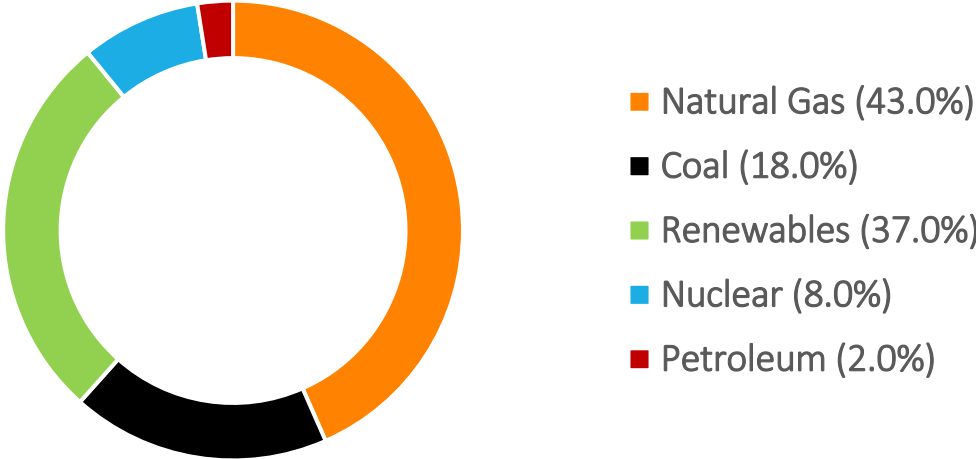
GENERATING CAPACITY (1,143,757 MW)

- The maximum generating potential from a power asset

ANNUAL GENERATION (4,120,000,000 MWh)

- The total amount of electricity generated by power plants in a year

Generating Capacity by Fuel Type (1.14 million MW)
(US, 2021, EIA)



Annual Generation by Fuel Type (4.12 billion MWh)
(US, 2021, EIA)

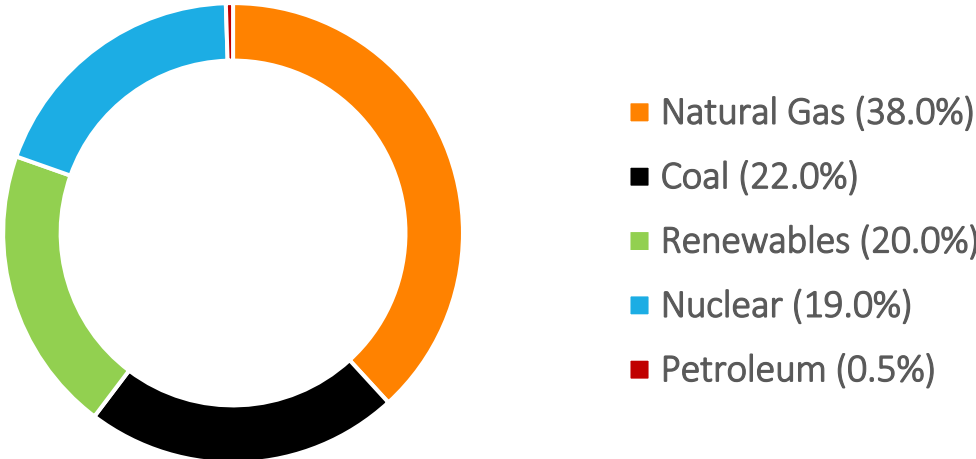


Image Credit: [Energy Information Administration](#)

GENERATION

GENERATING CAPACITY (1,143,757 MW)

- The maximum generating potential from a power asset

ANNUAL GENERATION (4,120,000,000 MWh)

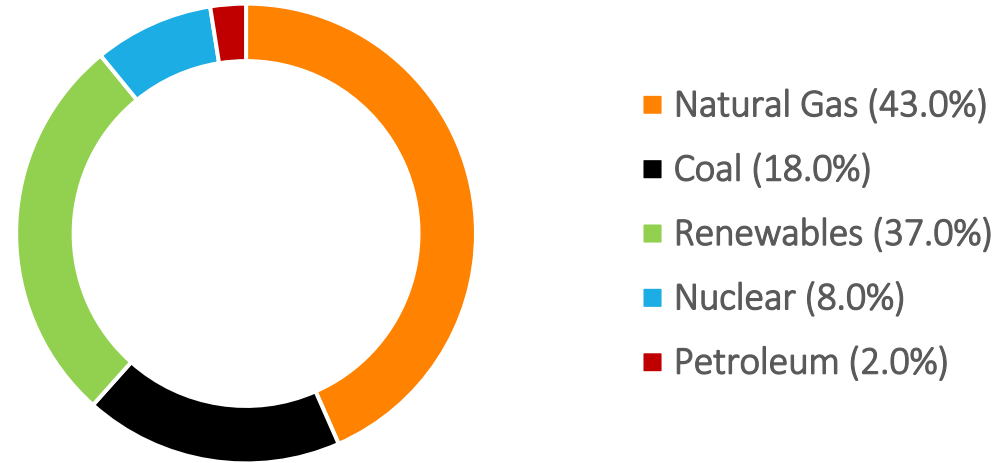
- The total amount of electricity generated by power plants in a year

CAPACITY FACTOR

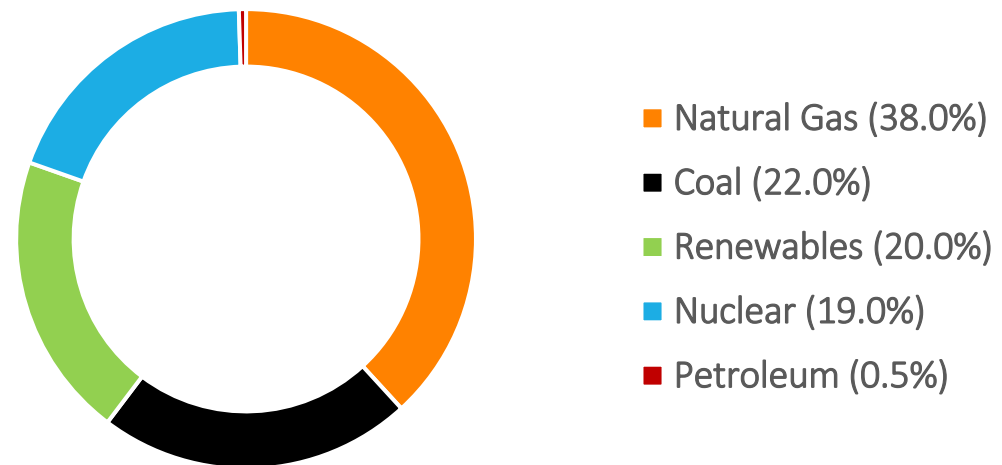
- A measure of how often a power asset is operating at maximum power
 - Natural Gas (36.0%)
 - Coal (49.7%)
 - Renewables (29.9%)
 - Nuclear (93.0%)
 - Petroleum (8.2%)

Fossil Fuel and Nuclear Generating Capacity and Generation still Dominate

Generating Capacity by Fuel Type (1.14 million MW)
(US, 2021, EIA)



Annual Generation by Fuel Type (4.12 billion MWh)
(US, 2021, EIA)



The Transmission system is a network to connect generation to local utilities

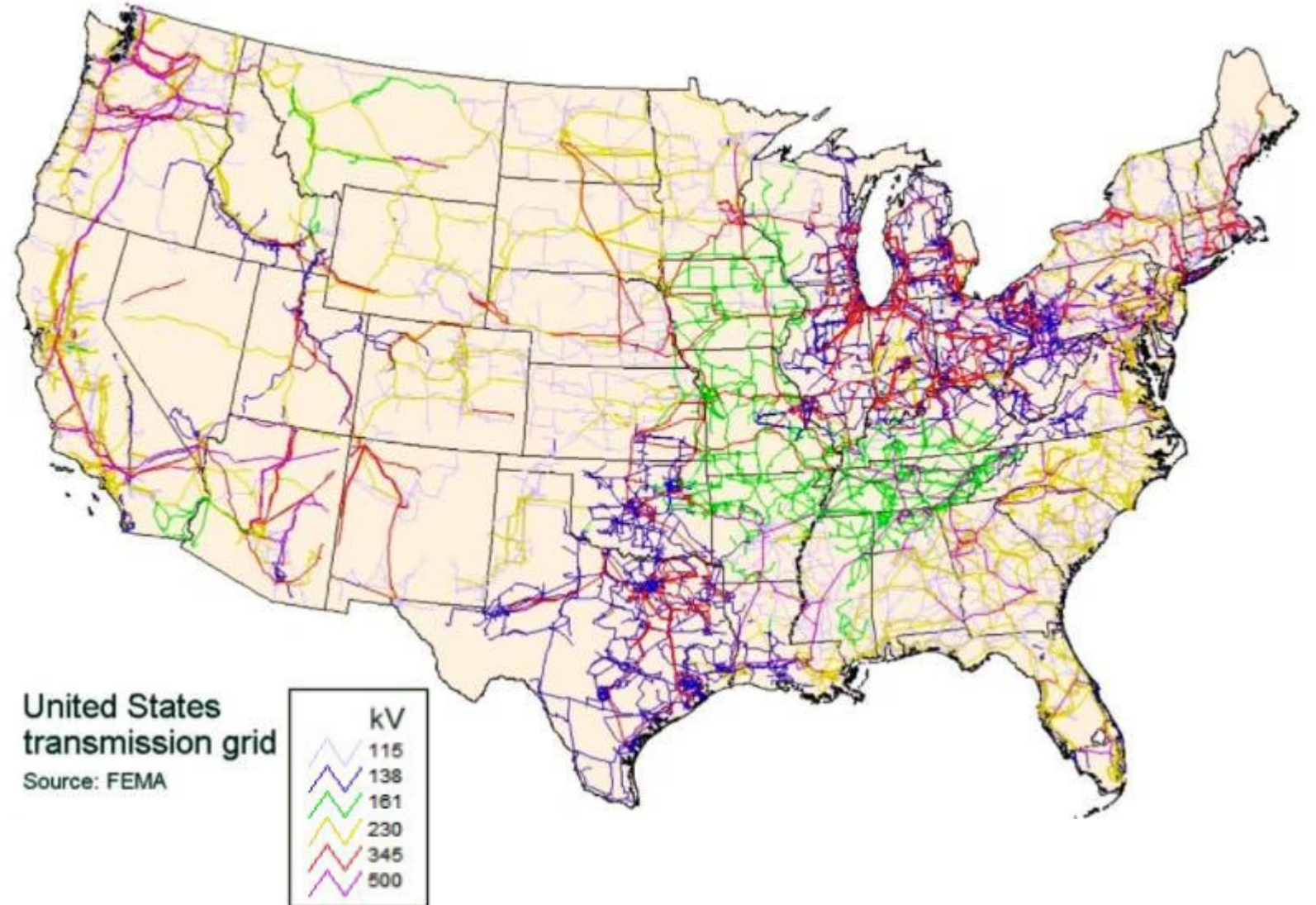
TRANSMISSION

Structure

- 138-765kV lines that connect power assets to local utility systems

Purpose

- Redundancy (reliability)
- Resource variety (cost)



Voltage Classification (Kilovolts)

- Under 100 (Kilovolts)
- 100-161 (Kilovolts)
- 220-287 (Kilovolts)
- 345 (Kilovolts)
- 500 (kilovolts)
- 735 and Above (Kilovolts)
- Not Available

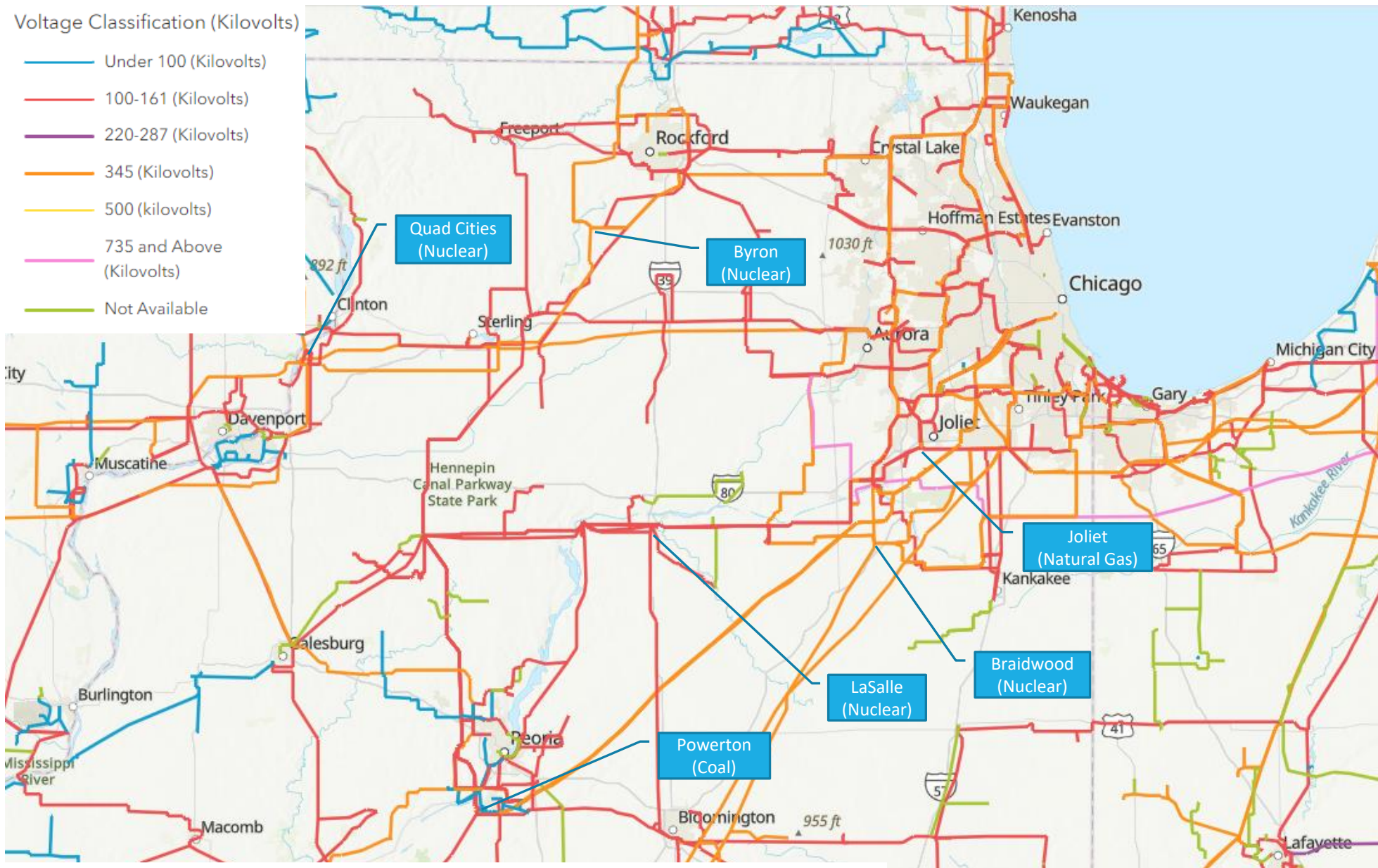


Image Credit: [ARC GIS](#)

TRANSMISSION

INTERCONNECTIONS

- Transmission networks that interconnect allow electricity to flow throughout regions (subject to physics and economics)
- Some flows between Interconnections
- North America has five (5) primary Interconnections
 - Western Interconnection (west of the Rockies)
 - Eastern Interconnection (east of the Rockies)
 - Texas Interconnection (most of Texas)
 - Quebec Interconnection
 - Alaska Interconnection

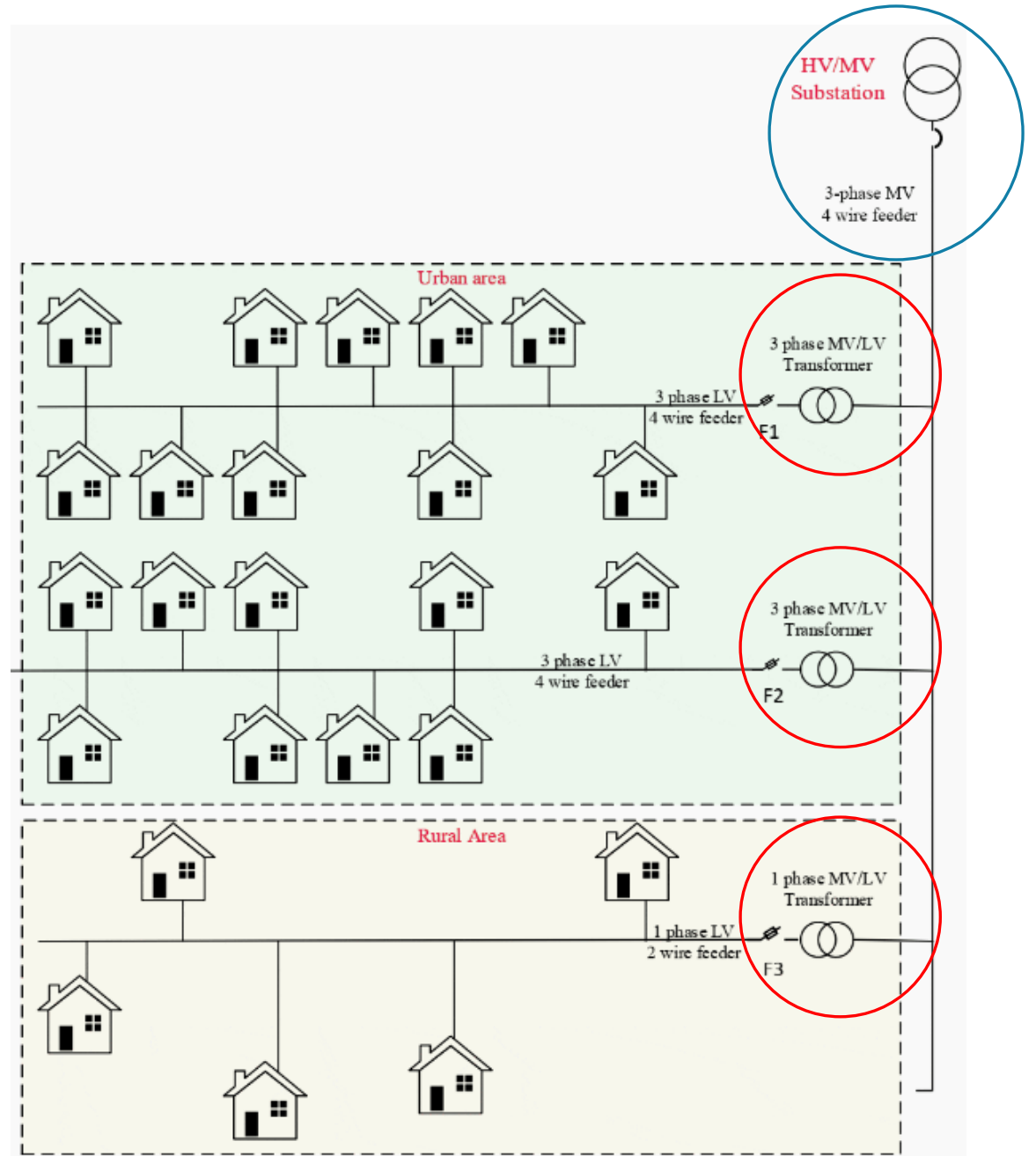


Image Credit: [Congressional Budget Office](#)

DISTRIBUTION

TRADITIONAL LOCAL DELIVERY

- High voltage electricity from the Transmission system is converted (“stepped down”) to lower voltage at local utility substations
- Lower voltage electricity flows from utility substations to transformers which step down voltage to meet consumer needs
- Generally designed with a one-way flow of energy in mind (from substation to consumer)



DISTRIBUTION

SMART GRID

- New distribution system design concept
 - Two-way energy flows (grid to consumer, consumer to grid) and more automated controls
 - Requires significant technology and infrastructure upgrades to distribution systems
 - Intended to facilitate more robust energy options (distributed generation, energy storage, demand response, electric vehicles, etc.)

The move towards a Smart Grid is intended to deliver more flexibility

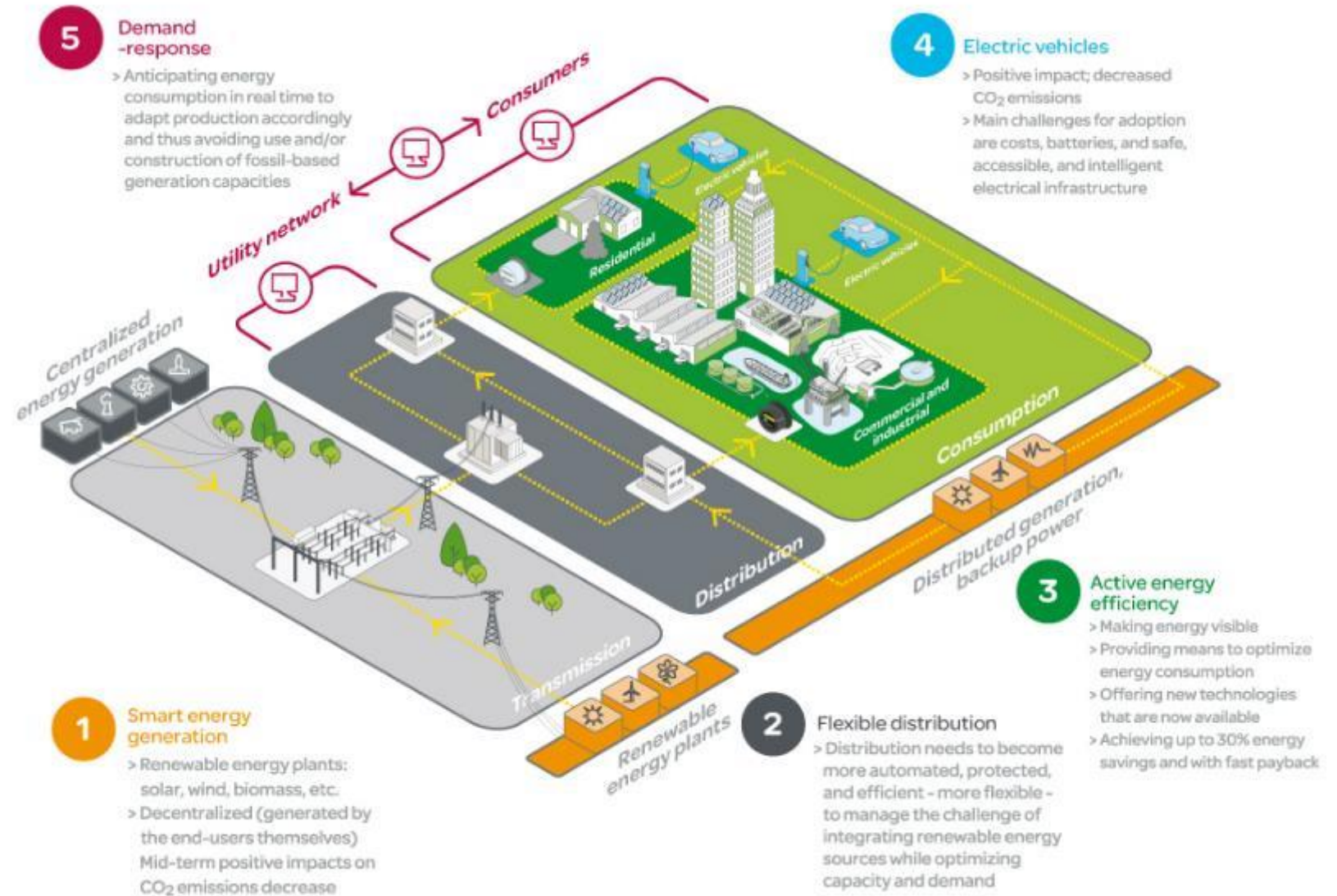


Image Credit: [Schneider Electric](#)



ENERGY & EMISSIONS PATTERNS

Electricity generation in the US has remained stable over the past 12 years

ENERGY PATTERNS (US)

TOTAL ELECTRICITY GENERATION

- Generation has plateaued in recent years
- Nuclear generation is relatively stable
- Coal is in decline
- Natural gas has greatly increased
- Renewables have shown modest gains

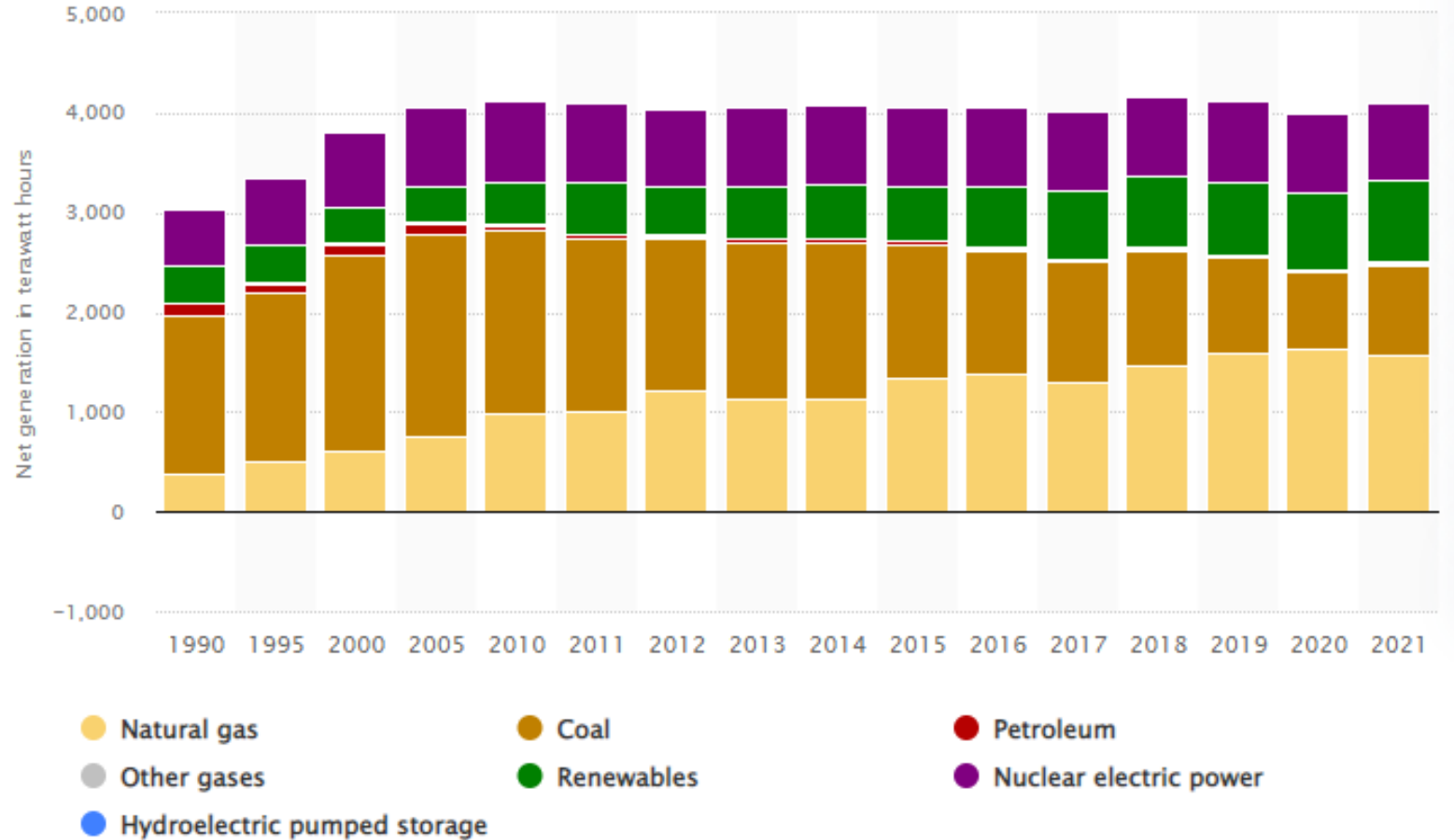


Image Credit: [Statista](#)

EMISSIONS PATTERNS (US)

EMISSION SOURCES

- Likely a temporary drop in all sectors in 2020 due to Covid
- Electric generation sector appears to have longer term downward trend
- Most other sectors appear relatively level

The overall GHG emissions trend in the US is downward

U.S. Greenhouse Gas Emissions by Economic Sector, 1990-2020

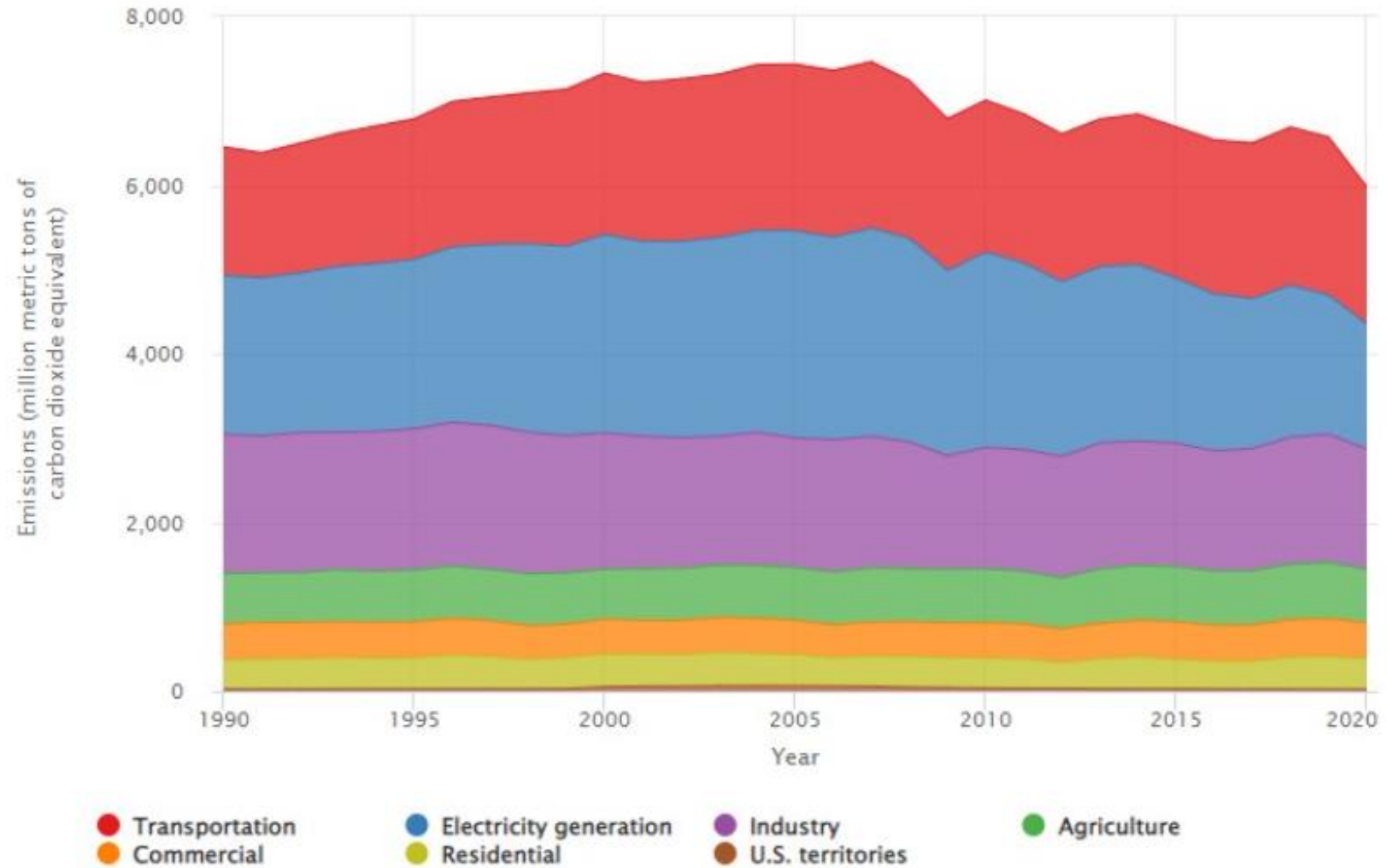


Image Credit: [US Environmental Protection Agency](https://www.epa.gov/ghgemissions)

EMISSIONS PATTERNS (US)

GHG GASES

- Longer term downward trend in CO2 emissions
- Relatively flat changes for other GHGs

The overall CO2 emissions trend in the US is downward

U.S. Greenhouse Gas Emissions by Gas, 1990–2020

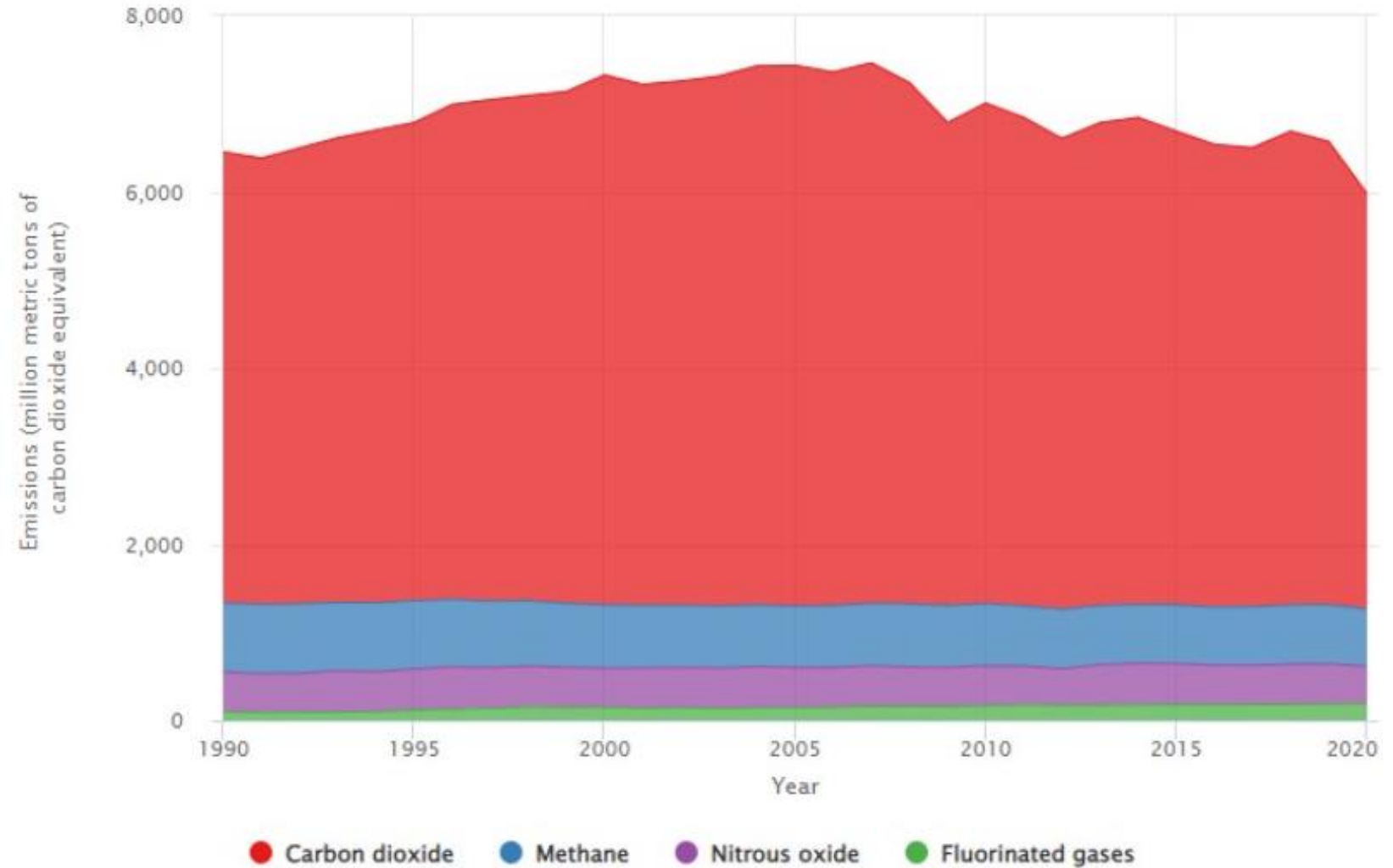


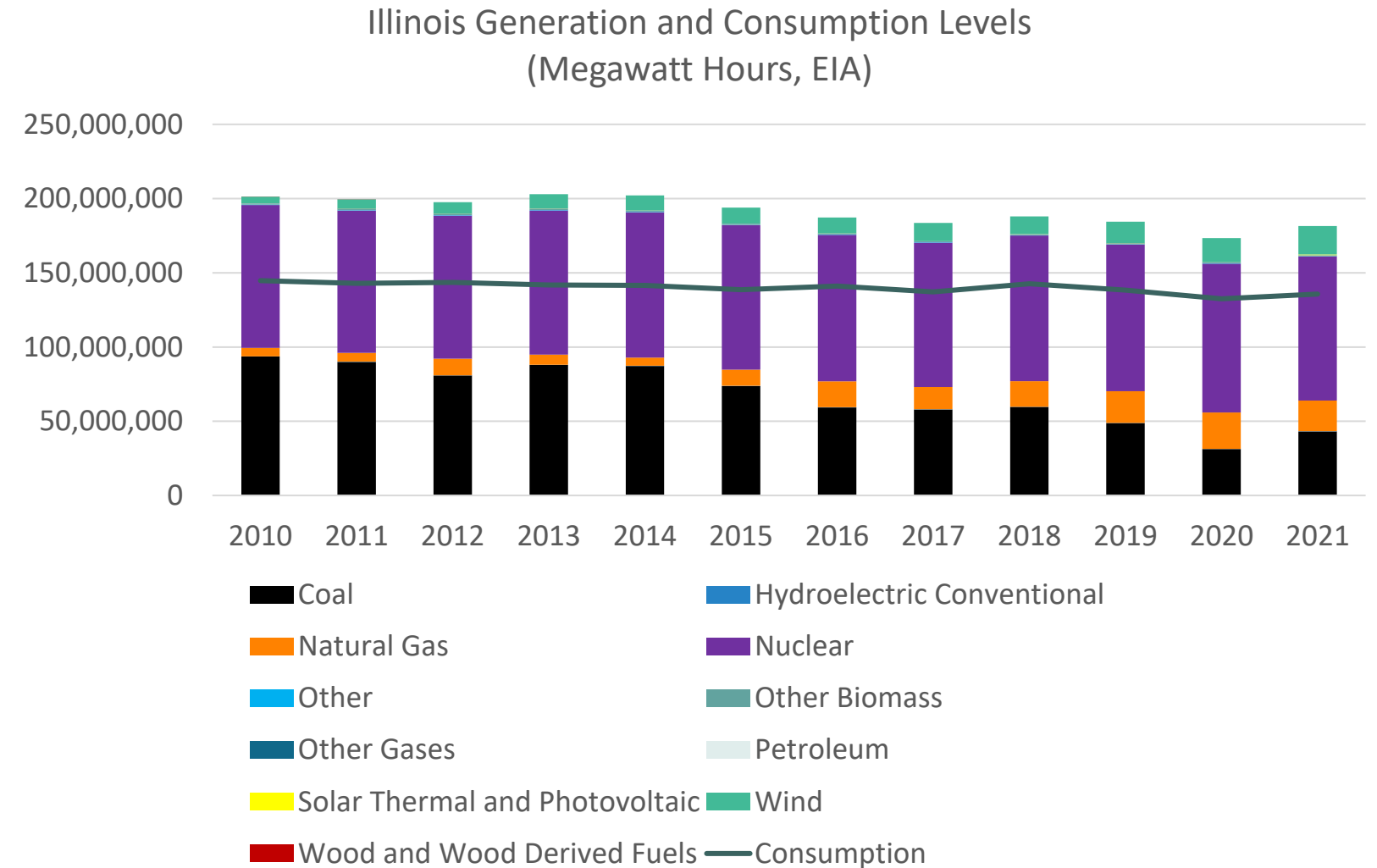
Image Credit: [US Environmental Protection Agency](#)

EMISSIONS PATTERNS (ILLINOIS)

ILLINOIS POWER SUPPLY & DEMAND

- Overall generation levels are falling
- Most reduction from coal-fired generation assets
- Nuclear remains stable
- Renewables sector remains fairly low in proportion to overall generation (11% of total)

CO2 Emissions in Illinois from all sources is falling



Source Data: [US DOE \(EIA\)](#)

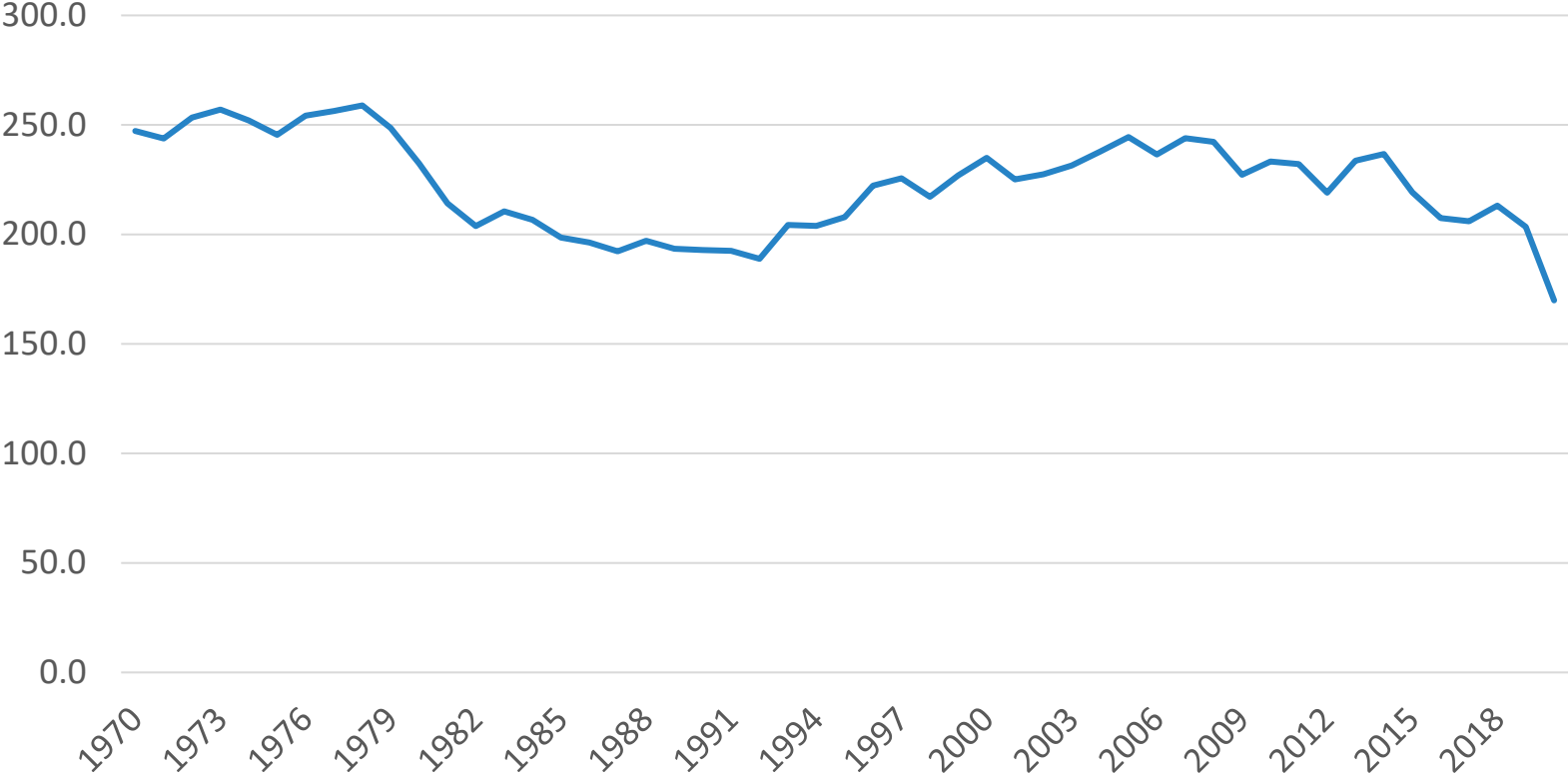
CO2 Emissions in Illinois from all sources is falling

EMISSIONS PATTERNS (ILLINOIS)

OVERALL CO2 EMISSIONS ARE FALLING

- Overall emissions are falling
- Transportation sector is now the largest emitting sector

Historical CO2 Emissions for Illinois, MMTCO2e (1970-2020, EIA)



Source Data: [US DOE \(EIA\)](#)

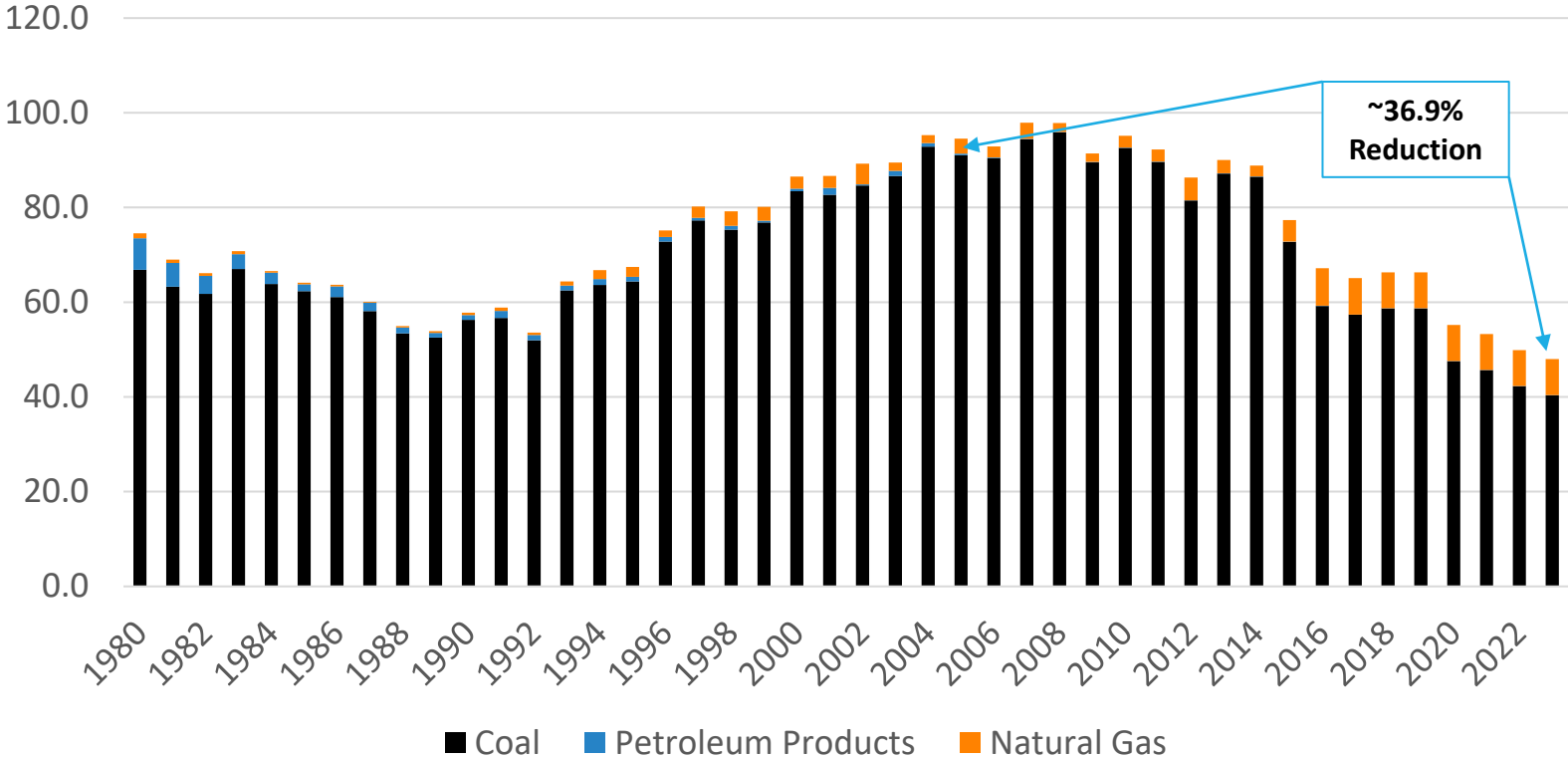
CO2 Emissions from the Illinois power sector are projected to continue falling

EMISSIONS PATTERNS (ILLINOIS)

ILLINOIS POWER SECTOR A MAJOR CONTRIBUTOR TO ILLINOIS MEETING ITS US CLIMATE ALLIANCE GOALS

- Implement policies that advance the goals of the Paris Agreement, aiming to reduce greenhouse gas emissions by at least 26-28 percent below 2005 levels by 2025.

Historical & Projected Emissions from Illinois Electricity Sector (Million Metric Tonnes CO2)



Source Data: [US DOE \(EIA\)](#)



DISCUSSION

THANK YOU

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