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# Lesson 3.2: Reading "Climate Change Solutions"

Human activities are causing the levels of carbon dioxide and methane in the atmosphere to increase and there are several possible solutions for this serious situation. Today you will learn about some of the creative ways people are trying to combat climate change and protect the Earth system.

## Unit Question

- What causes climate change?

## Chapter 3 Question

- What can be done to stop the carbon dioxide and methane in Earth's atmosphere from increasing?

## Key Concepts

- Carbon dioxide and methane in the atmosphere increase as a result of human activities, such as combustion.

## Vocabulary

- atmosphere
- carbon dioxide
- claim
- climate
- climate change
- combustion
- energy
- human activities
- methane
- temperature

## Digital Tool

- *Earth's Changing Climate* Simulation

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# Warm-Up

Earth's climate is getting warmer because more carbon dioxide and methane are being added to the atmosphere from human activities. There are things we can do to put less carbon dioxide and methane into the atmosphere.

*What are your ideas about how humans can reduce the amount of carbon dioxide and methane they add to the atmosphere?*

_____

_____

_____

_____

_____

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# Reading "Climate Change Solutions"

1. Read and annotate "Climate Change Solutions."
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. After reading, answer the question below.

Rate how successful you were at using your Active Reading skills by responding to the following statement:

**As I read, I paid attention to my own understanding and recorded my thoughts and questions.**

- ☐ never
- ☐ almost never
- ☐ sometimes
- ☐ frequently/often
- ☐ all the time

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**Active Reading Guidelines**

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.



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# Revisiting the Anticipation Guide

Turn to page 6 in your Investigation Notebook and review your original response to statement #7 in the Anticipation Guide.

7. _____ Human actions cannot change Earth's atmosphere.

Do you currently agree or disagree with this claim? (circle one)

a. agree

b. disagree

Have your views changed throughout the unit? (circle one)

a. yes

b. no

Describe the evidence you would use to support your current thinking about this claim.

_____

_____

_____

_____

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# Homework: Investigating Forest Cover in the Sim

All plants take in carbon dioxide, use it to make food for themselves, and release oxygen. Use the *Earth's Changing Climate* Simulation to find out how forest cover affects the amount of carbon dioxide in the atmosphere.

**Predict:** If I increase forest cover in the Sim, carbon dioxide will (check one)

☐ increase ☐ decrease ☐ not change

Test your prediction by conducting two tests in the Human Activities mode of the Sim.

**Test 1:**

1. Decrease the population to 2 billion.
2. Run the Sim until the time reaches 20.
3. Increase Forest Cover to high.
4. Observe carbon dioxide and temperature in the graph. Make and annotate a sketch of the graph.

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In Test 1, what happened to carbon dioxide? What happened to temperature?

_____

_____



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# Homework: Investigating Forest Cover in the Sim (continued)

**Test 2:**

1. Reset the Sim and leave the population at 7 billion.
2. Run the Sim until the time reaches 20.
3. Increase Forest Cover to high.
4. Observe carbon dioxide and temperature in the graph. Make and annotate a sketch of the graph.

In Test 2, what happened to carbon dioxide? What happened to temperature?

_____

_____

How does forest cover affect the amount of carbon dioxide in the atmosphere?

_____

_____

Why do you think the results were different for these two tests?

_____

_____

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# Lesson 3.3: Explaining Possible Solutions

The head climatologist is calling on you to help put together a climate change solutions blog. This blog will spread the word and inspire people to make these solutions a reality. Today you will explore one solution in detail and use the Modeling Tool to help you explain this solution and its effect on the climate in your blog post.

## Unit Question

- What causes climate change?

## Chapter 3 Question

- What can be done to stop the carbon dioxide and methane in Earth's atmosphere from increasing?

## Key Concepts

- Carbon dioxide and methane in the atmosphere increase as a result of human activities, such as combustion.
- Some ways to stop the increase of carbon dioxide and methane include decreasing combustion and removing these gases from the atmosphere.
- Humans can take actions in their daily lives that will reduce the amount of carbon dioxide and methane in the atmosphere.

## Vocabulary

- atmosphere
- carbon dioxide
- change
- claim
- climate
- climate change
- combustion
- energy
- evidence
- human activities
- methane
- stability
- temperature

## Digital Tools

- *Earth's Changing Climate* Modeling Tool activity: Climate Change Solution
- *Earth's Changing Climate* Simulation

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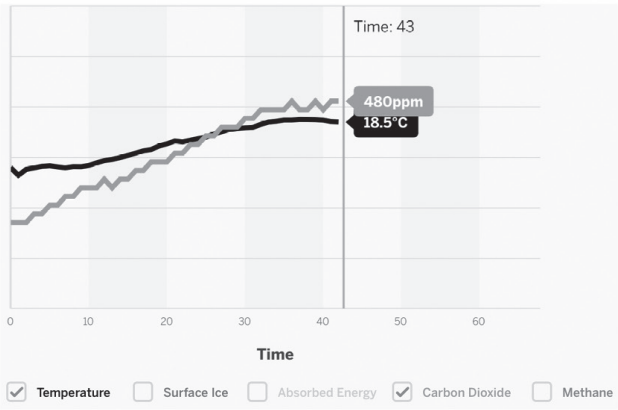
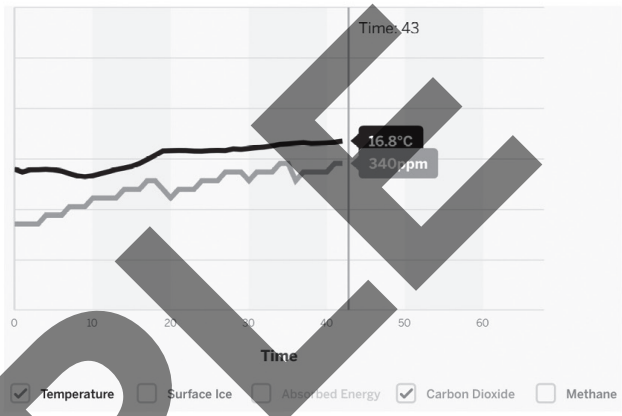
# Warm-Up

One of these Sim tests was run with the Combustion per Person set to high; the other one was run with Combustion per Person set to medium. Which is which? Select the setting for each graph.

Combustion set to ☐ medium ☐ high




Combustion set to ☐ medium ☐ high




Explain how you knew which graph was which.

_____

_____

_____

_____

_____

_____

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# Rereading About One Solution

## Analyzing One Solution to Climate Change

Read about ONE possible solution from "Climate Change Solutions." Your partner will read about a different solution. You are rereading part of this article so you can better understand one solution, explain it to your partner, and write about it in your report for WCI.

Highlight helpful information as you read, and then answer the following questions:

1. Which solution did you read about? (circle one)
   a. solar power
   b. bikes and transit
   c. capturing methane from cows
   d. capturing carbon dioxide at power plants
   e. reforestation

2. What kind of solution is it? (circle one)
   a. This solution produces less carbon dioxide.
   b. This solution removes carbon dioxide from the atmosphere.
   c. This solution removes methane from the atmosphere.

3. Explain why the solution is needed.

_____

_____

_____

4. Explain how the solution works.

_____

_____

_____

5. Is this a good solution? Why or why not?

_____

_____

_____

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# Modeling One Solution

When your model is complete, press HAND IN.
If you worked with a partner, write their name here: _____

Use the Modeling Tool activity: Climate Change Solution to create a diagram that shows how the solution you read about would affect climate. Hand in your finished model and annotate it to help explain what you included.

**Goal:** Show how one solution would work to stop carbon dioxide or methane in the atmosphere from increasing and how it will affect temperature.

**Do:**

- Select one solution that will stop either carbon dioxide or methane from increasing.
- Show how this solution would affect energy, carbon dioxide or methane, and temperature.

**Tip:**

- If the Modeling Tool does not allow you to show all your ideas, complete what you can, press HAND IN in the Modeling Tool to see a screenshot of your model, and add annotations to further explain your ideas.

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# Stable Temperature in the Sim

**Sim Mission: Stable Temperature:** Keep the temperature as stable as possible (not increasing or decreasing) until the time reaches 100 or more.

- Use the *Earth's Changing Climate* Simulation and select Human Activities mode.
- Leave population at 7 billion (close to what the world population is today).
- Adjust Combustion per Person, Livestock per Person, Forest Cover, and Gas Capture.
- When you succeed at the mission, make two sketches: (1) the Earth system and (2) graph view showing the stable temperature.
- Do not let the temperature reach 30°C.
- Answer the question.

| Sketch: the Earth system | Sketch: graph view |
|---|---|
| | |

Why do you think these human activity settings resulted in a stable temperature? If it helps you answer, annotate your sketches.

_____

_____

_____

_____

_____

_____

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Name: _____ Date: _____

# Homework: Blog Post: Climate Change Solution

Dr. Lee asked you to write a blog post that describes and explains the solution you read about in "Climate Change Solutions." When you write your explanation, remember that the general public is your audience. Try to be as convincing as possible. Carefully explain the solution, how it would affect climate change, and why it is needed.

**Word Bank**

| | | |
|---|---|---|
| absorb | energy | methane |
| atmosphere | enter | redirect |
| carbon dioxide | exit | surface |

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Name: _____ Date: _____

# Homework: Reading "What Are We Doing About Sea Level Rise?"

Read "What Are We Doing About Sea Level Rise?" to learn about how people are preparing for a future with higher ocean levels. As you read, highlight any information that will help you answer the two questions below. After reading, use your annotations to help you answer the questions.

1. What are some things that will happen if global sea levels rise?

_____

_____

_____

2. What are the ways coastal cities are preparing for sea level rise?

_____

_____

_____

3. Why is wetland restoration an effective way to prepare for sea level rise?

_____

_____

_____

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**Active Reading Guidelines**

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
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# Homework: Check Your Understanding

This is a chance to reflect on your learning so far. This is not a test. Be open and truthful when you respond.

Scientists investigate in order to explain their observations. You have been investigating why the climate has been changing. Are you getting closer to understanding what causes climate change?

1. I understand how the atmosphere is related to the ice melting. (check one)

   ☐ yes ☐ not yet

   Explain your answer choice.

   _____

2. I understand what can affect energy entering and exiting the Earth system, and how this affects climate. (check one)

   ☐ yes ☐ not yet

   Explain your answer choice.

   _____

3. I understand what can happen when energy hits gases. (check one)

   ☐ yes ☐ not yet

   Explain your answer choice.

   _____

4. I understand what causes the amount of gases in the atmosphere to change. (check one)

   ☐ yes ☐ not yet

   Explain your answer choice.

   _____

5. I understand that scientists can only make explanations about things they can observe and gather evidence about. (check one)

   ☐ yes ☐ not yet

   Explain your answer choice.

   _____

6. What about climate change are you still wondering?

   _____

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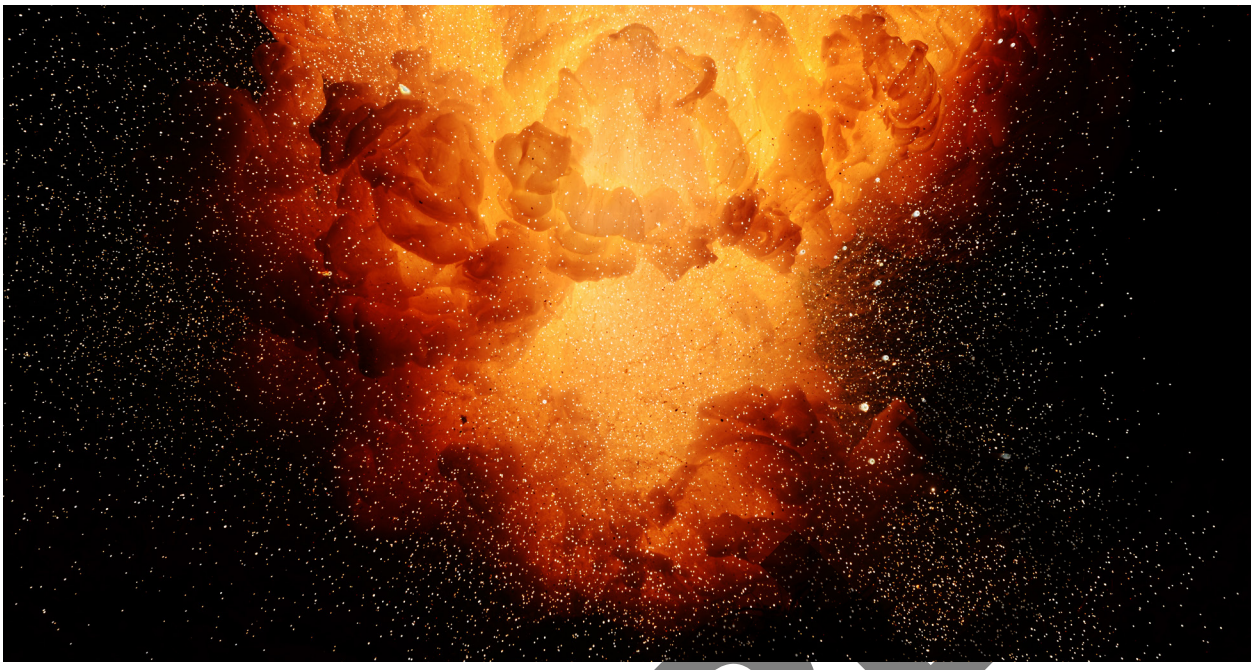

**Combustion, or burning fuel, is the process used to power most of our homes, businesses, and cars. Combustion adds carbon dioxide gas to the atmosphere.**

# Climate Change Solutions

## The Problem: Too Much Carbon Dioxide and Methane

Most of the energy sources humans use to power our homes, businesses, and cars involve burning fuel, a process we call combustion. Combustion leads to higher temperatures on Earth—but not because fires are hot. The process of burning almost any fuel puts carbon dioxide ($CO_2$) into the atmosphere, whether the fuel is coal, oil, natural gas, or wooden logs. It's this increase in carbon dioxide that warms the planet.

Carbon dioxide is not the only gas that affects the Earth's climate. Would you believe that some of the gases that warm the planet come from inside farm animals? Cows and other grass-eating animals, like sheep and goats, produce a gas called methane, which also warms the planet when it gets into the atmosphere. Methane is also produced by industrial sources such as using natural gas to produce electricity. However, of the methane put into the atmosphere by human activities, 35% comes from raising grass-eating animals.

Because they warm the planet, carbon dioxide and methane are known as greenhouse gases. How do we solve the problem of too much carbon dioxide and methane in the atmosphere? Many people have thought of possible solutions, like capturing carbon dioxide at power plants, reducing the amount of methane animals release into the air, and using more solar power. We may need to use all of these solutions together if we want to solve as huge a problem as climate change!

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## Part of the Solution: Producing Less Carbon Dioxide

### Solar Power

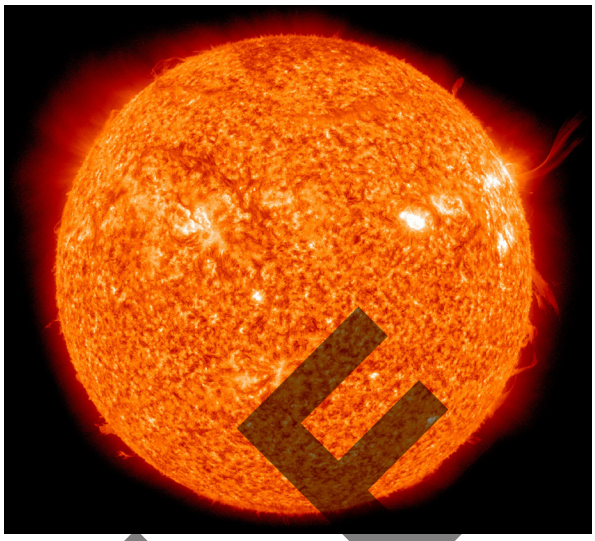
What energy source is about 93 million miles away? The sun, of course! Solar power plants convert light energy from sunshine into electrical energy. Increasing our use of solar power can help reduce the amount of carbon dioxide in our atmosphere. But how? Solar power isn't taking carbon dioxide out of the air. How can solar power affect the amount of carbon dioxide in the atmosphere?

Unlike solar power plants, most power plants produce electricity by burning fuel—that is, combustion. Burning fuel releases carbon dioxide. Solar power plants work differently: instead of burning fuel for power, they use energy from the sun. If we can produce electricity using energy from the sun instead of energy from burning fuel, we can stop putting so much carbon dioxide into the atmosphere.

One drawback to solar power is that it's expensive. However, engineers are working to make solar power cheaper. With smart engineering, they hope to make solar power an even bigger part of the carbon dioxide solution now and in the future.

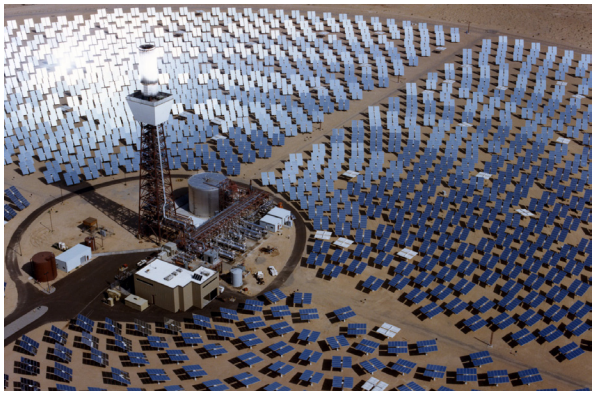
### Bikes and Transit

One way humans can keep carbon dioxide out of the atmosphere is to drive cars less frequently. Driving cars increases carbon dioxide in the atmosphere. Most cars burn fuel through combustion, and burning fuel releases carbon dioxide into the atmosphere. Even electric cars tend to increase the amount of carbon dioxide in the atmosphere because they get energy from being plugged into an electrical outlet. The electricity they get comes from power plants, and most power plants produce electric energy by burning fuel, which releases carbon dioxide into the atmosphere. People can keep some of that



**The sun provides energy without adding carbon dioxide to Earth's atmosphere.**

**Solar panels like these convert light energy from the sun into electrical energy people can use in their homes.**



**This solar power plant uses energy from the sun's light instead of from the combustion of fuel.**

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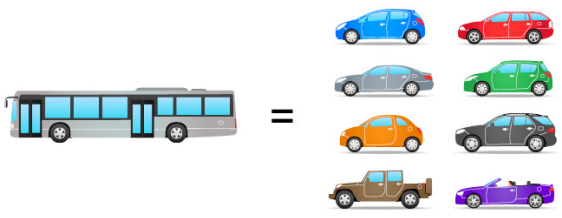
carbon dioxide from being released by driving less, no matter what kind of car they have.

How can people stop driving cars so much? One answer is to find other ways of traveling. For short trips, people can ride bikes or walk instead of driving. For longer trips, people can use public transit—buses, trains, and subways. These vehicles usually burn fuel (or run on electricity generated by combustion), but lots of people can ride them at once. If eight people are riding a bus at one time, that's one engine burning fuel to move eight people. If those same eight people are each riding in a separate car, that's eight engines burning fuel to move eight people. Even though transit vehicles often burn fuel, riding public transit helps reduce the amount of carbon dioxide we put into the air.

**Riding bikes instead of driving cars helps reduce the amount of carbon dioxide in the atmosphere.**

**Subways help people get around without driving cars.**



**Public transit allows many people to travel using fewer engines and putting less carbon dioxide into the atmosphere.**

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## Part of the Solution: Removing Carbon Dioxide and Methane

### Capturing Methane from Cows

Cows are very good at getting energy from plants, but the microorganisms that live in their digestive systems and help them eat grass also produce a lot of methane—and that methane has to get out somehow. In this case, it leaves the cows' bodies through burps and farts! In one year, one cow puts out methane in about the same amount as one car puts out carbon dioxide.

To reduce the amount of methane cows produce, some scientists are working on inventing ways for cows to produce less gas when they digest their food. Some are trying to find out whether different diets for cows might help them put out less gas. Others are trying to change the way microorganisms in the cows' digestive systems process food. If the microorganisms produce less methane, so will the cows.

Another solution would be to eat less beef: if humans ate less meat that comes from cows, farmers would raise fewer cows, and there would be less methane in the atmosphere.

### Capturing Carbon Dioxide at Power Plants

We put carbon dioxide into the atmosphere by using electrical devices like lights, phones, and computers. Why is that? Phones and light bulbs don't burn any fuel—they run on electrical energy. However, that electrical energy had to come from somewhere. It traveled through power lines from a power plant. Most power plants generate electricity by burning fossil fuels like coal, oil, or natural gas. Burning those fuels sends carbon dioxide into the atmosphere.

For now, millions of people rely on power plants for electricity, and those power plants nearly always release carbon dioxide. What

**Cows produce a lot of methane, which stops energy from leaving the Earth system and causes the planet to warm.**

**Most of the electrical energy we use in our homes, schools, and businesses comes from power plants that burn fuel.**

**Big power lines like these carry electrical energy from power plants to places where it is needed.**

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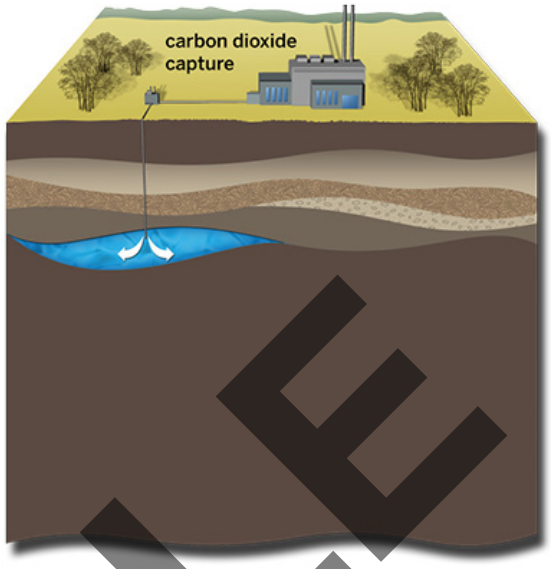
if we could stop that carbon dioxide from reaching the atmosphere? Some power plants use complicated processes to capture the carbon dioxide produced by burning fuel and store it deep underground. Capturing carbon dioxide keeps it out of the atmosphere, which helps stop the planet from warming as quickly. However, capturing carbon dioxide is expensive, and we don't know what the long-term effects might be of burying huge amounts of carbon dioxide underground.




**At some power plants, carbon dioxide is buried deep in the ground to keep it from reaching the atmosphere.**

## Reforestation

To reduce the amount of carbon dioxide in the atmosphere, we can use less energy and store our carbon dioxide before it reaches the atmosphere—or we can rely on a natural process to absorb carbon dioxide from the air. That natural process involves trees and other plants.

All plants take in carbon dioxide, use it to make food for themselves, and release oxygen. The more plants there are in the world, the more carbon dioxide is removed from the atmosphere. One reason there is so much carbon dioxide in the atmosphere today is that humans have cut down many of the trees on Earth and used them to build buildings and make paper and other materials. There are millions fewer trees on Earth than there once were, which means there is less carbon dioxide being taken in.

**Planting trees, or reforestation, is one way to reduce the amount of carbon dioxide in the atmosphere.**

One way of solving the problem of too much carbon dioxide in the atmosphere is reforestation, or planting trees. Many tree-planting projects are located in places where people cut down forests in the past. By replacing trees that have been removed and planting new trees (even in places where they never grew before), people can cause the world's forests to take in more carbon dioxide. Reforestation also creates forest habitat, benefiting many kinds of animals and plants that live in forests.

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