



Carbon Footprints & Sustainable Solutions

Dana Haine & Kelly Robinson
UNC Institute for the Environment
Environmental Resource Program



“If we could see CO₂ then maybe we’d have more incentive to do something about it.”

-Neal deGrasse Tryson, COSMOS

NASA: ORBITING CARBON OBSERVATORY

LAUNCHED JULY 2, 2014

- Will take more than 100,000 measurements of carbon dioxide in the Earth's atmosphere every day
- Will provide the precision, resolution, and coverage needed to characterize CO₂ **sources and sinks** on regional scales
- Will quantify CO₂ variability over the seasonal cycles year after year



"For society to better manage carbon dioxide levels in our atmosphere, we need to be able to measure the natural source and sink processes."

-David Crisp, OCO-2 science team leader at NASA's Jet Propulsion Laboratory

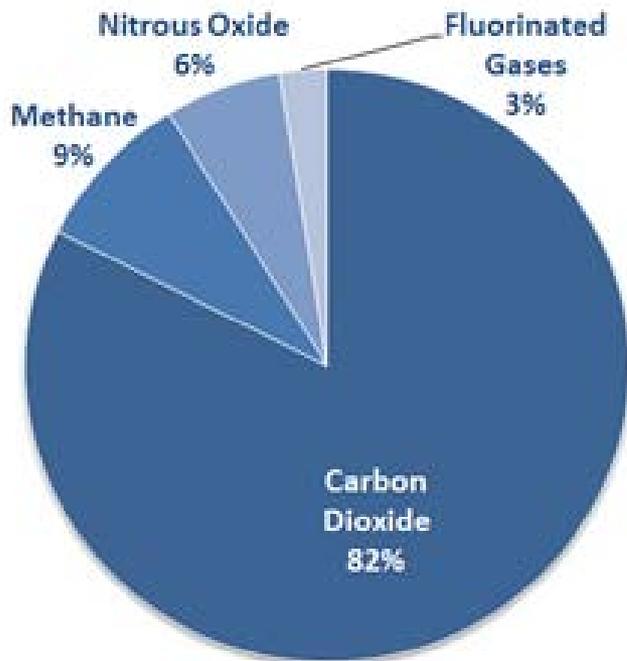


SESSION AGENDA

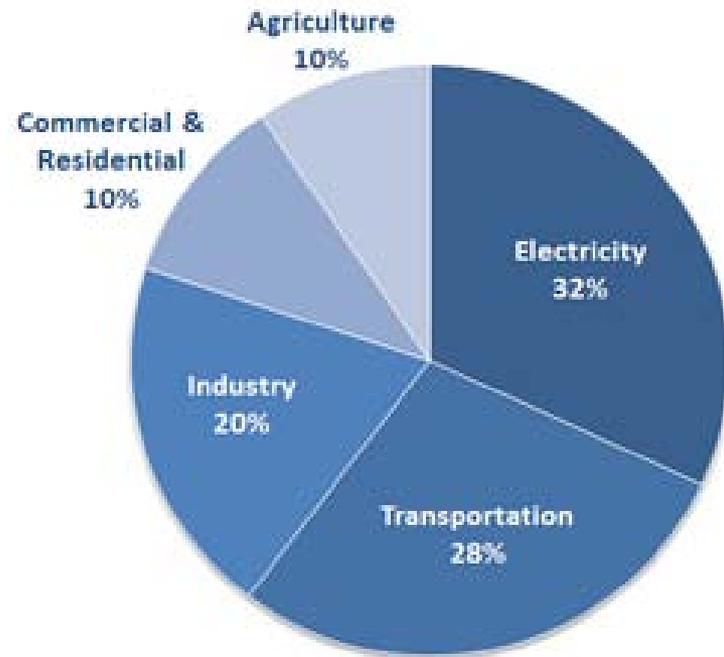
- Activity 1
Connecting Electrical Consumption to Coal & CO₂
- Activity 2
What is your carbon footprint?
- Activity 3
Evaluating Sustainable solutions
- Activity 4
Hidden energy
- Evaluation

<http://erp.unc.edu/>

Overview of Greenhouse Gases



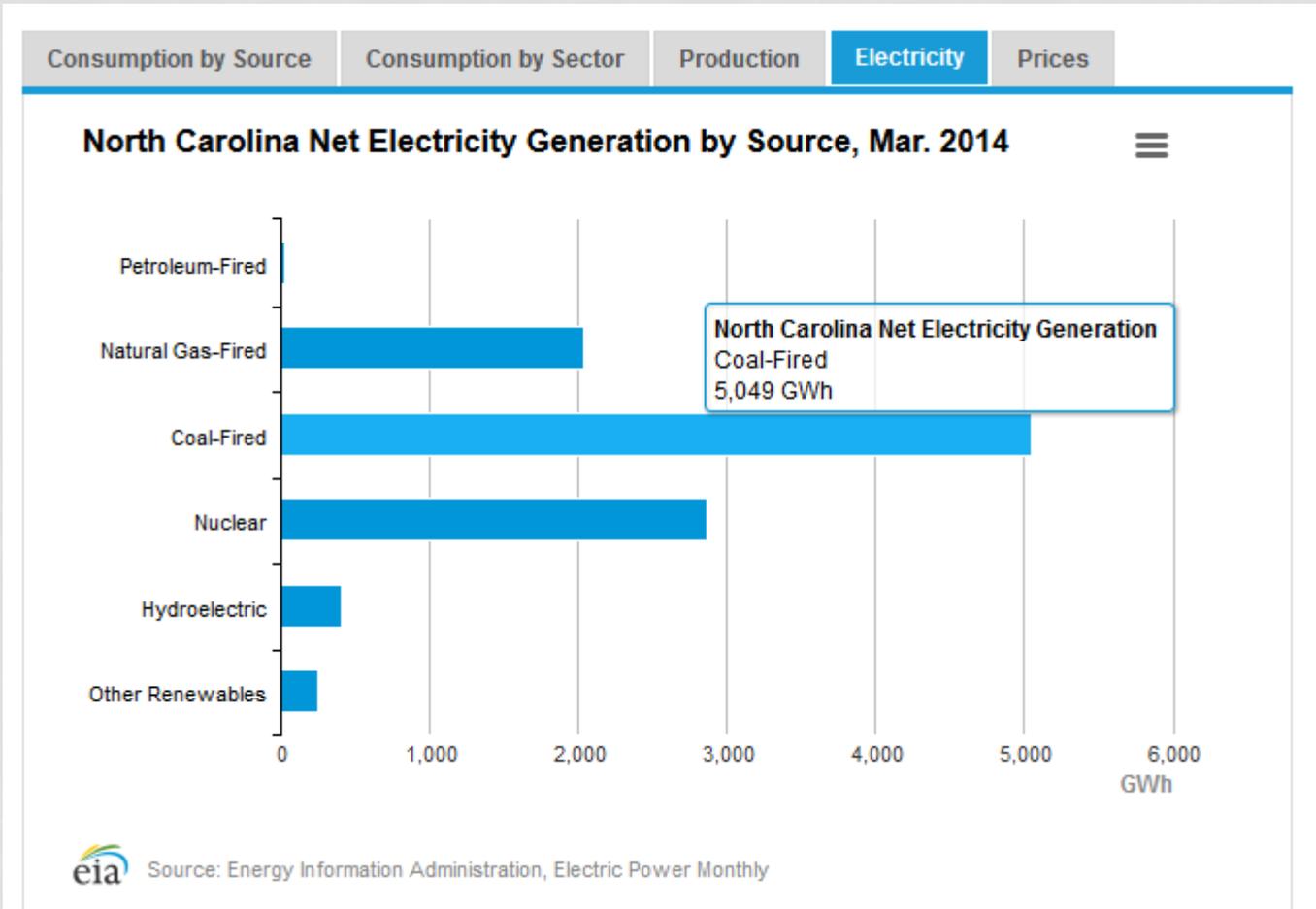
Sources of Greenhouse Gas Emissions



INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2012 (April 2014)

<http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

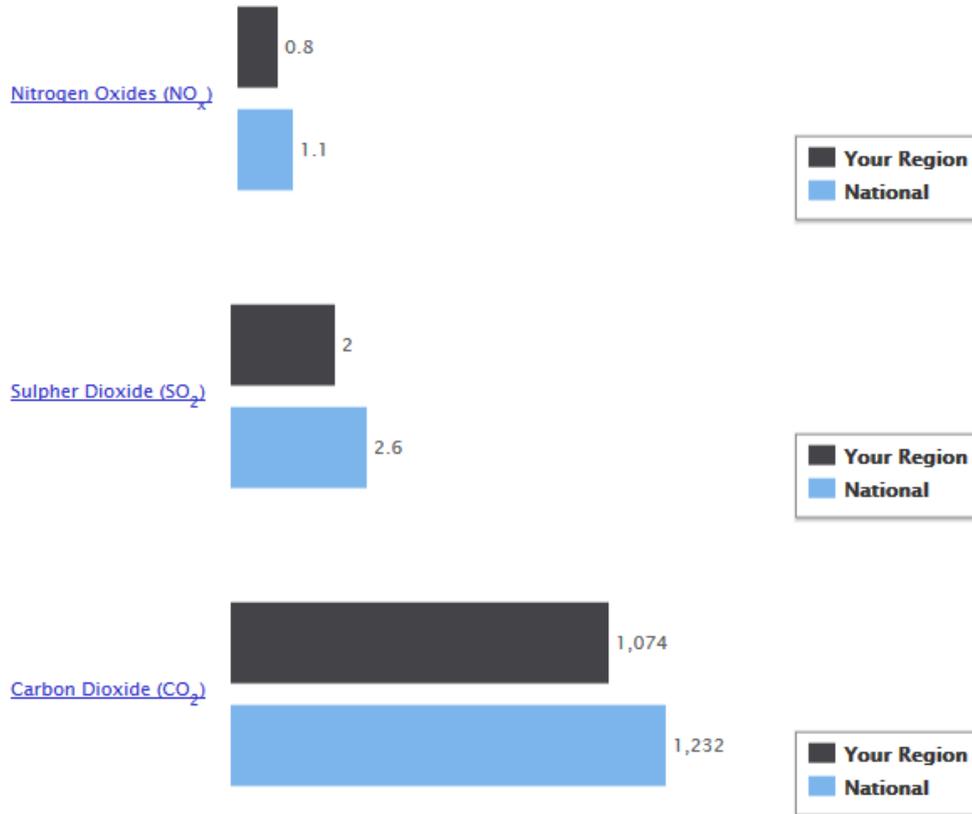
ELECTRICITY GENERATION BY SOURCE



HOW CLEAN IS THIS ELECTRICITY?

Emission Rate Comparison

This chart compares the average emissions rates (lbs/MWh) in your geographical region to the national average emissions rates (lbs/MWh) for nitrogen oxide, sulfur dioxide, and carbon dioxide.



EPA'S CLEAN POWER PLAN

- The EPA has proposed that North Carolina lower its carbon pollution by 40% by 2030.
- This proposed rule provides a great opportunity for your students to:
 - examine the current energy sources used to generate electricity in NC
 - critically assess the various strategies that could be used to reduce carbon pollution by the electricity sector in NC

SUGGESTED STRATEGIES FOR REDUCING CARBON

- improving efficiency at existing coal-fired power plants,
- increasing utilization of existing natural gas fired power plants,
- expanding the use of wind, solar, or other low- or zero-emitting alternatives, and
- increasing energy efficiency in homes and businesses

INDIVIDUAL BEHAVIORS AND CONSUMER CHOICES

Energy Conservation
Solid Waste Reduction
Transportation Choices
Civic Engagement

CARBON REDUCTION SOLUTIONS

Reducing CO₂ emissions benefits:

- The Environment
- The Economy
- Society



ACTIVITY: CONNECTING ELECTRICAL CONSUMPTION TO COAL AND CO₂



Carbon footprint analysis



ACTIVITY:

CALCULATING YOUR CARBON FOOTPRINT

- **THINK-PAIR-SHARE:** Find a neighbor who has a different size footprint and discuss the reason(s) for the difference.
- What aspect(s) of your lifestyle were not taken into account by the EPA carbon calculator?
- How would your carbon footprint be altered if the online calculator took this into account? Would it be bigger or smaller?
- What can you do to reduce your carbon footprint?



ACTIVITY: EVALUATING SUSTAINABLE SOLUTIONS

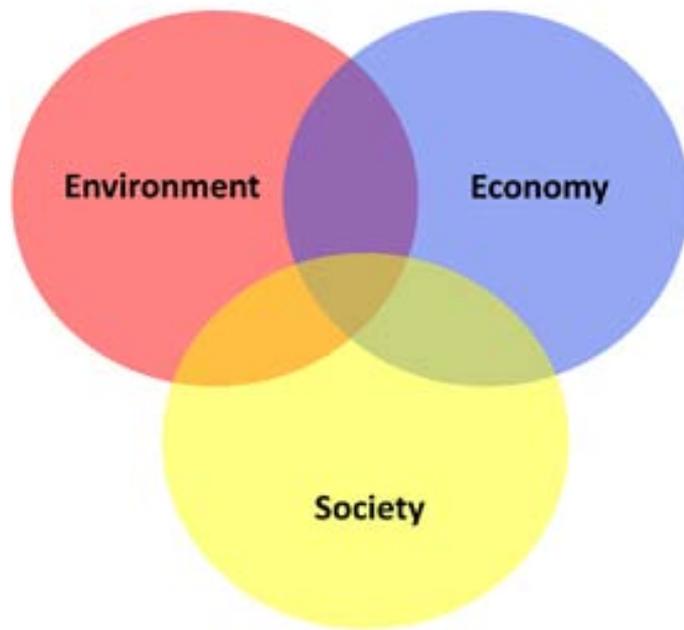
- Define **sustainability**.
- Evaluate the sustainability of a carbon reduction solution by identifying both positive and negative impacts the solution has on the environment, the economy, and society.

SUSTAINABLE DEVELOPMENT

- "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
 - Our Common Future



THREE PARTS OF SUSTAINABILITY



Healthy **Environment**
Healthy **Economy**
Healthy **Society**

<http://www.epa.gov/region4/p2/sustainability.html>

SUSTAINABILITY SCALE

UNSUSTAINABLE

SUSTAINABLE



SUSTAINABILITY ANALYSIS

For each solution consider the following:

- **Environmental Impact**
 - Carbon footprint
 - Water footprint
 - Air and water pollution
 - Biodiversity
- **Societal (Human) Impact**
 - Workers
 - Consumers
- **Economic Impact**

STRATEGIES FOR REDUCING CARBON

- improving efficiency at existing coal-fired power plants,
- increasing utilization of existing natural gas fired power plants,
- expanding the use of wind, solar, or other low- or zero-emitting alternatives, and
- increasing energy efficiency in homes and businesses
 - Installing LED bulbs
 - Weatherization of buildings

CARBON REDUCTION SOLUTIONS

- Individual behaviors and consumer choices impact an individual's carbon footprint.





HIDDEN ENERGY: SECONDARY CARBON FOOTPRINTS

- Consider the following as you observe this product:
 - Raw materials
 - Manufacturing
 - Packaging, transport, and storage
 - Marketing
 - Use/Lifespan
 - Disposal

HIDDEN ENERGY

- Finally, indicate the steps on your diagram that use energy and result in CO₂ emissions.



HIDDEN ENERGY: SECONDARY CARBON FOOTPRINTS





HIDDEN ENERGY

View your object **from the perspective of the manufacturer:**

- How could the carbon footprint of your object be reduced?
- What other positive benefits might result from these changes?
- What negative consequences might arise from these changes?

MANUFACTURERS: REDUCED PACKAGING



MANUFACTURERS: PRODUCT REDESIGN

- Saves 890,000 lbs/yr in paper fiber
- Reduces greenhouse gases by 11%
- Eliminates 500 trucks on the road each year.
- Increases shelf pack-out by 20%, allowing retailers to sell the same amount of product in less space.



MANUFACTURERS: UPCYCLING

Terra Cycle uses packaging waste to make new products such as shower curtains, umbrellas, pencil cases, totes, lunchboxes and backpacks -- a process known as **upcycling**.





HIDDEN ENERGY

View your object **from the perspective of the consumer:**

- Is this an item that you need or want?
- What actions could you take as a consumer to reduce the carbon footprint of this object?
- When presented with choices in brands when purchasing this type of item, what factors will influence which item (brand) you select?

CONSUMERS: REDUCE, REUSE, RECYCLE



CONSUMERS: CONSIDER ALTERNATIVES



LIFE CYCLE **IMPACT** ANALYSIS

What impacts arise as a result of the lifecycle of this item?

- Energy source acquisition and use
- Air emissions
 - Greenhouse gas emissions
 - Particulate matter and aerosols
- Water pollution
- Solid waste
- Human health
 - Exposure to toxics – metals, persistent organic pollutants
 - Air and water pollution
- Environmental justice

Dana Haine

K-12 Science Education Manager

dhaine@unc.edu

(919) 843-5735

Kelly Robinson

Research Assistant

krubin@email.unc.edu

(919) 966-7238

Environmental Resource Program

UNC Institute for the Environment

<http://erp.unc.edu/>



UNC
INSTITUTE FOR
THE ENVIRONMENT

BURROUGHS
WELLCOME
FUND 

 **DUKE
ENERGY®**