



# The Energy-Carbon Connection: Where Do I Start?

ESI 2023 Conference  
Tuesday, September 26, 2023  
12:45 – 1:30 p.m.



# About Advanced Energy

Advanced Energy is a nonprofit energy consulting firm.

We work with electric utilities, government and a wide variety of private organizations in the residential, commercial and industrial, renewables, motors and drives, and electric transportation markets. Our customized services include research, testing, training, consulting and program design.

# Today's Topics

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- Energy Background
  - The Big Picture
  - Energy Efficiency
  - Energy Intensity
- Scope 1, 2 and 3 GHG Emissions
  - Seven Major GHGs
  - The Energy-Carbon Connection
  - Definitions and Impacts
- Decarbonization Programs
  - SEM/ISO 50001
  - EV Infrastructure Planning
  - Renewables Planning
  - RECs and Carbon Offsets





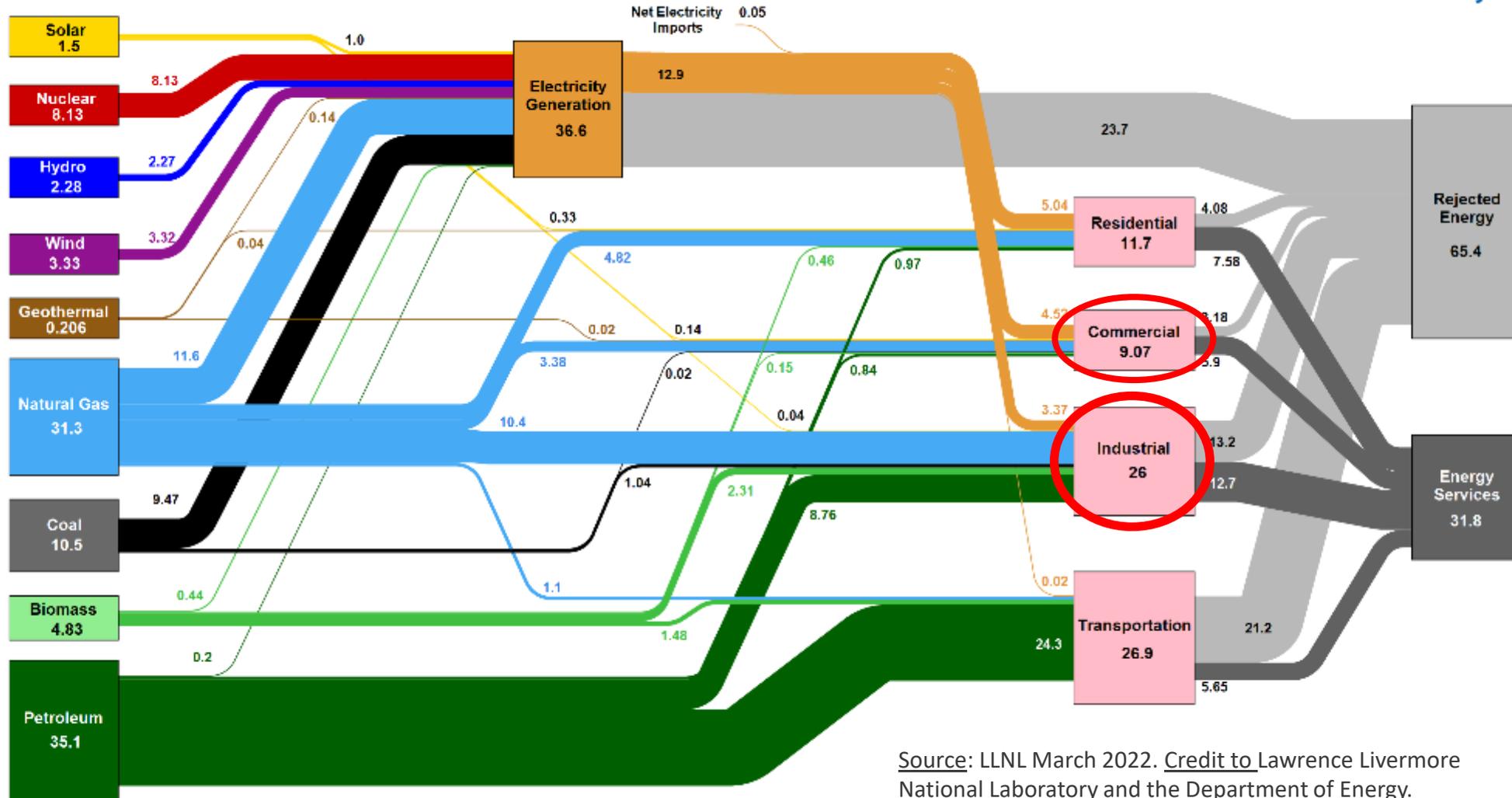
# Energy Background

It takes a lot of energy to make and move things!

# Energy: The Big Picture

NOTE: 100.41  
QUADS in 2022

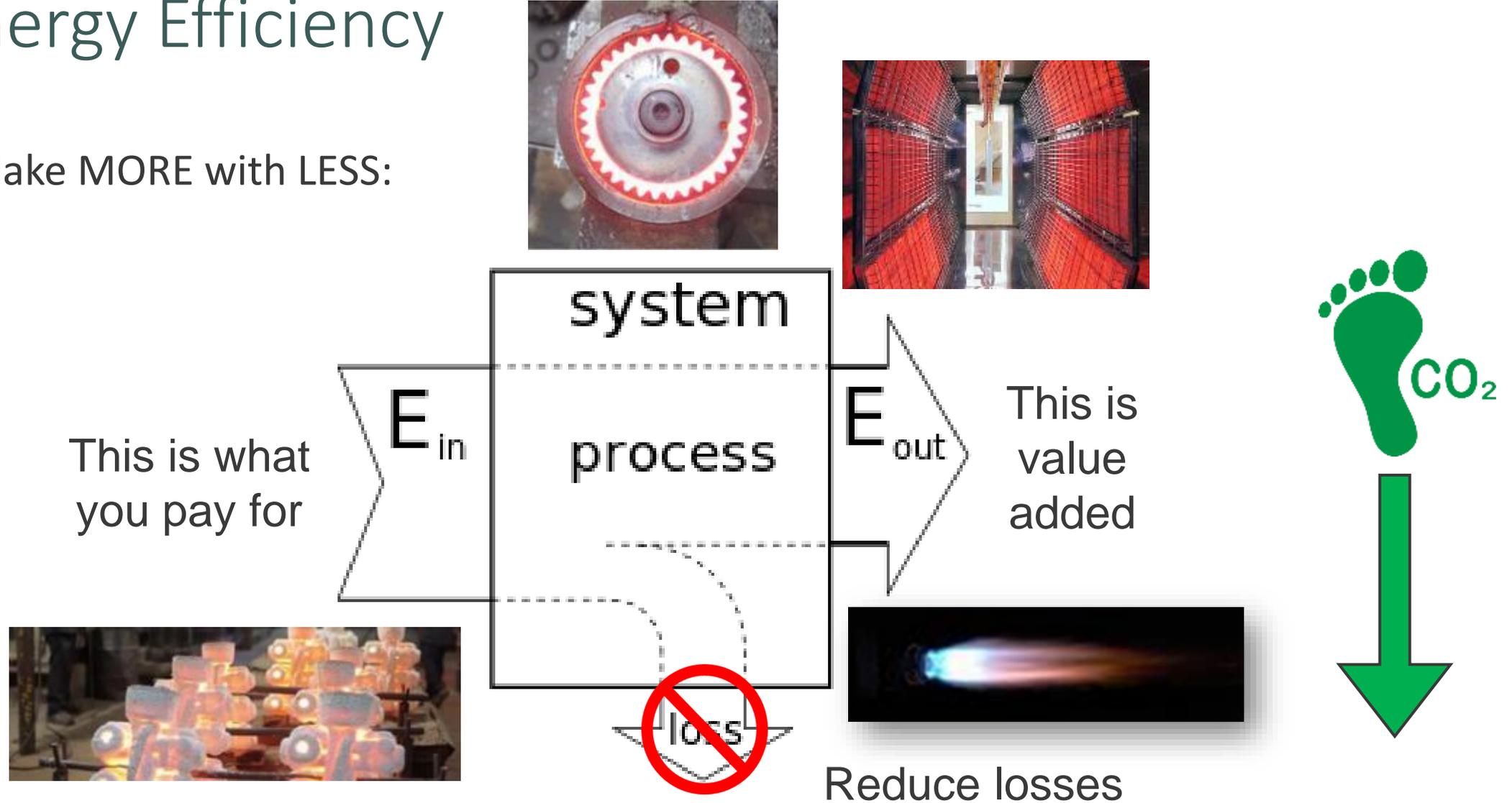
Estimated U.S. Energy Consumption in 2021: 97.3 Quads



Source: LLNL March 2022. Credit to Lawrence Livermore National Laboratory and the Department of Energy.

# Energy Efficiency

- Make MORE with LESS:



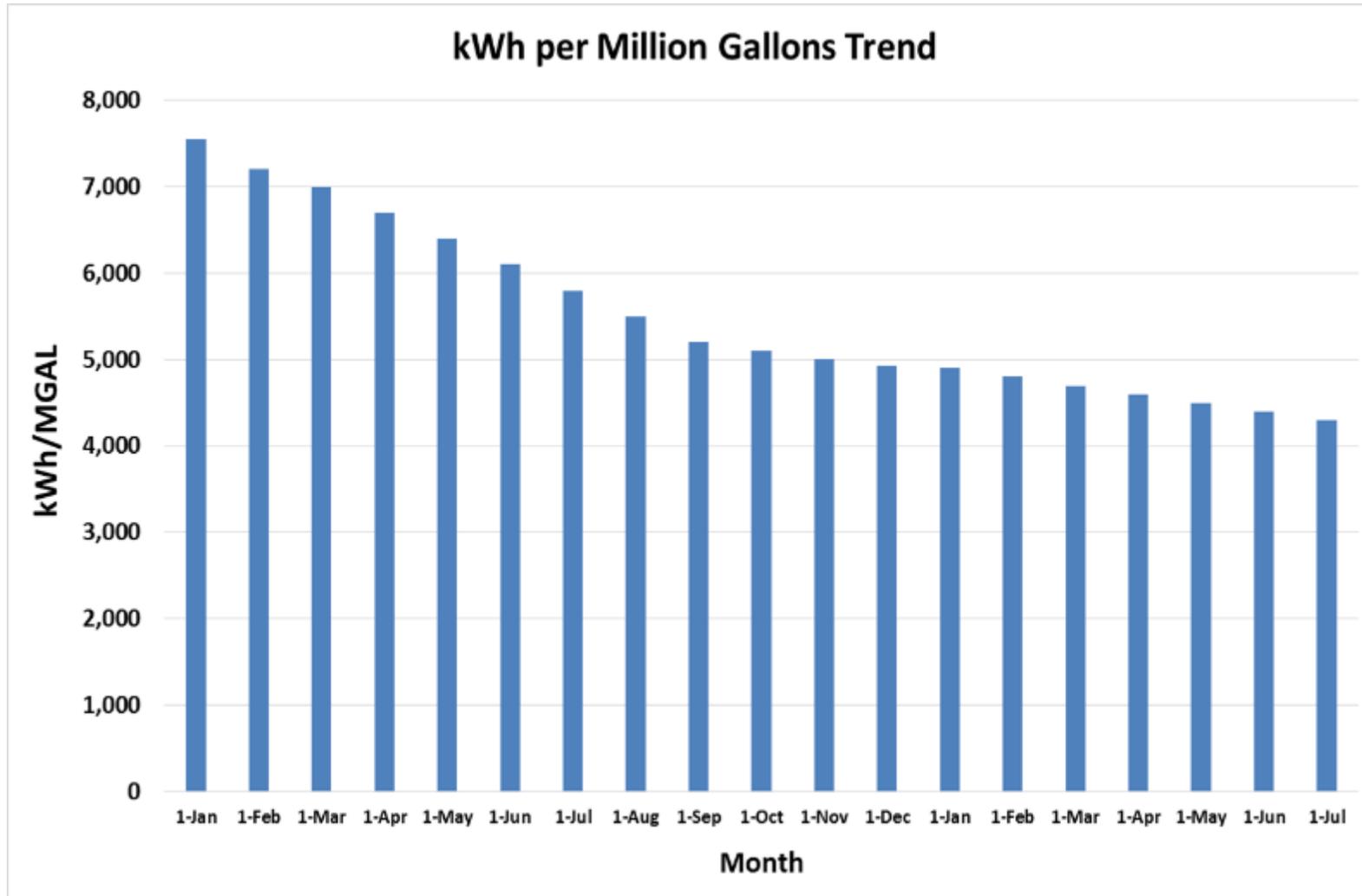
# Energy Intensity

- Can be thought of as the amount of total site energy consumed divided by the amount of production for the same period, e.g., monthly
- Examples:
  - MMBTU per ton
  - MMBTU per production unit (gear, car, tire, lawn mower, engine, etc.)
  - kWh per gallon
  - MWh per square foot for buildings
- Trend your data

$$EI = \frac{\text{ENERGY}}{\text{PRODUCTION}}$$



# Energy Intensity — Trend





# Scope 1, 2 & 3 GHG Emissions

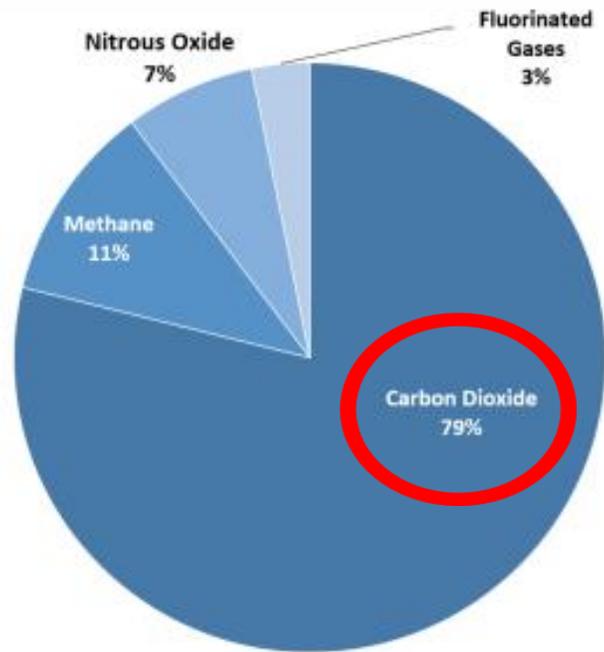
Definitions and Sources

# The Seven Major GHGs

Gas	100-Year GWP (CO <sub>2</sub> e)
Carbon Dioxide (CO <sub>2</sub> )	1
Methane (CH <sub>4</sub> )	25
Nitrous Oxide (NO <sub>2</sub> )	298
Hydrofluorocarbons (HFCs)	12 to 14,800
Perfluorocarbons (PFCs)	7,390 to 12,200
Sulfur Hexafluoride (SF <sub>6</sub> )	22,800
Nitrogen Trifluoride (NF <sub>3</sub> )	17,200

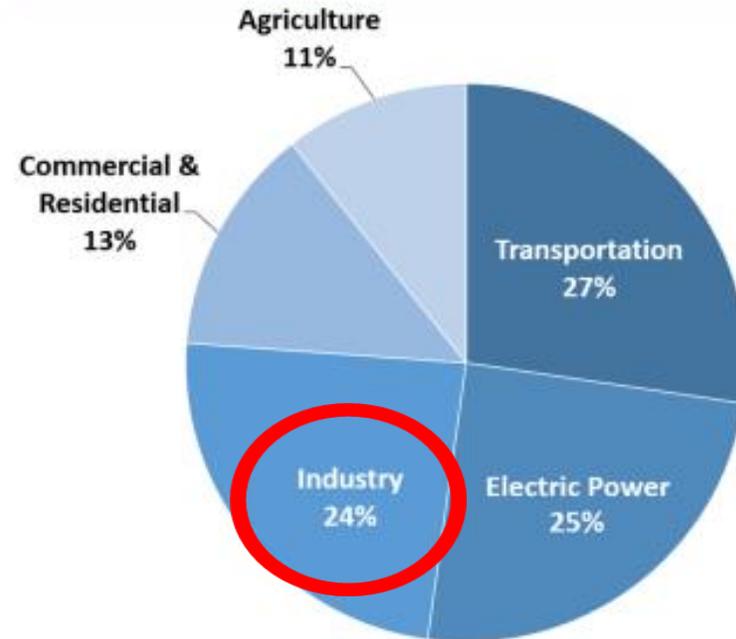
# U.S. Carbon Emissions

Overview of U.S. Greenhouse Gas Emissions in 2020



Note: All emission estimates from the [\*Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020\*](#).

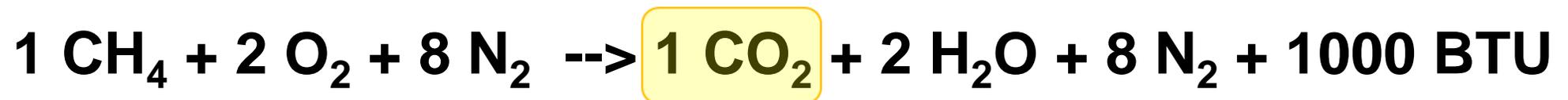
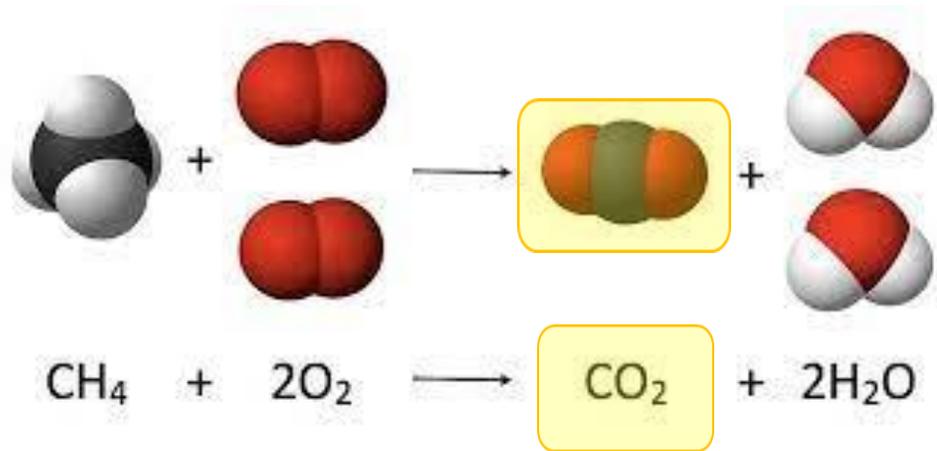
Sources of U.S. Greenhouse Gas Emissions in 2020



Note: All emission estimates from the [\*Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020\*](#).

# The Energy-Carbon Connection

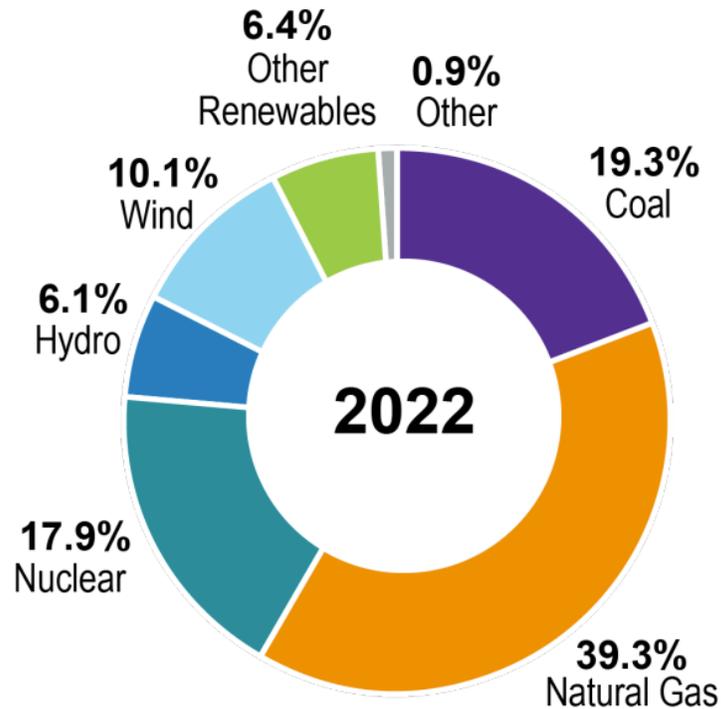
- Many commercial and industrial processes require heat
- Much of the needed heat is produced using combustion



# The Energy-Carbon Connection



## Electric Companies Use a Diverse Mix of Resources to Generate Electricity



## 2022 National Energy Resource Mix

\*Other Renewables\* includes universal (or large-scale) solar, private (or rooftop) solar, geothermal, and generation from biomass sources (agricultural waste, landfill gas recovery, municipal solid waste, wood, non-wood waste).

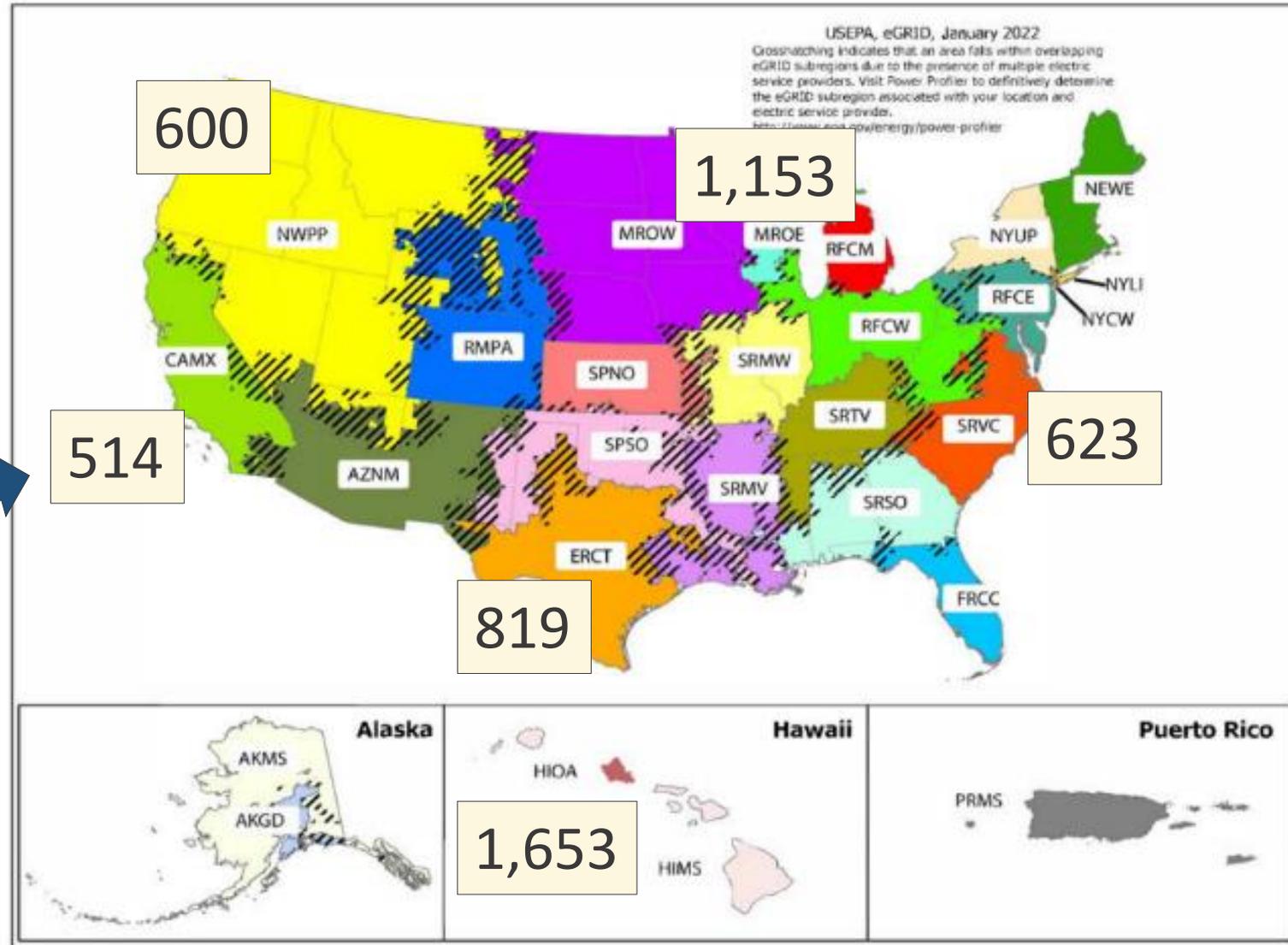
\*Other\* includes generation by fuel oil, tires, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

Source: U.S. Department of Energy, Energy Information Administration.

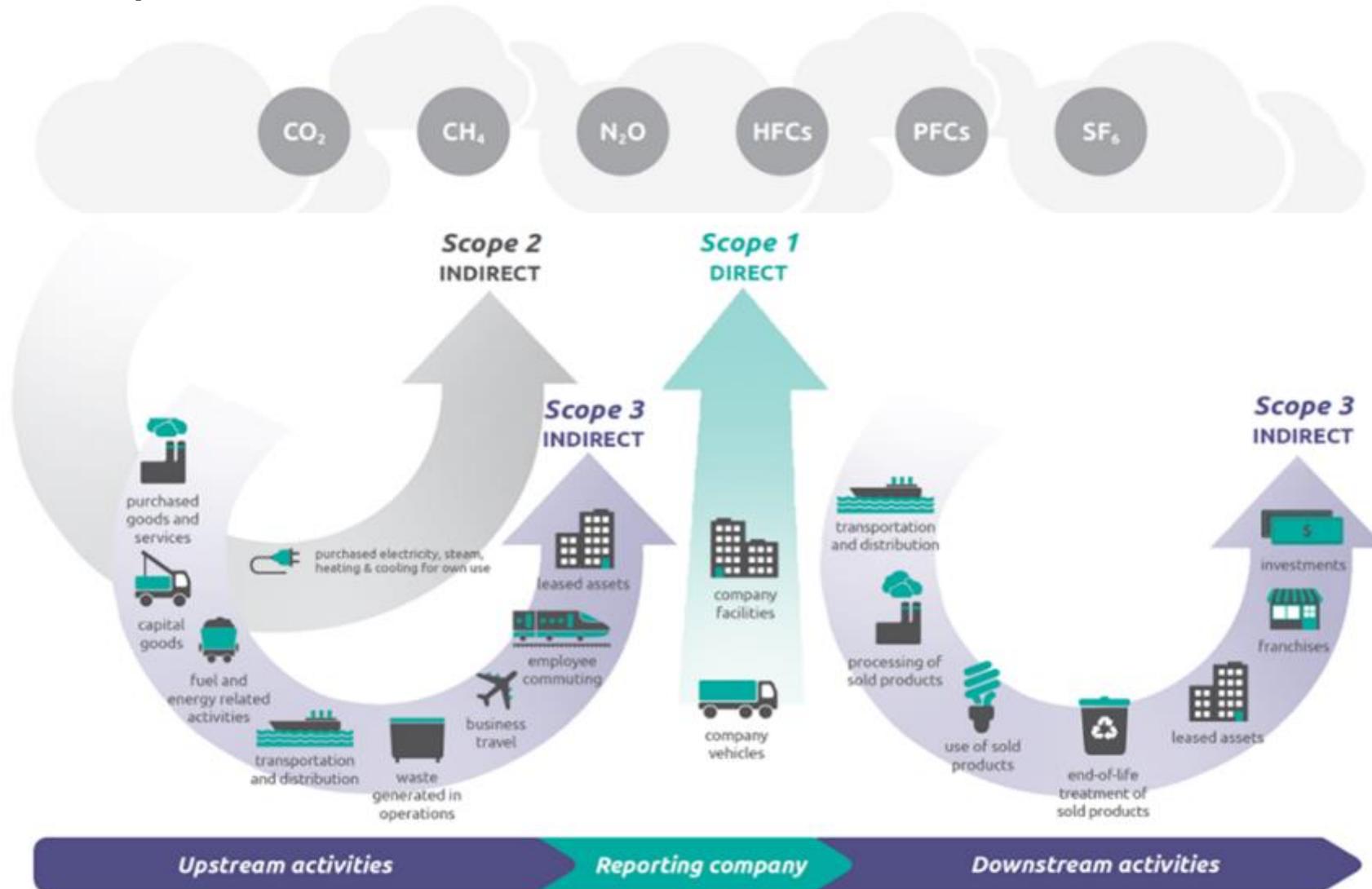
- Consuming electricity also contributes to your carbon footprint

# The Energy-Carbon Connection

- Carbon content of purchased electricity depends on your utility's generation portfolio
- CO2 Factor (lb./MWh)



# GHG Scopes



# GHG Scopes — Definitions

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- Scope 1: Direct emissions from sources that are owned or controlled by the organization
  - On-site fossil fuel combustion and fleet fuel consumption
- Scope 2: Indirect emissions from sources that are owned or controlled by the organization
  - Purchased electricity, heat, or steam generated by a utility
- Scope 3: Indirect emissions from sources other than Scope 1 or 2 that are related to the activities of the organization

# GHG Scope 1 & 2 — Definitions

## GHG Emission Sources: Scope 1



- Direct Emissions from Stationary Combustion
- Direct Emissions from Mobile Combustion Sources
- Direct Fugitive Emissions from
  - Refrigeration and Air Conditioning Systems Leakage
  - Fire Suppression Systems
  - Purchase and Release of Industrial Gases

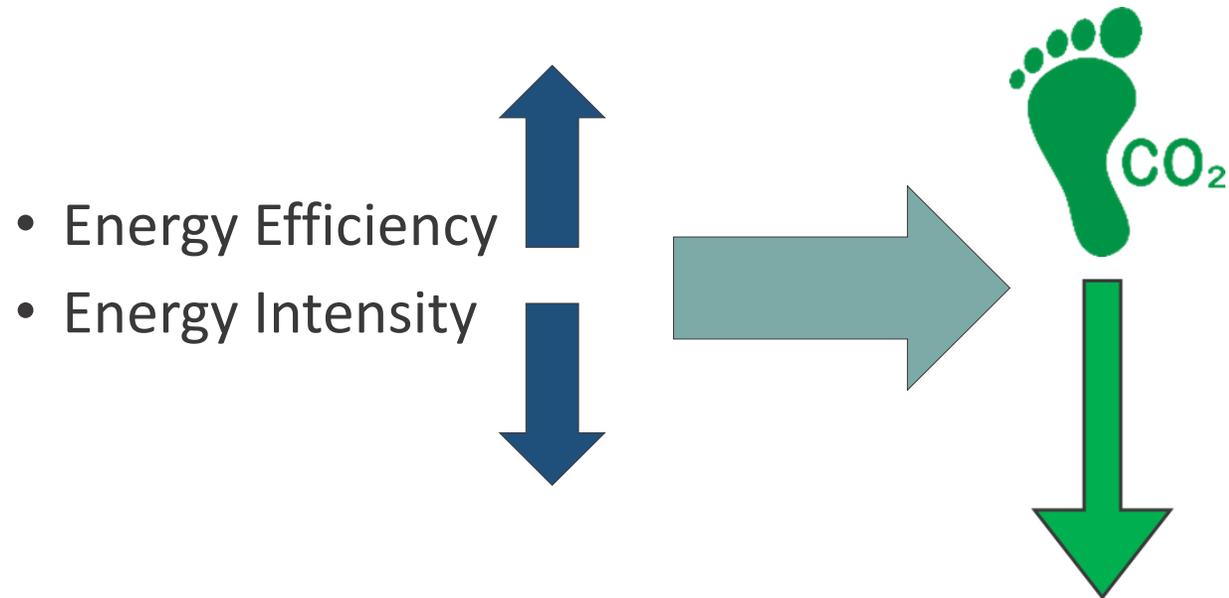


## GHG Emission Sources: Scope 2

- Purchased Electricity
  - Location-Based: average emission factors for the local grid
  - Market-Based: contractual agreements with utilities
    - Green Power (Wind, Solar, Hydro, Nuclear, Biomass)
    - Renewable Energy Credits (RECs) (MWh)
- Purchased Steam, Heat, or Cooling

# Impacting Your Scope 1 & 2 GHG Emissions

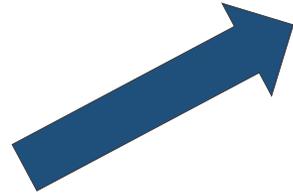
- On-site energy consumption directly connected to Scope 1 and 2 emissions (i.e., carbon footprint)



- Energy efficiency project implementation will impact carbon footprint

# GHG Scope 3 — Definitions

## GHG Emission Sources: Scope 3



Scope 1 & 2 at  
Manufacturing Site



### Upstream

1. Purchased Goods and Services
2. Capital Goods
3. Fuel- and energy-related activities (not in Scope 1 or 2)
4. Transportation and Distribution
5. Waste Generated by Operations
6. Business Travel
7. Employee Commuting
8. Leased Assets

Where to  
focus?

### Downstream

9. Transportation and Distribution
10. Processing of Sold Products
11. Use of Sold Products
12. End-of-life Treatment of Sold Products
13. Leased Assets
14. Franchises
15. Investments

# Scope 3 — Cradle to Grave



- Think about some of the materials used to make the tractor and disc harrow
- Think about all the energy used and GHGs generated to get these materials from the source, then processed, and then to the manufacturing site



Rubber



Bauxite



PVC



Iron Ore



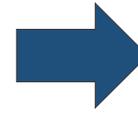
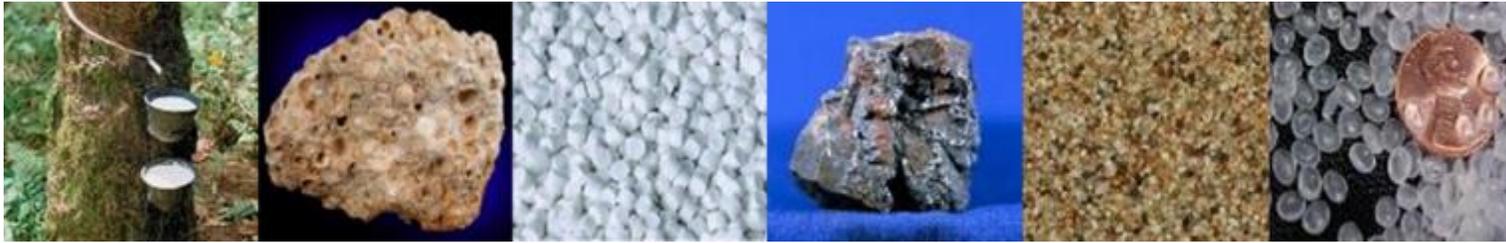
Sand



Polyester

# Scope 3 — Cradle to Grave

- Scope 3 emissions go from “cradle to grave”



Visit our tabletop to learn more

# Decarbonization Programs

Where Do I Start?



# SEM/ISO 50001

- Step-by-step support to help companies achieve 50001 Ready recognition, ISO 50001 certification
- Suite of services
  - Certification consulting
  - Gap analysis
  - Internal audit
  - Training
- Can start wherever a site is on its strategic energy management journey



# EV Infrastructure Planning

- Customized approach to address EV charging needs and goals
- Multiyear plan to assist in transition to EVs, including unbiased assessment of charging stations (how many, what type, costs, incentives, etc.)



# Renewables Planning

- Initial feasibility study
- Evaluate correct sizing, upfront cost, rate impacts, payback period
- Can assess battery storage for backup power or demand shaving
- Can also provide full system commissioning
- Unbiased recommendations to ensure you are making the best decisions for your site from start to finish



# RECs and Carbon Offsets

- Offer local RECs and regional carbon offsets through NC GreenPower program
  - All RECs sourced from North Carolina; carbon offsets sourced from North Carolina, South Carolina, Virginia
- Supports community projects, local economy and environment



# Questions

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# Thank you!

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**Kitt Butler**

919-857-9017

[kbutler@advancedenergy.org](mailto:kbutler@advancedenergy.org)

[www.advancedenergy.org](http://www.advancedenergy.org)



**Michael Stowe**

919-857-9043

[mstowe@advancedenergy.org](mailto:mstowe@advancedenergy.org)

[www.advancedenergy.org](http://www.advancedenergy.org)