

# Greening Our Future By Educating Tomorrow's Workforce



## Module 3: Energy Efficiency and Carbon Footprint

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## What You Will Learn From This Module:

- Carbon intensity of various energy sources
- The role of carbon dioxide and other air emissions in the greenhouse effect.
- How to calculate a discrete carbon footprint and propose ways to reduce it.
- How to read and disseminate information from an industrial energy bill.
- Energy intensive manufacturing processes and equipment.

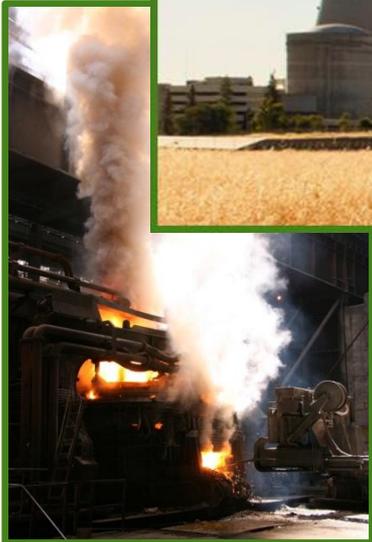


# Why Care About Energy?

- Economic imperative
- Energy security
- Environmental impacts



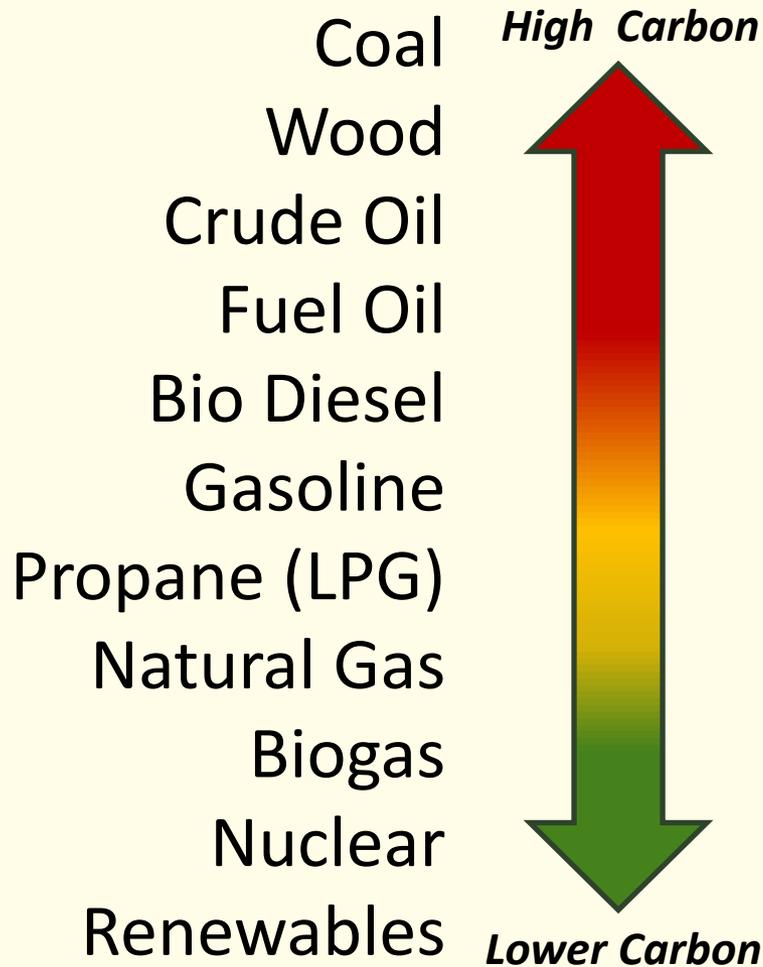
# Carbon Intensity of Energy Sources



*All energy sources are not created equally...*



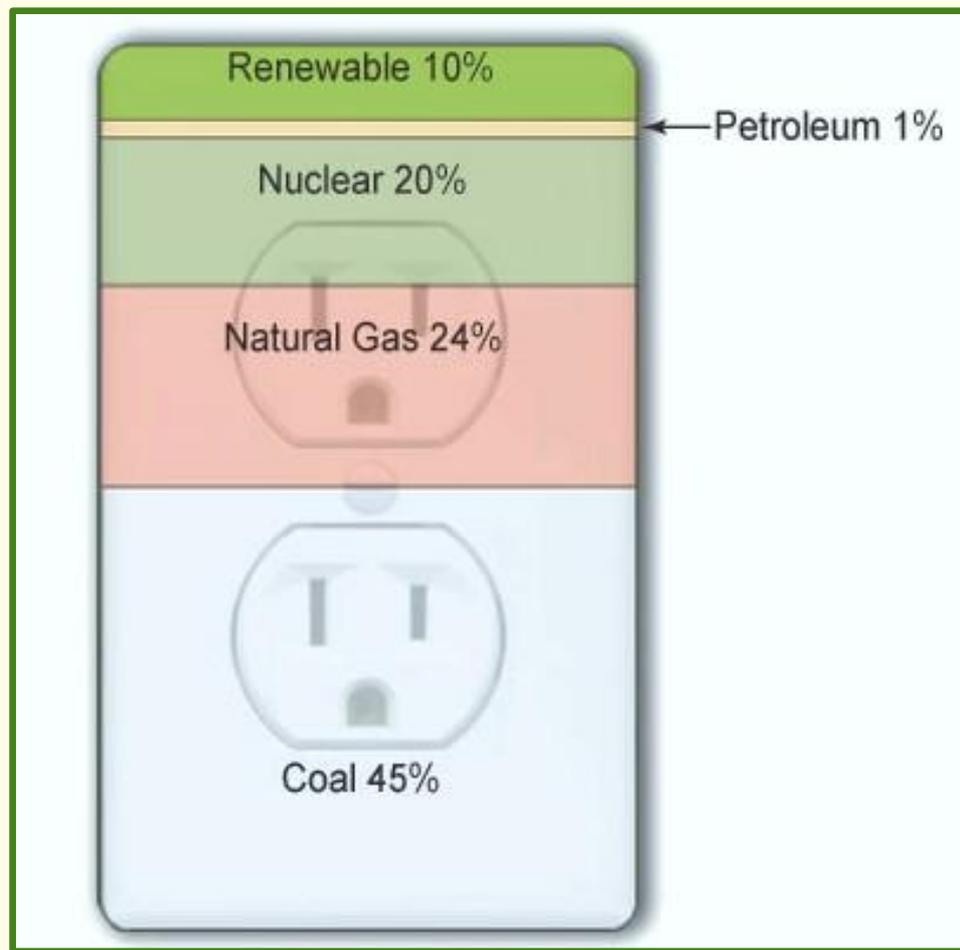
# Carbon Intensity of Energy Sources



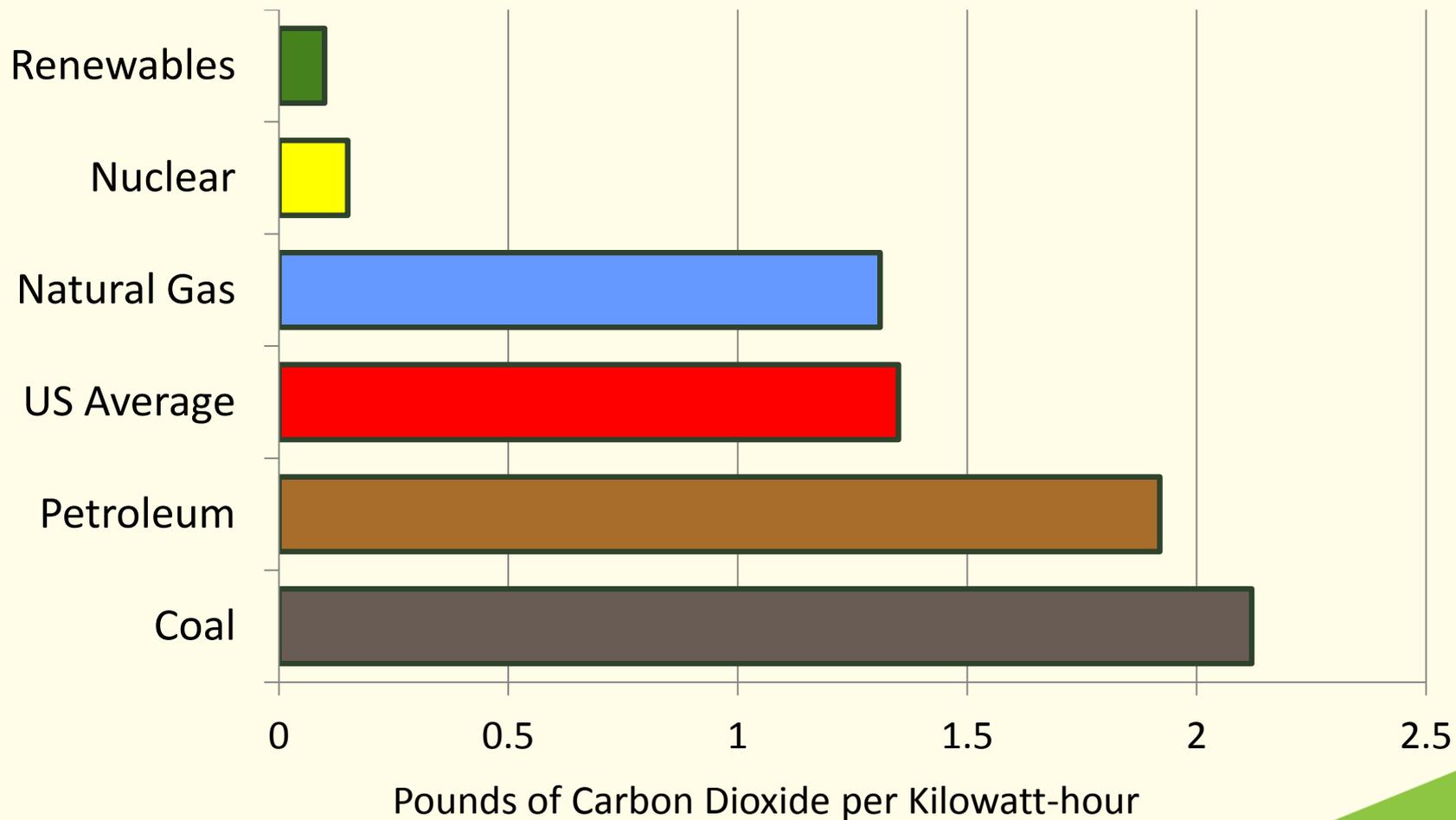
**Q.** *What about electricity?*



# Sources of Electricity Generation in the U.S.



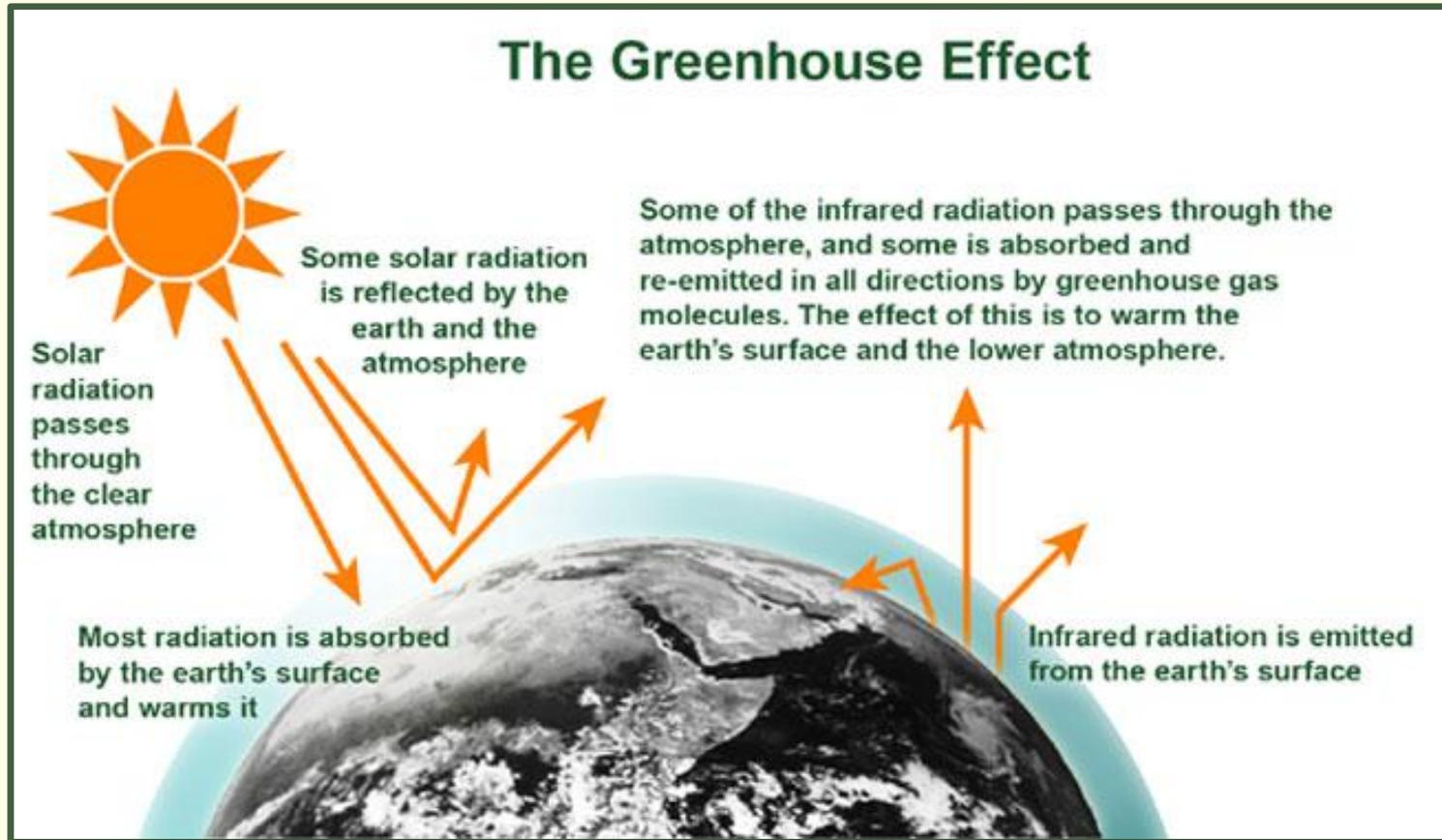
# Carbon Intensity of Electricity Sources



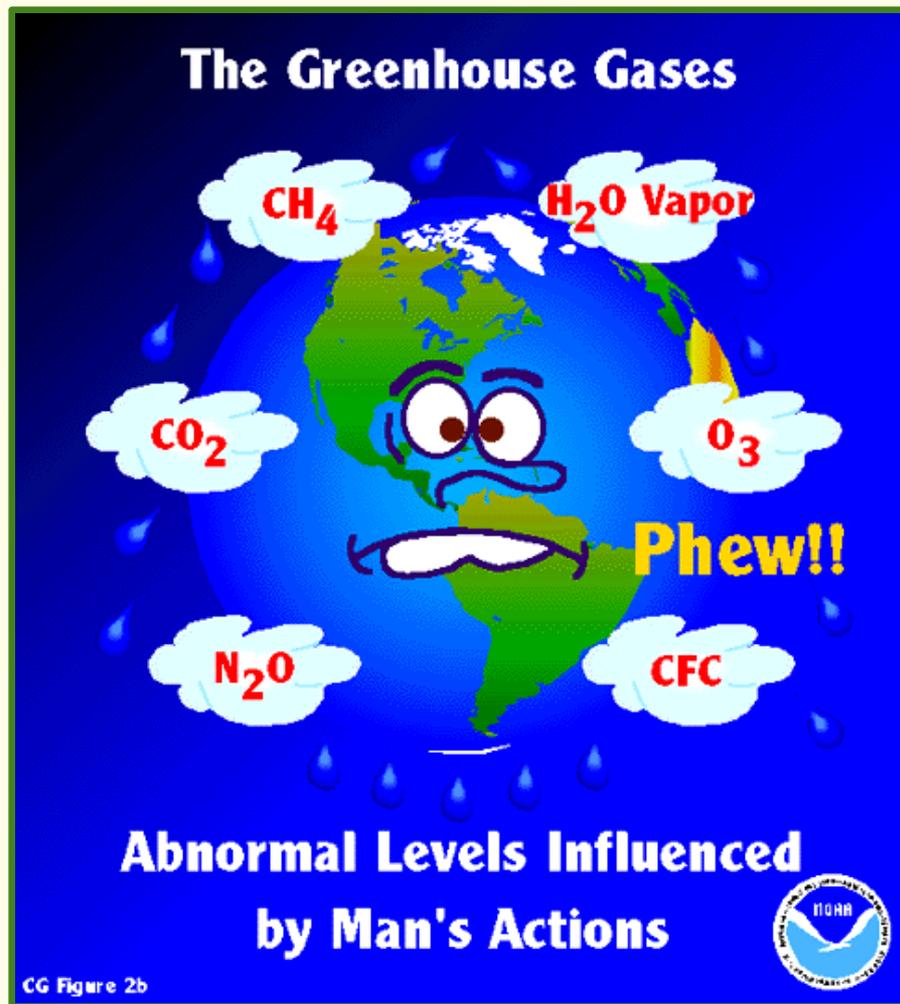
# Why Does Carbon Matter?



# Greenhouse Effect



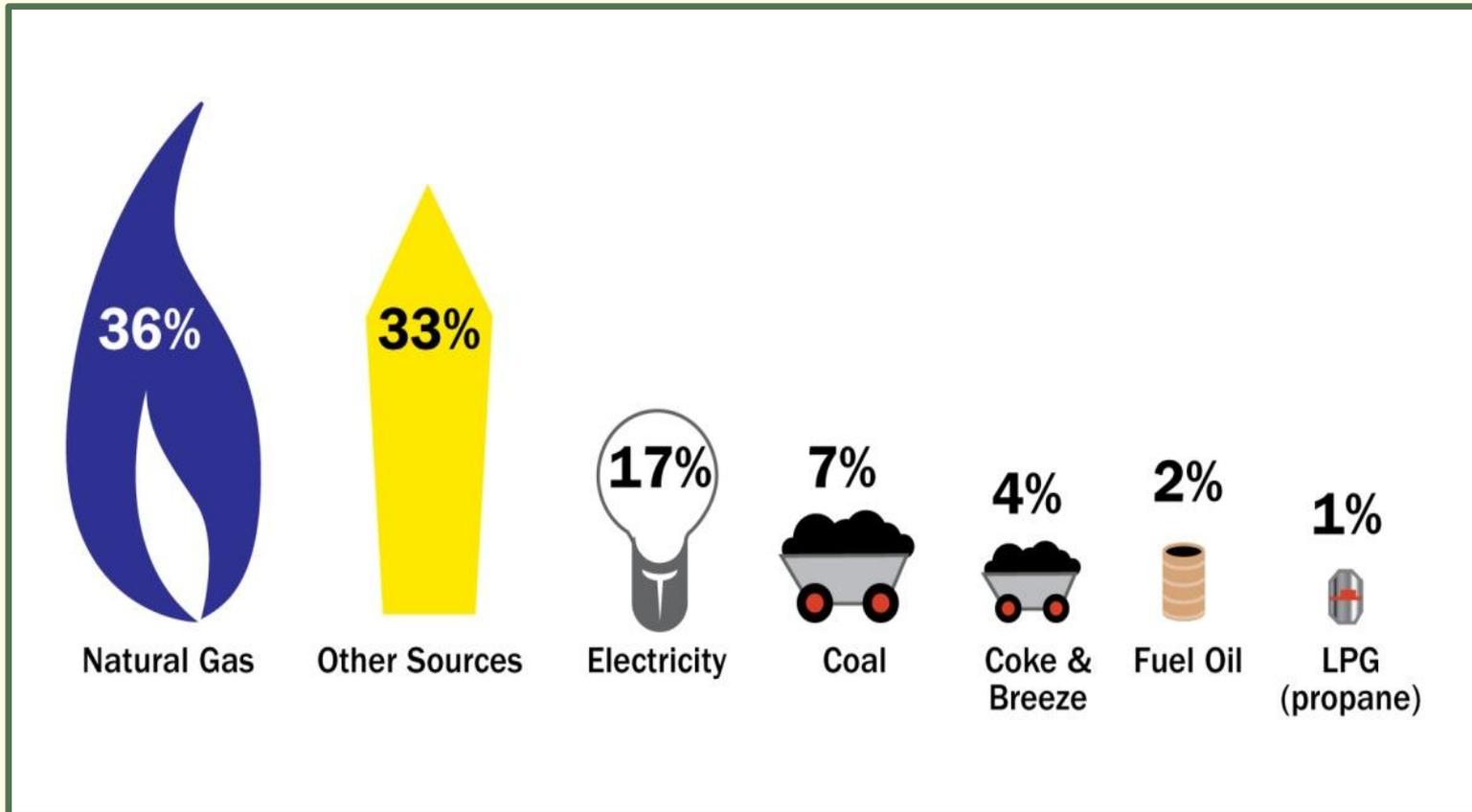
# Role of Greenhouse Gases



# What's Your Carbon Footprint?



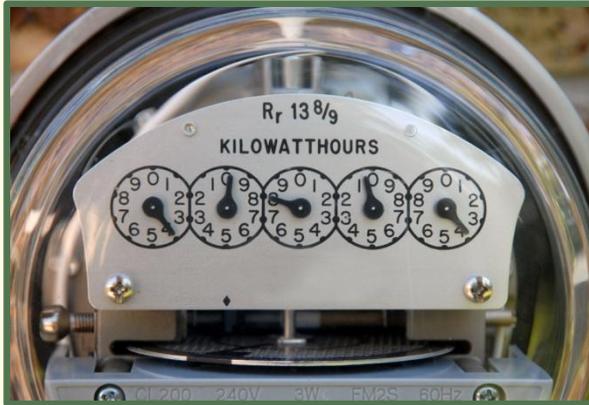
# Sources of Energy Used in Manufacturing



Source: U.S. Energy Information Administration, Annual Energy Review 2005



# How Manufacturers Pay for Energy



- Fuel Costs
- Consumption Charges
- Demand Charges
- Transmission Charges
- Power Factor Adjustments
- Fuel Adjustment Charges



# Demand Versus Consumption

Electrical charges typically have two metered components:

1. Demand
2. Consumption



# Peak Electric Demand

- **Q:** Why do electricity providers need to charge demand-based fees?
- **A:** Demand-based fees cover the cost for the utility to maintain the infrastructure capacity to meet all its customers' needs at all times.



# Using Energy Bills as a Data Source

Energy bills can...

- Serve as up-to-date accounting of monthly energy consumption and associated costs.
- Provide records for each type of energy used (e.g., gas, electric, and oil)
- Can be converted into a single common unit to express the heating values of the various fuel sources (MMBtu).
- Detect trends and irregularities in energy usage and costs.



# Reading Natural Gas Bills

Natural Gas Charges typically have two metered components:

- Supply charges—the cost to purchase natural gas from wholesalers.
- Distribution charge—the cost to deliver natural gas to the customer.

## Energy Units

- Ccf—one hundred cubic feet
- Mcf—one thousand cubic feet



# Legislating Energy Efficiency

U.S. Congress passed major legislation that addressed energy efficiency and energy management.

- Energy Policy Act of 1992
- Energy Policy Act of 2005



# Why Energy Efficiency?

“Of one thing we can be sure; energy will be more challenging and more important in the future. Will you, and your business, be ready?”

— Peter Schwartz, Chairman, Global Business Network

“My interest is in the future because I going to spend the rest of my life there.”

— Charles Kettering, Founder of A.C. Delco and Former VP of Research General Motors



# Energy Intensive Manufacturing Processes

- Air make-up units
- Heating, cooling, and ventilation unit
- Boilers
- Lighting
- Compressed air systems
- Melting, smelting, and metal heating
- Conveyors
- Milling rotors
- Curing and drying ovens
- Transportation
- Electric motors
- Any process with large amounts of waste heat as byproduct.



# Holistic Energy Efficiency Opportunities

- Total productive maintenance
- Autonomous maintenance
- Right-sized equipment
- Reduce movement /motion
- Install visual controls



# Distribution of Electricity Use in Vehicle Assembly Plants

End Use	Share of Electricity Use (%)	Estimated Typical Electricity Consumption (199) (KWh/car)	Average Electricity Applied in Analysis (kWh/car)
HVAC	11 – 20	95 – 170	160
Paint Systems (e.g., fans)	27 – 50	230 – 320	260
Lighting	15 – 16	130 – 140	130
Compressed Air	9 – 14	80 – 120	120
Materials Handling/Tools	7 – 8	60 – 70	60
Metal Forming	2 – 9	20 – 80	30
Welding	9 – 11	80 – 95	80
Miscellaneous	4 – 5	35 – 45	20
Total	100%	730-1040	860

# Energy Audits

Manufacturers perform energy audits to establish a baseline for energy use, estimate potential savings, and benchmark energy reductions.

- Use accounting to gain a picture of a manufacturer's energy consumption.
- Compare energy used versus what is actually needed to produce products.
- Focus on specific energy-intensive processes or a comprehensive facility-wide assessment.
- Typically the first step taken in projects to increase energy efficiency.



# Appendix A

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# Appendix B

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# Appendix C

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# Concluding Activity

*“When you try to pick out anything by itself, you find it hitched to everything else in the universe.”*

*- John Muir*

## It's All Connected!

