CAP AND TRADE GAME

EARTH matters
Studies For Our Global Future

introduction

While the scientific community has reached consensus that humans are causing **climate change** through **greenhouse gas** emissions, there is no single policy answer to solve this problem. Even countries that have agreed to reduce their emissions have implemented different strategies to do so, with varying degrees of success. One possible solution is a **carbon tax**, where companies or consumers pay extra based on the amount of emissions produced by their activities. Because a price or monetary value is placed on the damage to the environment and economic forces are used to reduce pollution, it's called a **market-based solution**.

Another market-based solution is the "**cap and trade**" or "**emissions trading**" approach, in which companies that pollute are provided yearly allowances of pollutants by a government or other regulatory body. Those that pollute beyond their allowed amounts are fined. Polluters also have the option to buy the leftover allowances of other companies that reduced their own emissions. Over time, the number of allowance permits distributed decreases, and thus their value on the market increases. Ultimately, polluting becomes more and more costly, while reducing emissions becomes more and more profitable. Companies invest in upgrades because eventually, that is less expensive than continuing to pollute and pay the fine.

This cap and trade approach found great success in the United States when it was used to target sulfur dioxide and nitrous oxide emissions, the major contributors to acid rain. Monitoring data from the EPA shows that by 2020, acid rain sources reduced emissions by 95 percent (15 million tons) from 1990 levels.[1] This system has been applied to the issue of climate change, too. The European Union's Emissions Trading System is the largest climate market in the world and saw 35 percent emissions reductions from participating installations from 2005 to 2019.[2] In July 2017, the state legislature of California renewed its commitment to a statewide cap and trade program through 2030, and it will play a large role in the state's goals of reducing emissions by 40 percent in that time.[3]

It is essential that we consider the potential benefits and challenges of policies designed to reduce greenhouse gas emissions, especially as energy needs continue to grow rapidly with population and increasing affluence.

concept

A cap and trade policy can be used to reduce emissions of air pollution and greenhouse gases, using market forces to encourage companies to invest in cleaner energy and more efficient technologies.

objectives

Students will be able to:

- Record data, track financial transactions, and make strategic decisions during a multi-round cap and trade simulation.
- Explain the concept of cap and trade in their own words.
- Identify advantages and disadvantages of cap and trade policies designed to reduce emissions.

subjects

Environmental Science (General and AP), Government, Economics, AP Human Geography, Geography

skills

Analyzing costs and benefits, recording data, strategizing with teammates

method

Students play a game that simulates a cap and trade system, and analyze its successes and weaknesses as a policy to reduce emissions of pollutants and greenhouse gases.

Vocabulary: cap and trade, carbon tax, climate change, emissions trading, greenhouse effect, greenhouse gas, market-based solution

materials

- Rules of the Game (provided)
- Game Chart (provided)
- Play Money (provided)
- 2 dice per student

For each group:

- Upgrade Cards (provided)
- 75 poker chips

procedure

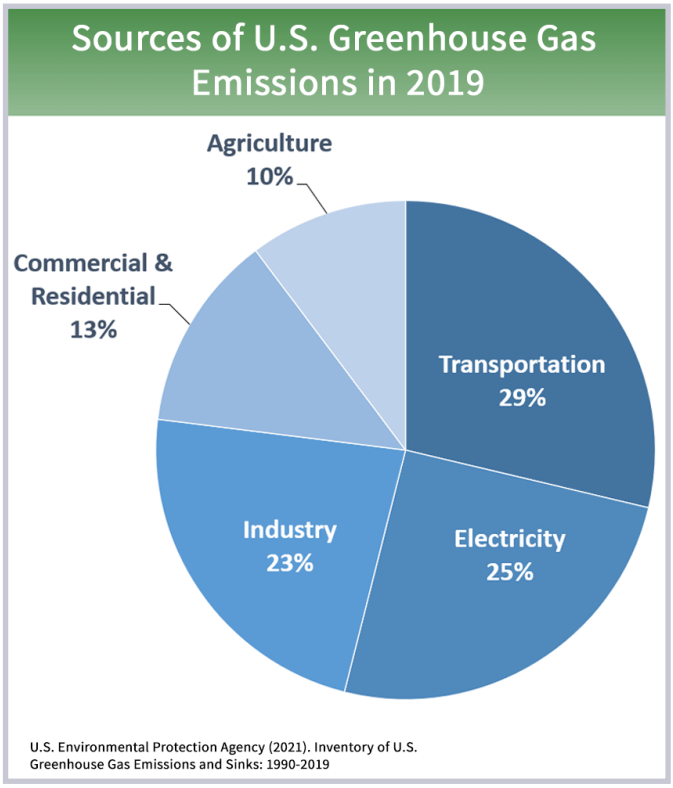
Note: This lesson does not explicitly teach the **greenhouse effect** or the in-depth science and data behind climate change. Before starting this lesson, students should have a basic understanding of how humans' greenhouse gas emissions cause climate change, as well as some of the social and environmental costs of a warming world.

1. Display the graph to the right.

2. Ask students to identify the largest single source of greenhouse gases (GHG) in the United States. *(Answer: Electricity)*. Explain to students that all electricity production, for any purpose, is included in this category, so it includes the emissions from electricity used in homes, schools, and businesses. Given this fact, ask students to brainstorm steps that individual citizens can take to reduce their GHG emissions due to electricity.

   Answers may include: turning off and unplugging appliances when not in use, decreasing the use of hot water in your home, air-drying laundry, installing solar panels on your property, using the air conditioner or heater slightly less often, asking your power company to use more alternative energy sources, buying fewer new consumer items, recycling or upcycling whenever possible.

3. Explain to students that while individual actions are powerful, policy decisions can work on a larger scale to change the way that companies provide power to



consumers. Ask students to brainstorm what governments and companies can do to reduce the GHG emitted by generating electricity in the United States.

Answers may include: government investments in clean energy like wind and solar, providing tax breaks for people who install solar panels, fining the power companies that pollute the most, shutting down some companies or power plants, rewarding companies that reduce pollution with money or special "green" status.

4. Ask students to turn to a neighbor, choose one of the brainstormed strategies, and identify pros and cons.

   For example, for "government shutting down some polluting companies or power plants," answers may include:

   Pros – reduces pollution immediately, stops pollution more quickly than other strategies, sends a strong message about clean air and climate change, allows those power plant companies to do something new instead such as clean energy-related products.

   Cons – people who worked there will lose their jobs, not fair to choose some power companies to close over others, the company loses money, the consumers must pay more for energy, the remaining fossil fuel-burning power plants or companies may actually pollute more to meet increased demand.

5. Explain to students that one major way to reduce pollution emissions is called "cap and trade" or "emissions trading." The United States used this strategy with great success in reducing the sulfur dioxide and nitrous oxides that cause acid rain. This strategy is also currently being used by the European Union, the state of California, and a coalition of Northeastern states to address the GHG emissions that cause climate change. Students will be playing a game to see how this system works and to identify some of the pros and cons of it as a method for decreasing GHG emissions.

6. Divide the class into groups of 5-7 students. Assign one student within each group to be the Banker during the game (he or she can still play). Each group needs one set of Upgrade Cards (one printed page, cut out) and 75 poker chips. Each student needs two dice, $1,000,000 play money (one printed page, cut out), one Rules of the Game sheet, and one Game Chart.

7. Following the directions on the Rules of the Game sheet, students will play a game in small groups as if each person is a power company with fossil fuel-burning plants that emit the greenhouse gases causing climate change. The teacher will play the role of the regulatory agency for all groups, distributing a decreasing number of allowances each year and monitoring the buying/selling of allowances amongst the companies.

   Note: It would be helpful to play a practice round by modeling the process with a few student volunteers, so the whole class can see how the game is set up.

   - At the start of each new round, distribute a specific number of new allowances (poker chips) to each student according to amount listed on the Game Chart.
   - During the buying and selling period, monitor student transactions within their groups.
   - The student who is the Banker will handle the upgrades purchases.
   - Announce the time for the dice roll. After the dice are rolled, collect allowances (poker chips) from the players and levy fines if they rolled a higher number than their available allowances (poker chips). Students may earn money during dice rolls if they have purchased certain upgrades; the Banker in each group should provide that money.

discussion questions

1. What was your overall strategy? Did it work?

   Answers will vary. Ask a person from each group to share. Aim to have at least one person who won in their group and one person who came in last place in their group share.

2. Why do you think the winning person's strategy worked for them?

   Answers will vary. If students mention luck in rolling the dice, point out that this is part of it, but it is also very important what the person did with their extra allowances and funds. If he or she simply hoarded allowances to avoid fines, that person likely had trouble in the final rounds without any risk-reducing upgrades.

3. Who had the most allowances at the end? Is it better to have money or allowances?

   Answers will vary, but students may identify that the allowances are worth money on the market, so it's comparable. Other students may note that the value of the allowances changes over time, and may be more or less depending on the round and what other companies are doing. Ultimately, as the teacher you should emphasize that more allowances still means more potential pollution, and so having more of them means more impact on the environment. Having money means a company could ideally find more ways to reduce pollution.

4. Did your group reduce the total amount of pollution by the end of the game? If so, how?

   Answers will vary, but most likely, yes, as students would play to win and avoid the fines that come from polluting over the amount allotted. The upgrades allow students to earn money for future rolls (investing in clean energy), or lets them reduce their pollution through rerolling and/or rolling only a single die instead of both.

5. Did the price of an allowance change over the course of the game? What happened to it and why?

   If students are unsure, ask for a volunteer to share how much they paid for an allowance early on, and another volunteer to share how much they paid late in the game. Most likely, the price of the allowances on the market went up. This is because there were fewer allowances in play, so their value increased. If it went down in some groups, discuss with students why this may have happened—for example, everyone had invested in upgrades so the demand for allowances (and thus total pollution) was low.

6. Explain the term "cap and trade" in your own words, using examples from the game as needed.

   The government (teacher) capped the total amount of emissions for each person. Students then traded with the existing allowances and invested in upgrades. As the total number of allowances decreased, the price of a single allowance went up in trade. This allowed teams who had invested in clean energy or upgrades for their plants to make more money by selling their allowances. Overall, pollution was decreased.

7. What are at least two pros and two cons of a cap and trade strategy for reducing pollution?

   Pros – reduces emissions over time, gives companies choice, allows them to make money to invest in clean energy or other upgrades. Cons – difficult to decide who gets many allowances, it takes time to reduce the emissions, some companies ran out of money, some companies just paid the fine at first instead of trying to reduce their emissions, so they may pass the cost of upgrades on to their consumers

8. Do you think this is a worthwhile strategy? Do the pros outweigh the cons?

   Answers will vary. Ask students to defend their answers with evidence from the simulation.

9. What are some challenges of applying this strategy on a global level as a means of fighting climate change?

   Some people, even some political leaders, do not believe climate change is a threat, or reject the scientific consensus that it is anthropogenic. Many or all countries would have to agree and stick to their agreement in order to implement cap and trade on a global scale. If some countries defected and didn't limit their allowances or pollution, they may have a comparative advantage in terms of trade. In addition, consumers may not be happy to pay more for products, and technology may not always advance quickly enough for companies or power plants to improve their efficiency.

assessment

Student contributions to discussion can be assessed for comprehension and connections made from the simulation to the real world policy.

follow-up activities

1. Students explain how they would alter or edit the gameplay to make it more realistic, or design a game to represent carbon taxes or other ways of reducing pollution.

2. Have students research current implementations of carbon emissions trading (such as California's or the EU's) to identify how they are effective and how they can be improved.

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[1] United States Environmental Protection Agency. (2021). *Power Sector Programs Progress Report 2020*. Retrieved from https://www3.epa.gov/airmarkets/progress/reports/index.html

[2] European Commission, Climate Action. (n.d.). *EU Emissions Trading System*. Retrieved July 13, 2021 from https://ec.europa.eu/clima/policies/ets_en

[3] Plumer, B. (2017, July 26). Just How Far Can California Possibly Go on Climate? *The New York Times*. Retrieved from https://www.nytimes.com/2017/07/26/climate/california-climate-policy-cap-trade.html

CAP AND TRADE GAME

rules of the game

You are a power company that owns several fossil fuel-burning power plants to make electricity for the citizens of your region. The government has implemented a new policy called "cap and trade." **Your goal is to be the company with the most money (not the most poker chips) at the end of the game.**

1. Each player starts with $1,000,000, 8 poker chips (representing 8 allowances, or units of pollution they are allowed to emit), and two dice.

2. To begin the first year of gameplay, all players in the group roll their two dice. The number rolled represents how many units of pollution the player emitted that year. The teacher will come around and take away one allowance (poker chip) for each unit of pollution. (Example: if you rolled a 7, the teacher will take away 7 poker chips.) If you have any extra allowances (poker chips) left over, save them for now.

3. Any player who pollutes more than his or her current number of allowances (poker chips) will be fined $100,000 per unit above the limit. (Example: if you only have 8 poker chips and you roll an 11, you will be fined 3 units x $100,000 each = $300,000 total.) You can't go into debt, but you can have zero dollars.

4. To start the next year, the teacher will give each person their new allowances (poker chips). Notice that each year of gameplay, you receive one less new allowance (chip) than before. (The first year you start with 8, then 7, then 6…)

5. Once you have received your new allowances (poker chips) and before anyone rolls the dice, a period of buying and selling begins within your small group.

    - You can save all of your allowances for the future, when you will roll the dice.
    - You can sell your allowances to other people in your group who want them, or buy allowances from other people. There is **no set price**; it's up to you to negotiate. The price can change every time.
    - You can't go into debt and you can only sell the allowances (poker chips) you currently have in your possession.

6. After you have traded within your small group, your teacher will announce that you may buy upgrades for your power plants from the bank. These make your power plants more efficient, add new technology, or allow you to invest in clean energy. Buying these upgrades can help you make money later in the game, or help you roll lower numbers to reduce your pollution and avoid getting fined. You can only buy each upgrade once, and you can only buy one upgrade per round. There are a limited number of each one, so choose wisely!

    - Invest in clean energy! In future rounds, you will receive $100,000 profit for every 3, 4, or 5 (the total of both dice in the roll) any player in your group rolls. (Cost to purchase: $200,000)
    - Upgrade your plant's technology! You can have **one reroll** in each future round. You made some great updates and have a more efficient plant, which pollutes less. (Cost to purchase: $300,000)
    - Mega upgrade! You can have **two rerolls** of your dice per round, because you dramatically reduced the pollution your plant emits through new technology. (Cost to purchase: $400,000)
    - Transition to clean energy! You closed one of your fossil fuel-burning plants to open a wind farm. You only have to roll one of the dice instead of both each round. (Cost to purchase: $600,000)

7. After the buying and selling ends, everyone rolls the dice for that year. The teacher will take away one allowance (poker chip) for each unit of pollution emitted through your dice roll. He/she will fine the people who don't have enough allowances (poker chips) to cover their pollution (dice roll). Again, the fine is $100,000 per additional unit of pollution.

8. Each year, start by receiving your new allowances (poker chips) from the teacher. Then, you may buy and sell allowances with the people in your group, as well as purchase upgrades for your power plants. Finally, you will roll the dice and the teacher will take away the appropriate number of allowances, as well as collecting a fine of $100,000 per unit for any extra pollution you can't cover with your poker chips. Always record your starting number of money and allowances, your dice roll, and any financial transactions on the Game Chart.

9. At the end of the final round, the player with the most money wins.

CAP AND TRADE GAME

game chart

Year/ Round	Starting Totals		Pollution Units Emitted	Transaction History
	Money What you had at the end of last round	**Allowances** New ones given by teacher this round, plus any left over from last round	Dice Roll	• Record any money you spent on buying allowances or upgrades. • Record any money you earned from selling allowances or upgrades. • Note any fines you incurred from polluting over the limit.
1	$1,000,000	8		
2		7+		
3		6+		
4		5+		
5		4+		
6		3+		
7		2+		
8		1+		

CAP AND TRADE GAME

play money

$100,000 $ $	$50,000 $ $	$50,000 $ $
$100,000 $ $	$50,000 $ $	$50,000 $ $
$100,000 $ $	$50,000 $ $	$50,000 $ $
$100,000 $ $	$50,000 $ $	$50,000 $ $
$100,000 $ $	$50,000 $ $	$50,000 $ $

CAP AND TRADE GAME

upgrade cards

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