



Are you an energy efficient consumer?

Concerns about global warming have made energy use a major issue around the world. Simply put, the more energy people use to drive their cars, heat their homes, or run their appliances, the more carbon dioxide (CO₂) is emitted into the atmosphere. Scientists are researching how these CO₂ emissions affect climate change. They are concerned that as the world continues to get warmer, problems like sea level rise or increased, prolonged droughts may occur.

As a result, people want to know what steps they can take to use less energy. The more energy each person uses, the more CO₂ is released into the atmosphere. With billions of energy consumers around the world, you can imagine just how much CO₂ is given off globally.

In this activity, you will gain a better understanding of how several countries use energy by observing how much light they give off at night. You will see firsthand how personal, national, and global decisions can impact the future of climate change. Finally, you will observe the consequences of choices you make every day as you trace the carbon footprint of an average American family.

Part I: How do different countries use energy?

One way to gain an understanding of how much energy a country uses is observing how much light it emits at night. Watch the short video that talks about lights at night around the world and then answer the questions below using the visualization software (http://koshlandscience.org/exhib_lightsatnight/index.jsp).

1. What continent is the brightest in 1993? 1997? 2003?

1993	North America (Answers may vary)
1997	North America (Answers may vary)
2003	North America (Answers may vary)

2. What continent is dimmest in 1993? 1997? 2003?

1993	Australia (Answers may vary)
1997	Australia (Answers may vary)
2003	Australia (Answers may vary)



3. **Locate the United States, China, India, and Europe on the map. Have these regions become dimmer or brighter between 1993 and 2003? Explain your answer.**

Many parts of the United States have gotten dimmer.

Many parts of China, India, and Europe have grown brighter.

Based on the data presented in the interactive, many parts of the U.S. appear blue between 1993 and 2003, indicating that these areas have gotten dimmer over the course of ten years. In China, India, and Europe, many regions appear yellow indicating that they have gotten brighter over time.

4. **Compare the Lights at Night information from 1997 to the world population map at <http://apod.nasa.gov/apod/ap030305.html>. Is there a relationship between some of the more populated areas in the world and those with the highest light intensity? Support your answer with details.**

There seems to be a connection between the areas that have the highest light intensity and those with the largest populations. These population centers use a great deal of energy to ensure that there is enough electricity and power for everyone in the region.

5. **The data indicate changes over time in the amount of light different countries emit. These variations can reflect differing patterns in energy use. Take a closer look at India and China. How do you predict each of these countries will change over the next few years? Will they get dimmer or brighter based on the evidence provided in the interactive?**

Between 1993 and 2003, India and China have gotten increasingly brighter. They will probably continue to get brighter as the populations grow in each country. Also, as both countries continue to advance technologically and more regions have access to electricity the amount of light emitted at night will increase.

6. **Look at the *Global CO2 Emissions Calculator* on the museum's website (<http://koshlandscience.org/exhibitgcc/responses03.jsp>). Compare the overall brightness of different regions in 2003 to the CO2 emissions in 2000. Is there a relationship between the brighter areas and regions with higher CO2 emissions? Explain your answer.**

The regions that have high light intensity and CO2 emissions are the U.S., Norway, Western Europe, and China. However, the former USSR and Eastern Europe also have high CO2 emissions, but do not emit large amounts of light at night. This is because light emissions are only one way to monitor how regions use energy. There are also other factors like automobile use and power plant emissions.



Part II: How are different regions around the world addressing energy efficiency?

There are many factors that influence how efficiently regions use energy and how much CO₂ they produce as a result. As you have learned, scientists can study this by observing light intensity. There are other ways to examine the problem.

Choose one of the regions listed below and explain how it is addressing CO₂ emissions. Use the stories in the websites below to help in your research. Remember, although these stories are only a part of the bigger picture, they can help scientists begin to understand how regions are responding to the issue. Be sure to support your answers with facts about how these regions use and produce energy. You may find it helpful to list both problems and solutions for each region.

Costa Rica:

<http://www.npr.org/templates/story/story.php?storyId=19141333>

China:

<http://www.npr.org/templates/story/story.php?storyId=89668099>

<http://www.npr.org/templates/story/story.php?storyId=89575832>

Atlanta:

<http://www.npr.org/templates/story/story.php?storyId=89231809>

<http://www.npr.org/templates/story/story.php?storyId=89250244>

North Carolina:

<http://www.npr.org/templates/story/story.php?storyId=9979875>

England:

<http://www.npr.org/templates/story/story.php?storyId=9972613>

Region selected: Costa Rica

How is the country approaching the problem of increased CO₂ emissions?

Problems:

- Released 12.5 million tons of CO₂ in 2007, but absorbed only 2.5 metric tons through trees.
- Transportation is the biggest CO₂ emitter.
- Costa Rica has an expanding middle class that is using more cars and high-emitting buses; transportation is the largest CO₂ source in the country.
- Expanding middle class encourages more consumption in general.
- Some people think the goal of zero emissions distracts from other environmental problems.

Solutions:

- Government initiated-program to preserve forests and plant trees to offset emissions.
- A very successful conservation program with a 5% tax on gasoline.

Region selected: China

How is the country approaching the problem of increased CO2 emissions?

Problems:

- China is developing very quickly and is relying on older methods of energy production (coal, natural gas), making it the largest emitter of CO2 in the world.
- China has been building new power plants at a rate of two coal-powered power plants every week.
- New buildings are huge and require a lot of energy.
- As the middle class expands, people are travelling more.
- Families typically have two cars.
- Second (vacation) homes are becoming more common for Chinese families, increasing travel from one home to another.

Solutions:

- The country has set goals to reduce carbon emissions by 2010 and has published mitigation measures published in government reports.
- Natural gas is used nationally for heating and cooking
- Some new initiatives are being introduced such as the new green office building in the business district that uses double-paned, argon filled windows; a rooftop with solar panels and rainwater collection bins; and a rooftop garden for green space and insulation.
- People are working to raise awareness about the issue.

Region selected: Atlanta

How is the city approaching the problem of increased CO2 emissions?

Problems:---Suburb---

- More affordable housing draws people to the suburbs, making long commutes (66 miles/day average) the norm.
- The average suburban family now owns 2 cars and emits double the greenhouse gases as families who live in the city and own 1 car per household.
- Suburban homes tend to be larger and have much higher energy costs (3x higher than city homes).

Solutions:

---City---

- Atlantic City has homes, offices, and shopping in one location, making it a model community for energy efficiency.
- Families living in these types of communities produce half the national average of CO2 emissions.
- People in these communities fill their automobile gas tanks once every two weeks compared to as many as three times a week in the suburbs.
- Apartments have lower energy costs than homes because they are smaller and regulate temperature more easily.
- These close communities permit people to walk more.

Region selected: North Carolina

How is the state approaching the problem of increased CO₂ emissions?

Problems:

- Most families' total CO₂ emissions are allocated as follows: ½ on heating and cooling; ¼ on transportation; and ¼ on lights, refrigerator, and electricity.
- Air travel doubles the amount of CO₂ emitted.

Solutions: (The episode follows one family that is trying to reduce their carbon footprint)

- If everyone in the United States adopted the same measures as this family, the amount of CO₂ emissions nationally would decrease a great deal.
- This family has kept the large trees surrounding the house.
- They have installed low-flow showerheads.
- They are using energy-efficient appliances.
- They try to buy local food which doesn't have to be transported as far.

Region selected: England

How is the country approaching the problem of increased CO₂ emissions?

Problems:

- Although some people are driving cars and many cars are diesel-powered, which increases fuel efficiency, there are still a significant number of driver who are driving large inefficient vehicles.

Solutions:

- People are much more aware of energy issues in the United Kingdom.
- The government has instituted a heavy gas tax that discourages people from driving.
- As a result, most British citizens drive diesel cars, which get more miles to the gallon.
- The subway system also allows people not to drive as much.



Part III: How can you be more energy efficient?

Go to <http://bie.berkeley.edu/calculator.html> and complete a carbon footprint for an average U.S. household of four people in your state. Use the default values assigned by the calculator, but make sure to take note as you complete the exercise. After discovering how much carbon is produced and why, answer the following questions for your state.

Your State: Answers will vary

1. How much CO₂ does an average family in your state produce in one year?

Answers will vary

2. What percent of global average CO₂ emissions does an average family produce in your state?

Answers will vary

3. In what area does the average family in your state produce the most CO₂ emissions: transportation, housing, food, or goods and services?

Transportation and housing

4. What surprised you the most about the carbon footprint?

Answers will vary

5. What does a carbon footprint tell you about how efficiently you consume energy? Explain your answer.

The lower an individual's carbon footprint, the more efficient that person is in his/her energy use.

6. Does the average U.S. family use public transportation or their own cars more frequently? Reverse the numbers to see if this choice affects your carbon footprint. Describe what happens below.

The average U.S. family uses their own cars more than public transportation. Encourage your students to see how their carbon footprint would change if they owned fewer cars (one instead of two for example) and used public transportation more frequently.

7. What other ways can you reduce your carbon footprint? Try to change different variables in the carbon footprint calculator, perhaps reflecting your own family's choices, and list how these choices affect your overall carbon footprint below. Be specific.

Answers will vary. Encourage your students to try to decrease their carbon footprint.

8. Visit the Koshland Science Museum's Carbon Dioxide Emissions Calculator at <http://koshlandscience.org/exhibitgcc/responses01.jsp>. What personal and national policy options have the largest impact on decreasing carbon emissions? Why do you think this is the case?

--Personal--

Drive 100 fewer miles per week (4.11% reduction)

Increase household vehicle efficiency by 10 mpg (5.45% reduction)

--National--

Increase the use of alternative energy sources to 25% of total US production (19% reduction)



Americans use the most energy running households and for transportation. If the focus turns to ways to reduce CO₂ emissions in these areas, then total U.S. carbon emissions would decrease a great deal.



9. **Think of ways that you personally can be more energy efficient and write them down below. Write a reflective essay below that examines how one person's energy use impacts total carbon emissions. How would the impact would be different by considering a family's choices? A community's? The nation's? The world's?**

Answers will vary. This activity should engage students in thinking about how personal choices can translate more broadly. In addition, students should gain a better understanding of how each country's approach to carbon emissions affects other regions of the world.