

The US Energy Landscape: Balancing Consumption with Carbon Neutrality Goals

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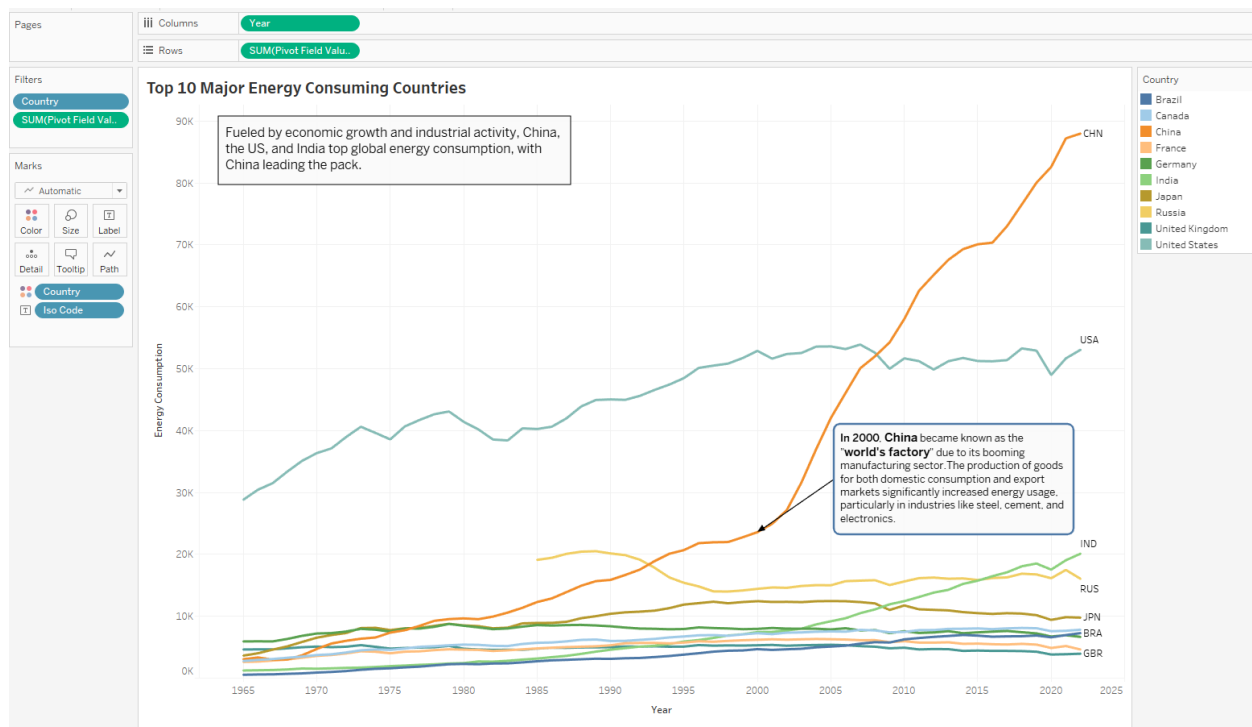
The US Energy Landscape: Balancing Consumption with Carbon Neutrality Goals

In this presentation, we'll analyze how various countries consume and produce energy, examining the correlation between increased energy consumption and rising global temperatures. We'll explore the diverse approaches nations are taking to transition away from non-renewable energy sources, with a focus on the United States' efforts to achieve its net-zero emissions goal.

We used Tableau as our primary tool for generating visuals leveraging datasets from Kaggle and OurWorldInData.

- World Energy Consumption.csv
- Zero emission targets.csv
- reworked_dataset_.csv
- temperature-anomaly.csv

The Rise of Energy Giants: A Look at Top Consumers

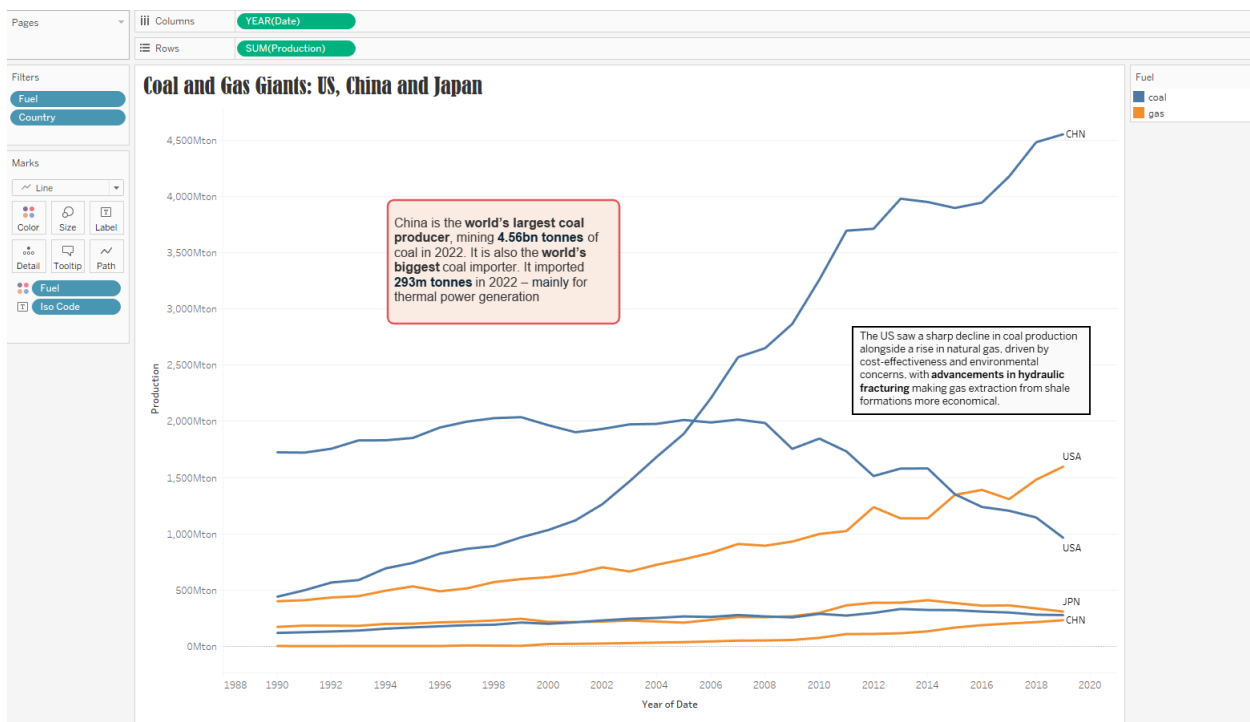


- **China:** China consumes the most energy globally, driven by its rapid economic growth and large-scale industrialization. The country's massive manufacturing sector relies

heavily on energy, particularly coal historically, though they're increasingly turning to natural gas and renewables.

- **United States:** The US ranks second in overall energy consumption. Factors contributing to this include a large population and widespread dependence on fossil fuels for transportation and electricity generation.
- **India:** India's energy consumption is rising rapidly due to its growing population and economic development. The country is heavily reliant on coal for power generation, though it's also investing in renewable energy sources like solar.
- **Russia:** Russia's abundant natural resources, particularly oil and natural gas, contribute significantly to its high energy consumption. Fossil fuels are a major source of energy for Russia's industries and households.

Kings of Coal:



Coal has fueled China's rapid economic expansion by providing a cheap and abundant source of energy for industries and electricity generation. Since after the launch of the “[reform and opening](#)” policy in 1978, China’s GDP growth has averaged almost 10% per year, resulting in a nearly 100-fold increase over four decades.

- **Air Pollution:** Coal burning is a major contributor to air pollution in China, leading to respiratory problems, acid rain, and smog.
- **Climate Change:** Coal is a significant source of greenhouse gas emissions, impacting China's efforts to address climate change.

- **Environmental Degradation:** Coal mining can have negative consequences for land reclamation, water resources, and ecosystems.

US Coal Production: A Boom, a Bust, and an Uncertain Future

The Boom Years (Pre-2008):

- **Dominant Source of Energy:** Coal was once the kingpin of US energy, powering a large portion of electricity generation and industry. Production peaked in 2008 at a staggering 1.17 billion short tons.
- **Factors Contributing to the Boom:** Affordable and abundant coal reserves, coupled with a lack of stringent environmental regulations, fueled this growth.

The Decline (Post-2008):

- **Sharp Drop in Production:** Since 2008, US coal production has witnessed a significant decline. By 2022, it had fallen to roughly 594 million short tons, a decrease of nearly 50%.
- **Reasons for the Decline:** Several factors contributed to this shift:
 - **Rise of Natural Gas:** Technological advancements made natural gas a cleaner and more cost-competitive fuel source for electricity generation.
 - **Environmental Regulations:** Growing concerns about air pollution from coal plants led to stricter regulations, making coal less attractive.

The Current Landscape:

- **Reduced Role:** Coal's role in US energy production has diminished significantly. In 2022, it accounted for only about 22% of electricity generation compared to over 50% in the early 2000s.
- **Job Losses:** The decline in production has led to job losses in the coal mining industry, impacting communities that relied heavily on coal.

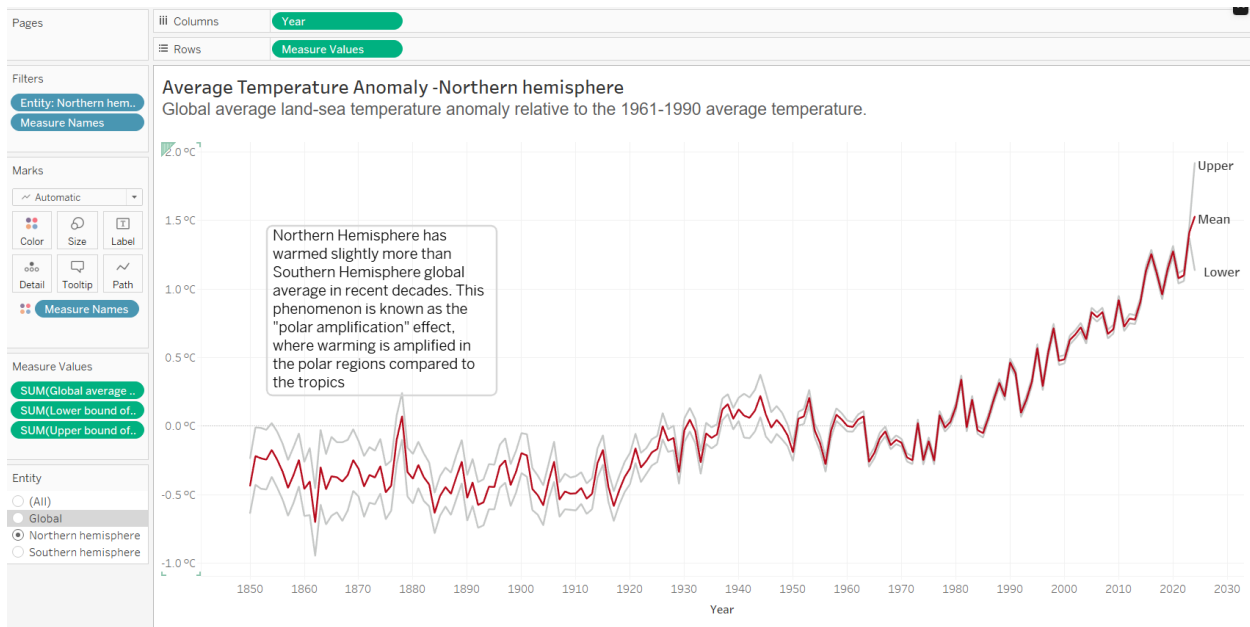
The Future of US Coal:

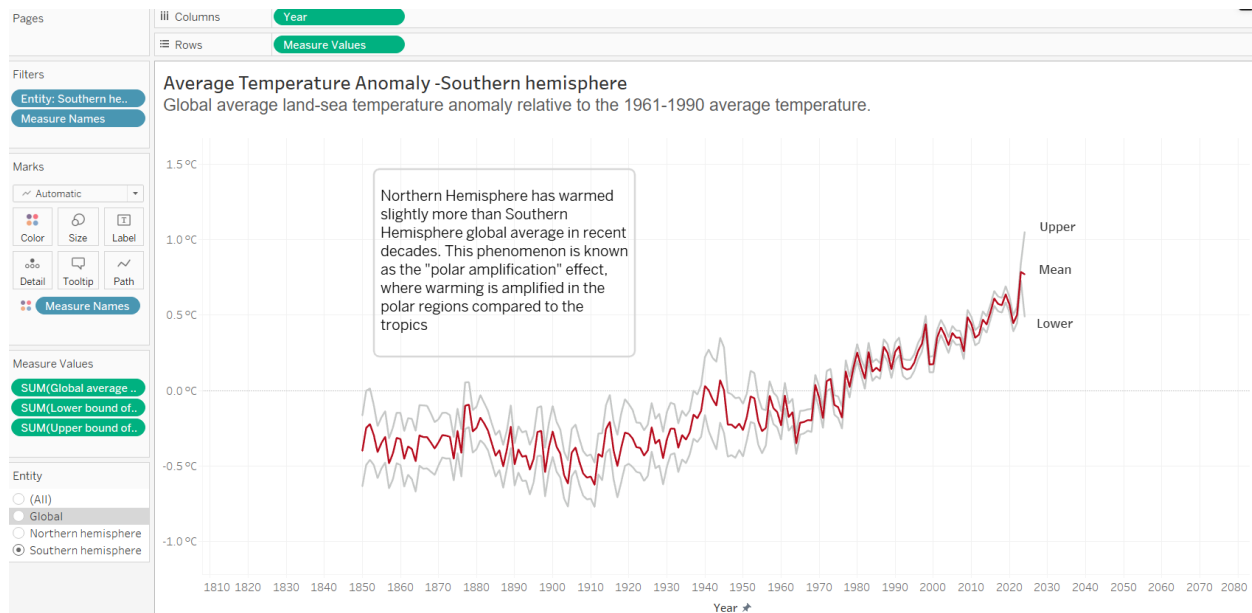
- **Uncertainty:** The future of US coal production remains uncertain. Factors like future energy prices, environmental regulations, and technological advancements in clean energy will all play a role.

Additional Points of Interest:

- **Export Market:** The US remains a net exporter of coal, with Europe being a major customer.
- **Environmental Impact:** The decline in coal production has had a positive impact on air quality and greenhouse gas emissions in the US.

A Warming World:- Temperature Anomalies Over Time

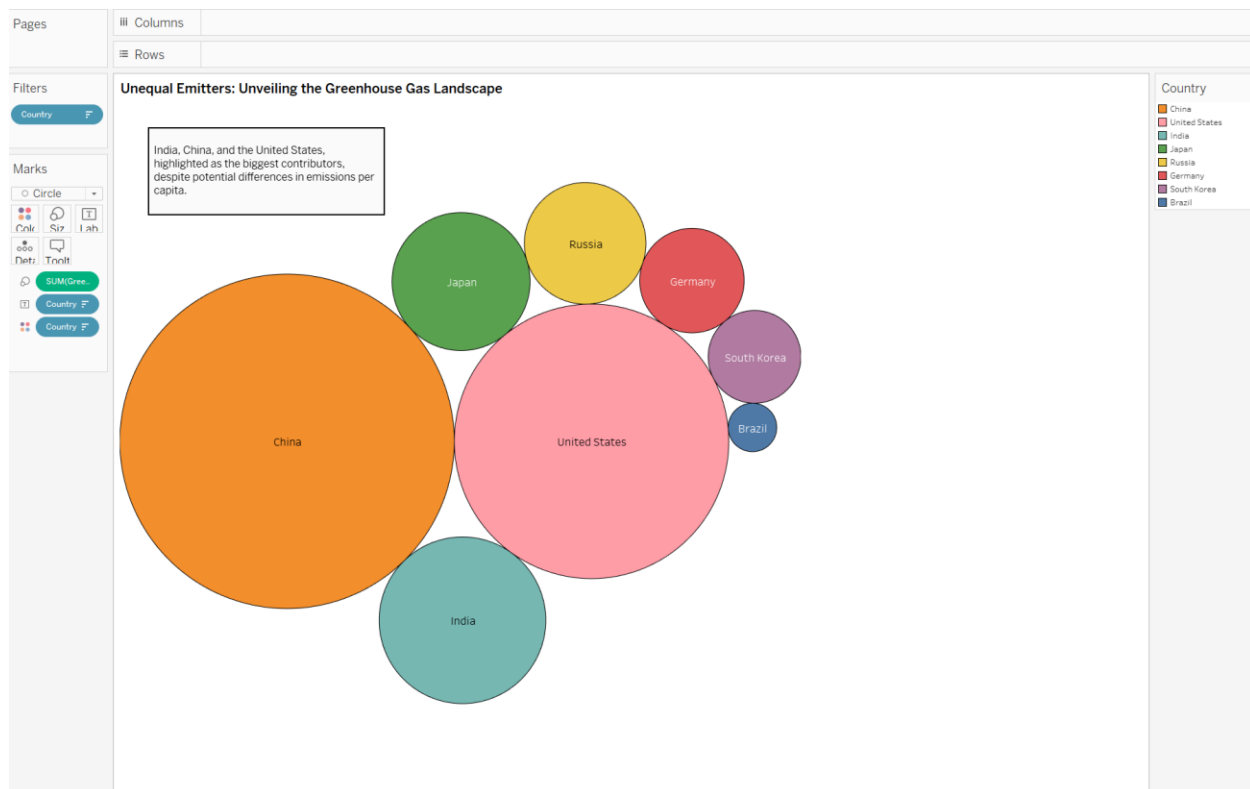




Carbon dioxide, methane and nitrous oxide — Earth’s major atmospheric greenhouse gases — reached record high concentrations in 2022. The global annual average atmospheric carbon dioxide concentration was 417.1 parts per million (ppm). This was **50% greater** than the pre-industrial level, 2.4 ppm greater than the 2021 amount, and the highest measured amount in the modern observational records as well as in paleoclimatic records dating back as far as 800,000 years.

Over the past half-century, the ocean has stored more than **90%** of the excess energy trapped in Earth’s system by greenhouse gases and other factors. The global ocean heat content, measured from the ocean’s surface to a depth of 2,000 meters, continued to increase and reached new record highs in 2022.

Global Greenhouse Gas Emissions by Country:



Top Emitters:

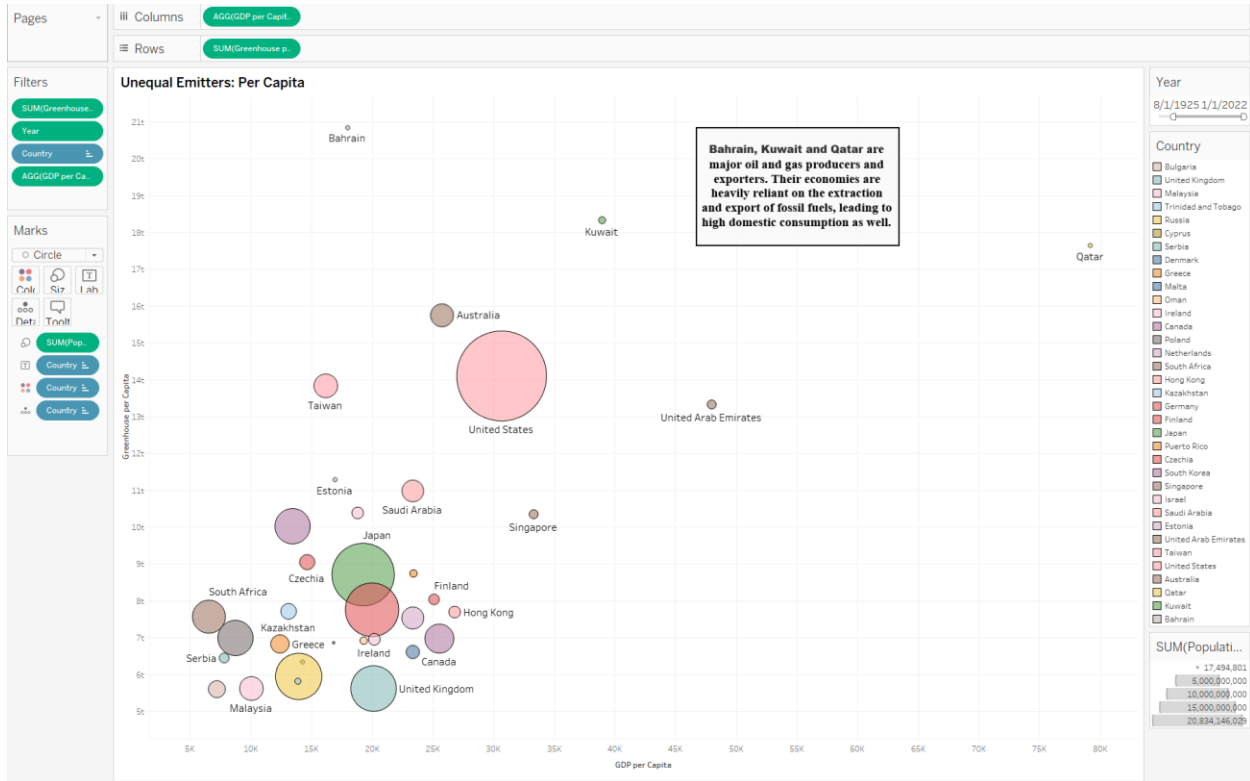
- **China:** Currently the world's largest emitter of greenhouse gases, primarily due to its reliance on coal for power generation and a booming industrial sector. In 2020, it emitted 12.3bn tonnes of CO₂ equivalent (GtCO₂e), amounting to 27% of global greenhouse gas emissions.
- **United States:** While historically the top emitter, the US currently ranks second. It remains a significant contributor due to its large population and established industrial base.
- **India:** As India's economy continues to grow, its greenhouse gas emissions are also rising. Coal consumption and a rapidly growing transportation sector are key contributors.

Greenhouse Gas Emitters: Beyond Total Numbers, Looking at Per Capita Emissions

While understanding total greenhouse gas emissions by country provides a big-picture view, it doesn't tell the whole story. When comparing countries, it's also important to consider greenhouse gas emissions per capita.

Why is Per Capita Important?

- When looking solely at total emissions, large and populous countries like China and India naturally appear at the top.
- However, per capita emissions provide a more nuanced view.
- A country with a smaller population might have high total emissions but a relatively low per capita emission rate if its population is small.



This visualization depicts the greenhouse gas emissions Per Capita for every country with respect to their population.

• Bahrain:

- **High Vehicle Ownership:** Bahrain has a high rate of car ownership per capita, leading to increased transportation emissions.
- **Limited Renewable Energy:** Bahrain has limited domestic renewable energy resources and currently relies heavily on fossil fuels for electricity generation.

• Kuwait:

- **Subsidized Energy:** Energy subsidies in Kuwait can lead to overconsumption of fossil fuels.
- **Industrial Activity:** Alongside oil and gas, Kuwait has a significant industrial sector that contributes to emissions.

- **Qatar:**

- **Highest Per Capita GDP:** Qatar has the highest GDP per capita in the world, often linked to higher energy consumption patterns.
- **Rapid Growth:** Qatar has experienced rapid economic growth in recent decades, leading to an increase in energy demand.

The Link Between Energy Consumption and Greenhouse Gases:

- When fossil fuels like coal for electricity, heat, or transportation are burned, they release carbon dioxide (CO₂) and other greenhouse gases into the atmosphere.
- These gases act like a blanket, trapping heat from the sun and causing the planet to warm.

Coal's Outsized Impact:

- Coal is particularly problematic because it releases the most CO₂ per unit of energy compared to other fossil fuels like natural gas.
- According to the Intergovernmental Panel on Climate Change (IPCC), coal combustion is the single largest source of global CO₂ emissions from the energy sector.

The Chain Reaction of Warming:

- As global temperatures rise, it disrupts weather patterns, leading to more extreme weather events like heatwaves, droughts, floods, and stronger storms.
- Rising sea levels threaten coastal communities, and melting glaciers contribute to water scarcity.
- These changes have wide-ranging impacts on ecosystems, agriculture, human health, and economies around the world.

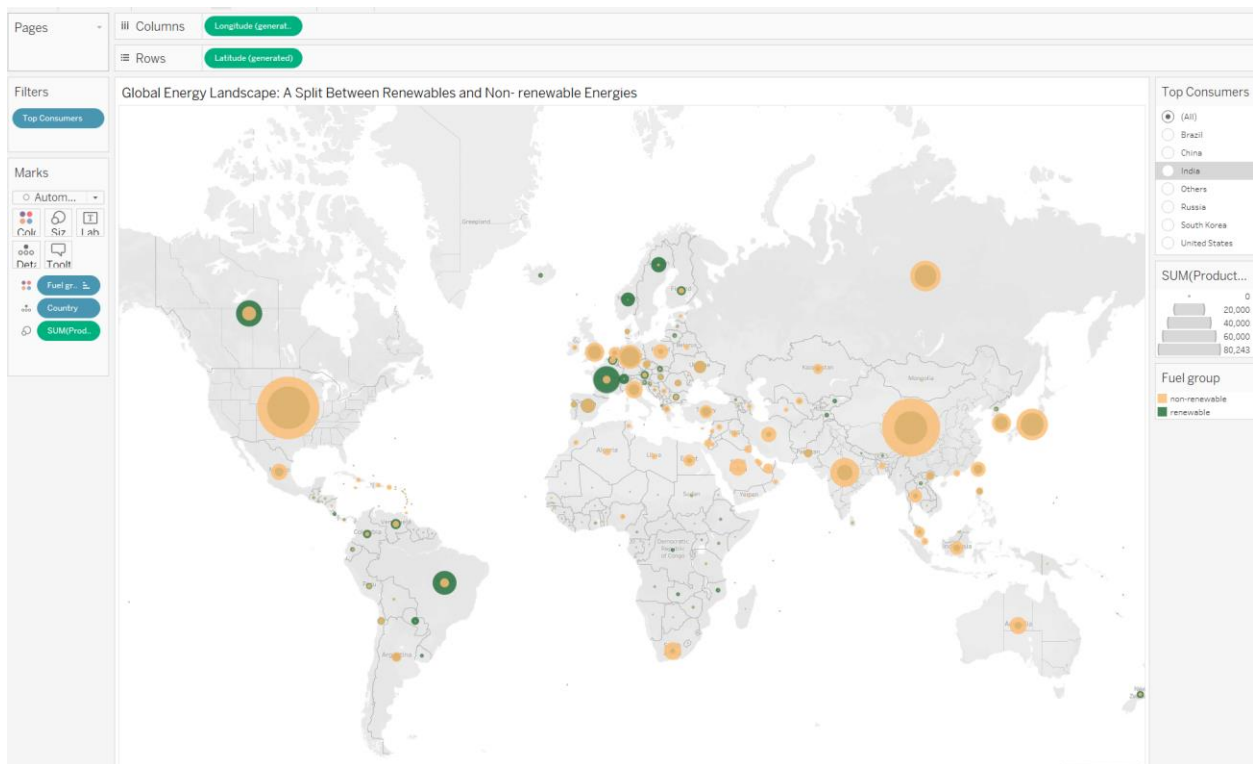
For decades, economic growth relied heavily on the excessive use of resources and fossil fuels. This approach fueled rapid development but came at a cost. The consequences of overconsumption are becoming increasingly evident: rising global temperatures, extreme weather events, and pollution.

Recognizing the severity of these issues, many countries are shifting gears. They are transitioning towards sustainable resource management and cleaner energy sources like solar and

wind power. This global effort aims to address the environmental damage caused by past practices and ensure a more sustainable future for generations to come.

Global Energy Landscape: A Split Between Renewables and Fossil Fuels

The United States has set a goal of achieving net-zero greenhouse gas emissions by no later than 2050. The goal is considered ambitious and requires significant progress compared to current trends.



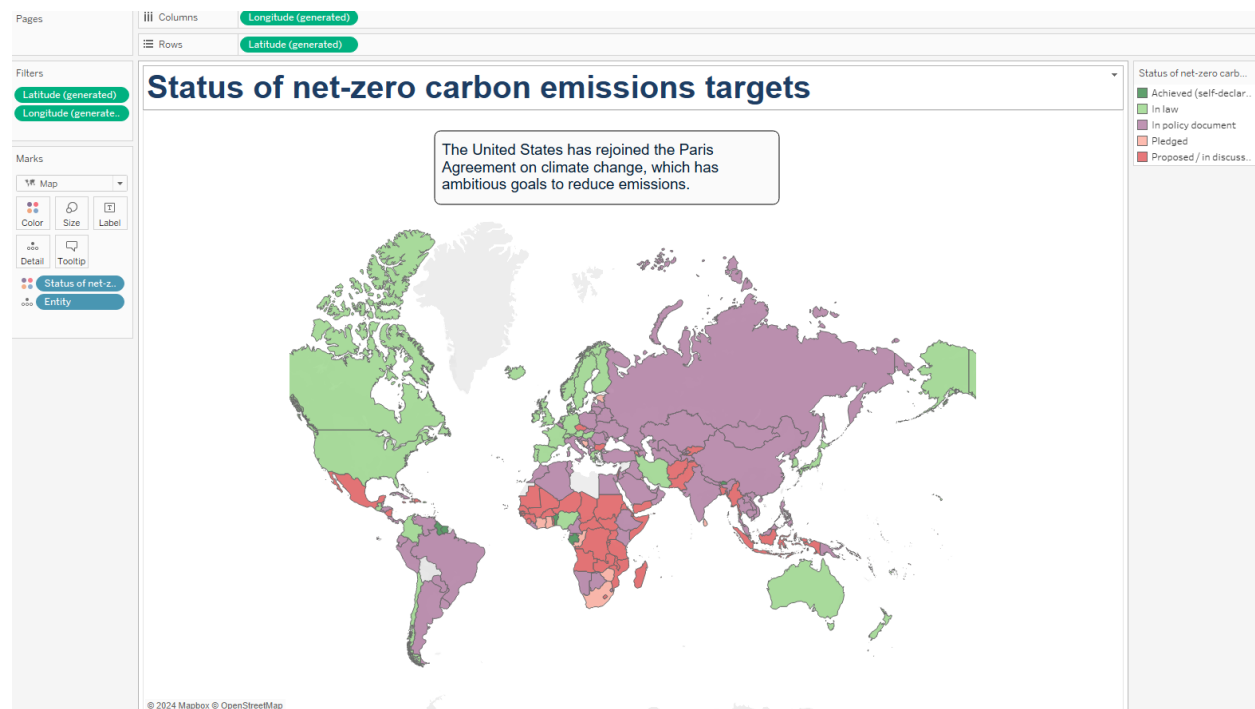
United States:

- The US has seen a rise in renewable energy adoption, driven by factors like falling costs and federal and state-level policies.
- Policies like tax credits for renewable energy projects and Renewable Portfolio Standards (RPS) that mandate a certain percentage of electricity come from renewables have been instrumental.

Currently, fossil fuels dominate the global energy mix, accounting for about 80% of global energy consumption. However, this is projected to change in the coming decades, with renewables playing an increasingly important role. By mid-century, the split between fossil fuels and non-fossil fuels is expected to be nearly even.

There are several reasons for this shift. One reason is that renewable energy sources, such as solar and wind power, are becoming increasingly cost-competitive with fossil fuels. Additionally, there are growing concerns about the climate impact of burning fossil fuels, which is driving a shift towards cleaner energy sources.

Paris Agreement: A global Goal



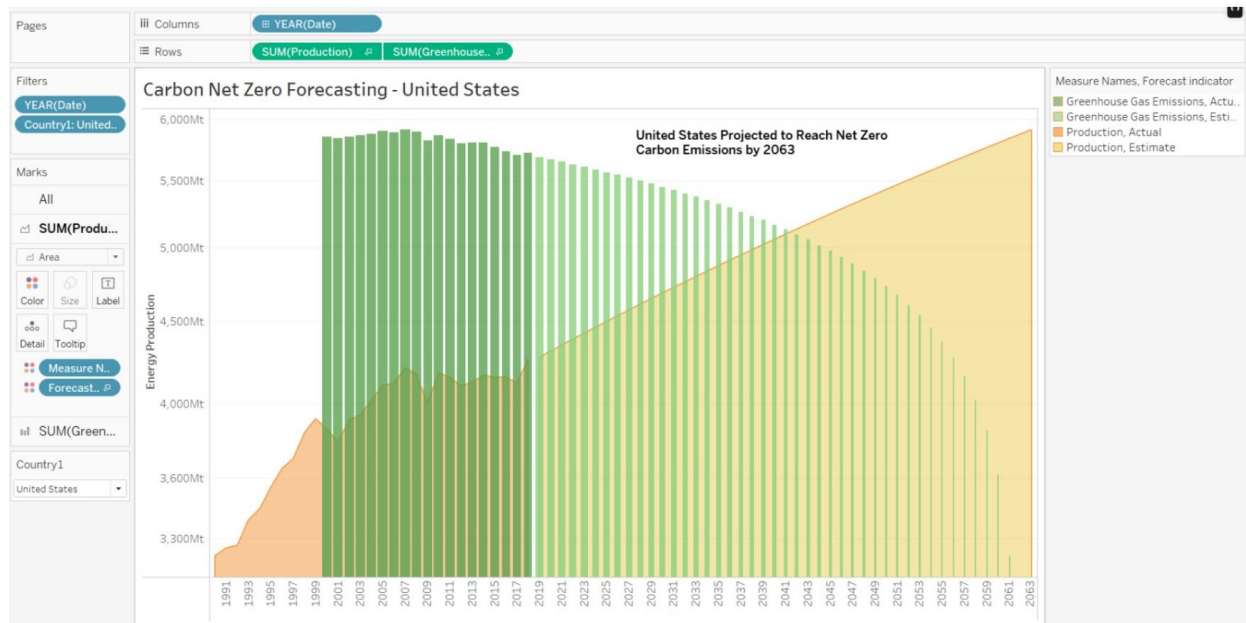
MOBILIZING TO ACHIEVE NET-ZERO WILL DELIVER STRONG NET BENEFITS FOR ALL AMERICANS.

Driving down Greenhouse Gases will spur investments that modernize the American economy, address the distributional inequities of environmental pollution and climate vulnerability, improve public health in every community, and reduce the severe costs and risks from climate change.

Benefits include:

- **PUBLIC HEALTH.** Reducing air pollution through clean energy will avoid 85,000–300,000 premature deaths, and health and climate damages of \$150–\$250 billion through 2030. It will avoid \$1–3 trillion in damages through 2050 in the United States alone. These measures will also help alleviate the pollution burdens disproportionately borne by communities of color, low-income communities, and indigenous communities.
- **ECONOMIC GROWTH.** Investments in nascent clean industries will enhance competitiveness and propel sustained growth. The United States can lead in crucial clean technologies like batteries, electric vehicles, and heat pumps, without sacrificing critical worker protections.
- **REDUCED CONFLICT.** Drought, floods, and other disasters fueled by climate change have caused large-scale displacements and conflict.

United States forecasting for its goal to Net Zero Carbon



THE 2050 NET-ZERO EMISSIONS GOAL IS ACHIEVABLE. The United States can deliver net-zero emissions across all sectors and GHGs through multiple pathways, but all viable routes to net-zero involve five key transformations:

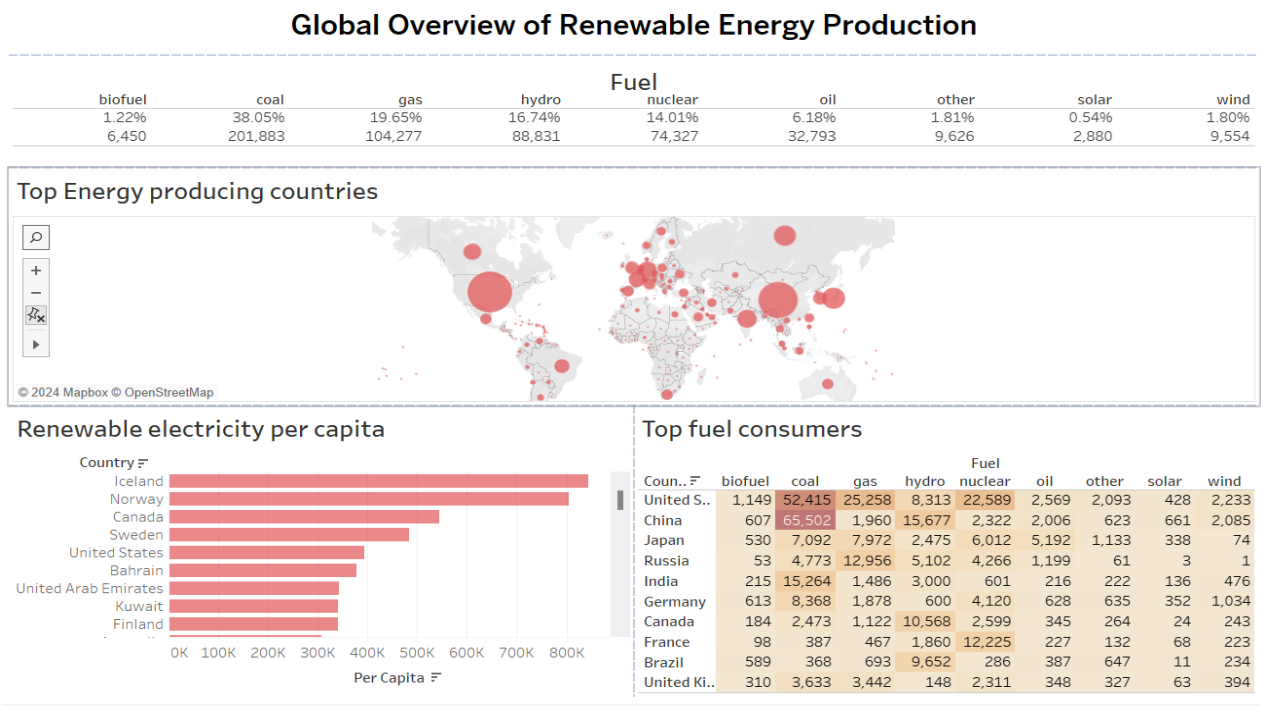
1. **DECARBONIZE ELECTRICITY.** Electricity delivers diverse services to all sectors of the American economy. The transition to a clean electricity system has been accelerating in recent years— driven by plummeting costs for solar and wind technologies, federal and subnational policies, and consumer demand. Building on this success, the United States has set a goal of 100% clean electricity by 2035, a crucial foundation for net-zero emissions no later than 2050.
2. **ELECTRIFY END USES AND SWITCH TO OTHER CLEAN FUELS.** We can affordably and efficiently electrify most of the economy, from cars to buildings and

industrial processes. In areas where electrification presents technological challenges—for instance aviation, shipping, and some industrial processes— we can prioritize clean fuels like carbon-free hydrogen and sustainable biofuels.

3. **CUT ENERGY WASTE.** Moving to cleaner sources of energy is made faster, cheaper, and easier when existing and new technologies use less energy to provide the same or better service. This can be achieved through diverse, proven approaches, ranging from more efficient appliances and the integration of efficiency into new and existing buildings, to sustainable manufacturing processes.

Interactive Dashboard to Give more insight into the global overview of production of different Energy sources.

Coal is still the primary energy source, but there is significant growth in Solar and Hydro energy production. Natural gas, which is less polluting than coal, is a good alternative for reducing global warming.



While coal remains the dominant energy source for now, the significant rise of solar and hydropower is a beacon of hope. These renewable sources are gaining momentum, offering a cleaner path forward. Natural gas can play a transitional role as we move away from

coal, but the goal must be a complete shift towards sustainable, renewable energy sources. By embracing innovation and prioritizing clean energy, we can secure a brighter future for our planet.