

Today I Learned About Carbon Offsets

Description:

Countries, companies and even individuals can pay for carbon offsets to reach “carbon neutral” or “net zero” targets. Students investigate carbon dioxide distribution, what carbon offsets are, the history of the Kyoto Protocol, and how forest health interacts with carbon offset claims.

Skills & Objectives

SWBAT

- Explain that carbon dioxide is emitted in some places more than others but distributes throughout the atmosphere.
- Describe the idea of a carbon offset.
- Understand the basics of the Kyoto Protocol.
- Analyze carbon offset claims of companies and organizations.

Skills

- Media literacy
- Discussion
- Map reading

Students Should Already Know

- A basic understanding of the relationship between carbon dioxide and climate change.

Standards Alignment:

HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

HS-ETS1-3 Evaluate a solution to a complex real-world problem

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author’s claim.

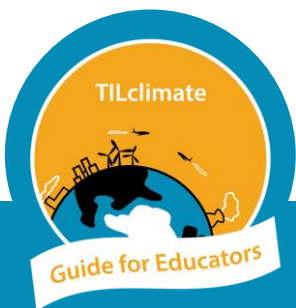
Disciplinary Core Ideas:

ESS2.D Weather and Climate

ESS3.A Natural Resources

ESS3.C Human Impacts on Earth Systems

ESS3.D Global Climate Change



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How To Use These Activities:



Pages with the circular “TILclimate Guide for Educators” logo and dark band across the top are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity.

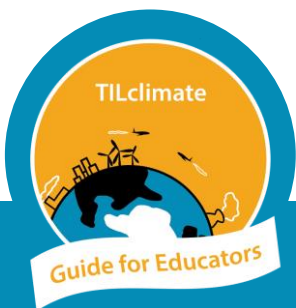
A Note About Printing/Materials

All student pages are designed to be printable in grayscale, except for the map on page 3. A few copies of this page could be printed color for students to share, or the image projected in the classroom.

The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

Podcasts in the Classroom: Throughout these Guides for Educators, we invite students to think about how they would share their learning with family and friends. One way to do this is to encourage your students to create their own podcasts - they're shareable, creative, and have multiple options for embedded assessment. We would love to hear any podcasts or see any other projects you or your students create! Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

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Today I Learned About Carbon Offsets

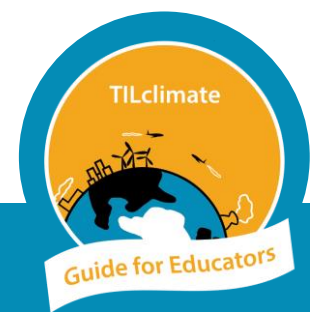
Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: TIL about carbon offsets, either as pre-class work at home or in the classroom. https://climate.mit.edu/podcasts/e6-til-about-carbon-offsets	10-15
1	Carbon Dioxide Distribution (internet required, see note)	Students watch a model of a year's worth of carbon dioxide build-up in Earth's atmosphere and explore the factors that affect it.	15-20
2-3	Kyoto Protocol (internet required, see note)	Students read about the 1997/2005 Kyoto Protocol in small groups. Then, in a jigsaw, they explore the three main market-based mechanisms of the Protocol.	30-45
4-5	Carbon Offsets (internet required, see note)	Students explore real-life carbon offset and climate statements from companies and analyze how effective they might be.	20-45
6-7	Forests and Carbon (internet required)	Using data from Global Forest Watch, students investigate the claims of carbon offsets that focus on deforestation and reforestation.	15-20

Internet Use

With limited or no internet access in class, the following adaptations can be made:

- Carbon Dioxide Video: Project on the wall for the whole class.
- Kyoto Protocol: Print a copy of the overall web page, as well as the three mechanism descriptions from the site.
- Carbon Offsets: See pages a-e for sample climate change statements from major retailers.



Today I Learned About Carbon Offsets

Carbon Offsets and the Kyoto Protocol

This Educator Guide includes data investigations, discussions, and history analysis. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Life/environmental science: Carbon cycle, forests.
- History/social science: Kyoto Protocol, geopolitics.
- ELA/literature: Climatepunk, hopepunk, and speculative fiction.
- ELA/nonfiction: Reading and understanding treaties.

MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. <https://climateprimer.mit.edu/>

Chapter 02

Chapter 10

- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. New Explainers are posted monthly. <https://climate.mit.edu/explainers>

Carbon Offsets

Climate Targets

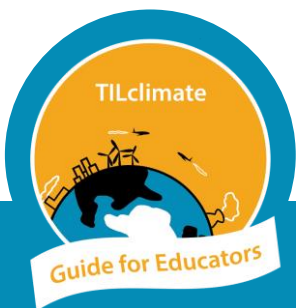
Forests and Climate Change

Soil-Based Carbon Sequestration

Coastal Ecosystems and Climate Change

Loss and Damage

Climate Justice



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Wrap-Up Discussion Questions

- Do you agree that “a CO₂ molecule warms the planet the same in Germany as in India, the planet [doesn't] notice the difference”? Why or why not?
- Describe the Kyoto Protocol in your own words.
- What questions do you still have about the Protocol?
- Which of the market-based mechanisms in the Kyoto Protocol interest you the most?
- Based on the podcast episode, how effective do you think carbon offset programs are?
- Why do you think this? Do you think they should or could be improved?
- How would you explain carbon offsets to a friend or family member?
- Would you buy carbon offsets? Why or why not?

Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than asking homeowners to install solar panels. For more on talking about climate change in the classroom, see “How to Use This Guide”.

•Energy Shift

How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?

•Energy Efficiency

What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?

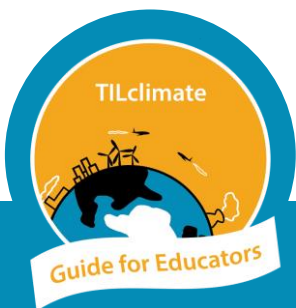
•Adaptation

How can cities and towns adapt to the impacts of climate change?

•Talk About It

Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?

What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.



Today I Learned About Carbon Offsets

"[Since] a CO₂ molecule warms the planet the same in Germany as in India, the planet [doesn't] notice the difference."

Laur Hesse Fisher, Host

TILclimate podcast: Today I Learned About Carbon Offsets

Carbon Dioxide Distribution

As we burn fossil fuels like coal, oil, and natural gas and cut down forests, we release carbon dioxide (CO₂) into Earth's atmosphere. This carbon dioxide stays in the atmosphere for centuries, acting like a blanket and trapping heat. Trapped heat is warming our Earth and ocean, causing dramatic changes such as extreme weather and flooding.

We are used to the idea that the smog (visible air pollution) stays within the same area where it is generated. The air is often cleaner in the country than in the city. Unlike most visible air pollution, carbon dioxide rises into the atmosphere, where it is moved around by upper winds, such as the jet stream.

Watch a Year In CO₂

1. Visit https://climate.nasa.gov/climate_resources/296/global-carbon-dioxide-2020-2021/
2. Watch the video.

Observe

What patterns do you notice? Where is carbon dioxide coming from? How does it change over the year?

3. Read the article below the video.

Analyze

What factors affect how carbon dioxide is distributed through Earth's atmosphere?

Extend

Do you agree with the statement above about CO₂? Why or why not?

Today I Learned About Carbon Offsets

“The Kyoto Protocol was the first main international global climate agreement under the UN that mandated that some countries needed to reduce their emissions.”

*Dr. Barbara Haya, Goldman School of Public Policy, University of California Berkeley
TILclimate podcast: Today I Learned About Carbon Offsets*

What is the Kyoto Protocol?

Written in 1997 and in effect since 2005, the Kyoto Protocol was an international treaty that created commitments for countries to reduce their emissions of carbon dioxide and other heat-trapping (“greenhouse”) gases.

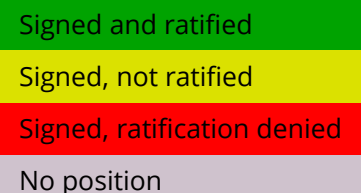
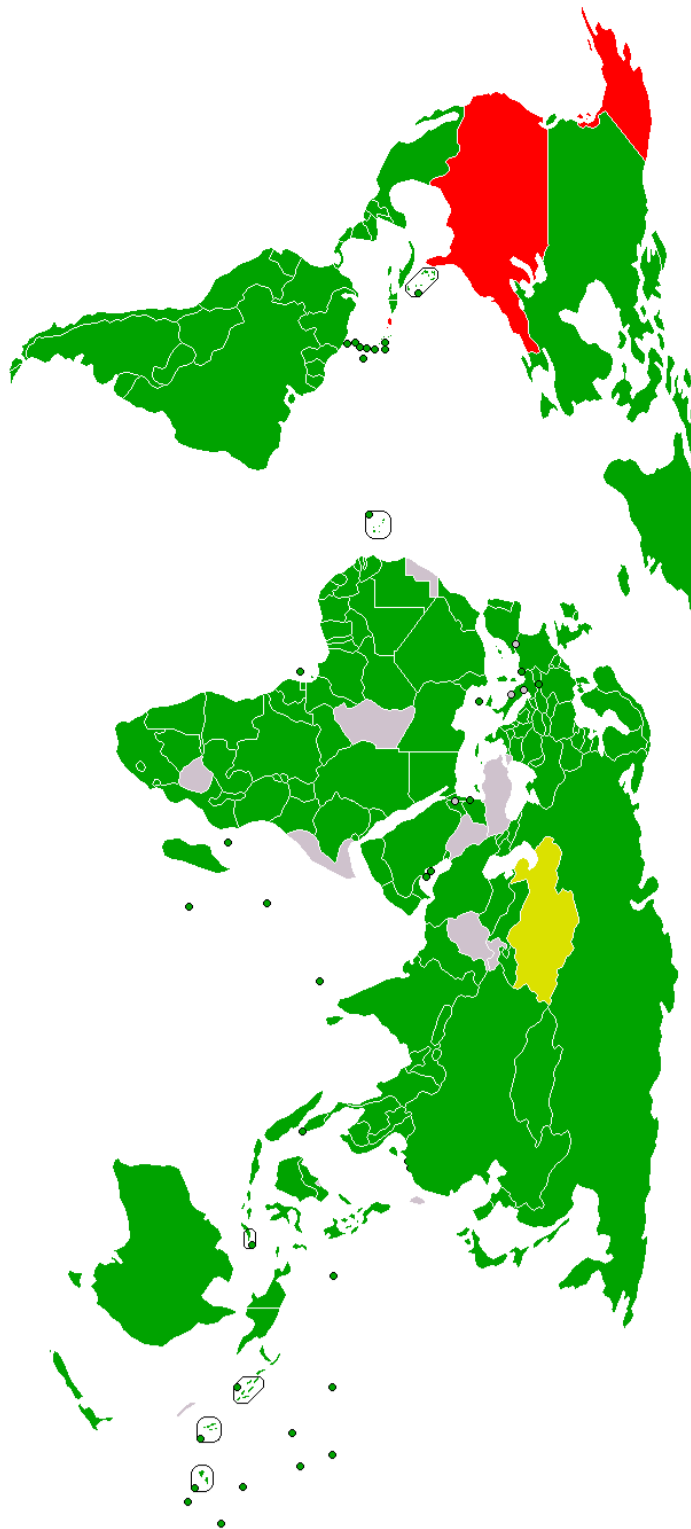
Based on the principle that not all countries emit equally and have equal resources to reduce emissions, the Protocol placed a higher burden on developed/industrialized nations. This concept is called “common but differentiated responsibility and respective capabilities”. In other words, richer countries are both responsible for more emissions and have more ability to invest in reducing those emissions.

Market-Based Mechanisms

1. In pairs or small groups, read through “What is the Kyoto Protocol” at https://unfccc.int/kyoto_protocol. Work together to clear up any confusing language.
2. As a class, discuss:
 - Describe the Kyoto Protocol in your own words.
 - What questions do you still have about the Protocol?
3. Each small group will investigate one of the three market-based mechanisms used in the Protocol. Start by clicking on the link for each mechanism in the article under “The Kyoto Mechanisms”. If you have time, you may research these topics further.
 - International Emissions Trading
 - Clean Development Mechanism
 - Joint Implementation
4. If more than one small group read about the same mechanism, work together to make sure that you agree on how to define it.
5. Teach the rest of the class about your mechanism. Make sure to include:
 - How does your mechanism work? (Which kinds of countries can use it, and how?)
 - How does your mechanism connect to carbon offsets?
 - What benefits and challenges do you see with this mechanism?

Today I Learned About Carbon Offsets

Signatories to the Kyoto Protocol, 2005



By Users Alinor, E Pluribus Anthony on en.wikipedia - Originally from en.Wikipedia, 26 March 2006

Today I Learned About Carbon Offsets

“So say you’re Germany, a well-off country that has agreed to lower its emissions. You could build a bunch of wind and solar farms to take some of your coal plants offline. But you can’t help but notice it would be cheaper to build that same clean energy in India, and take some of their coal plants offline.”

Laur Hesse Fisher, Host

TILclimate podcast: Today I Learned About Carbon Offsets

What are Carbon Offsets?

When we burn fossil fuels like coal, oil, and natural gas and cut down forests, we release carbon dioxide (CO₂) into Earth’s atmosphere. Carbon dioxide stays in the atmosphere for centuries, acting like a blanket and trapping heat. Trapped heat warms our Earth and ocean – which is causing dramatic changes to weather and climate patterns.

In order to reduce the effects of climate change, we must reduce the amount of carbon dioxide entering and staying in the atmosphere. This is called *climate change mitigation*, and can take many forms, including:

- **Energy Efficiency** – When buildings and other systems are more efficient, they use less energy overall. This means fewer fossil fuels must be burned, and it is easier to replace them with low- and no-carbon energy sources.
- **Energy Switch** – Cities and towns all over the world are switching away from getting all their energy and electricity from coal and natural gas and toward using low- and no-carbon sources such as solar and wind energy.
- **Carbon Removal and Sequestration** – Natural systems such as forests, prairies, and wetlands remove carbon dioxide from the atmosphere. Technology can be used to suck carbon dioxide out of the air and from smokestacks and store it underground.

Companies, countries, and even individuals may purchase *carbon offsets*. The goal of offsets is to fund climate mitigation projects, often in other countries. These projects may include stopping deforestation, planting trees, installing solar or wind energy systems, or capturing emissions from mining or landfills.

Discuss

Based on the podcast episode, how effective do you think carbon offset programs are?

Why do you think this? Do you think they should or could be improved?

How would you explain carbon offsets to a friend or family member?

Today I Learned About Carbon Offsets

Carbon Offset Transparency

Companies around the world are working to reduce their direct and indirect carbon dioxide emissions - the electricity in their buildings, the fuel for shipping, manufacturing energy, and more. They also may buy carbon offsets as a way to reduce their overall “net carbon” usage.

Search for a company you are familiar with that lists a ‘carbon neutral’ goal or otherwise mentions carbon offsets on its website. Most major retailers have a climate change statement of some kind.

Try search terms such as “[name of company] carbon neutral” or “[name of company] net zero”.

Observe

What language does the site use to describe its climate change goals, especially reducing greenhouse gas emissions?

Analyze

Does any part of this company’s climate change plan focus on actions to reduce the company’s own direct carbon dioxide emissions? For example, putting solar panels on their store buildings, or energy efficiency measures in their offices. What kinds of actions are they taking directly?

Carbon offsets usually take the form of money given to climate-related projects that are not directly reducing a company’s carbon dioxide emissions. For example, planting trees or building solar panels in another country. Is this company funding those kinds of projects?

Look for terms such as “investing in” offset projects that are not on-site for the business.

Discuss

Does this research change your opinion of carbon offsets?

How effective do you think programs like this are? Why do you think so?

Would you buy carbon offsets?

Excerpt from Target's Climate Statement

This is an excerpt from a multi-page website of information and statements.
Copied from <https://corporate.target.com/sustainability-ESG> November 15, 2022

Climate & Energy

We are committed to making our operations and our supply chain sustainable through reducing our greenhouse gas footprint which supports a more resilient and healthier environment for our guests, team members, and communities. Through our Target Forward strategy, we commit to being a net zero enterprise by 2040 to reduce climate impacts across our operations and supply chain.

Climate Policy

Target acknowledges the scientific consensus that the climate is changing, that our business is contributing to that change, and that our supply chain, operations and guests will continue to be impacted by the effects of climate change.

By 2040, Target commits to net zero greenhouse gas emissions across our enterprise, and to engaging constructively with industry peers, value chain partners, external stakeholders and policymakers to help accelerate the transition to a zero-carbon economy.

Target also supports the Paris Agreement and national, regional and local policy solutions to reduce emissions and build resilience to climate change. In 2019, The Science Based Targets initiative approved our climate goals. In addition to reducing scope 3 greenhouse gas emissions by an absolute 30% below 2017 levels by 2030, and committing that 80% of our suppliers will set science-based reduction targets on their scope 1 and 2 emissions by 2023, we have committed to reduce our scope 1 and 2 emissions by 50% below 2017 levels by 2030. We've also committed to join the Business Ambition for 1.5°C, ensuring that our emissions will contribute to no more than 1.5 degree warming.

Our efforts are focused on five areas:

- Increasing adoption of renewable energy in our own operations, on the electricity grid and in our supply chain.
- Driving energy and water efficiency in our own operations and in our supply chain.
- Investing in innovations supporting the transition to a zero-carbon transportation system, including vehicle electrification.
- Investing in solutions that protect, sustain and restore nature, including regenerative agriculture, agricultural residuals and responsible forest management to reduce climate impacts.
- Supporting communities most heavily impacted by climate change and building their resilience to climate change impacts, like extreme weather events.

Excerpt from Walmart's Climate Statement

This is an excerpt from a multi-page website of information and statements.
Copied from <https://corporate.walmart.com/purpose/sustainability> November 15, 2022

Sustainability

We understand that for a business to last, it must have a fundamental reason for being – which is found in the value it creates not only for shareholders, but for the world. That's why, for more than 15 years, Walmart has been collaborating with others to drive positive impact across global supply chains. Our focus on climate, nature, waste and people in supply chains has strengthened our business and communities in measurable ways.

The Climate and Our Future

0 Emissions Across Global Operations by 2040

We plan to hit this goal without carbon offsets by:

- Harvesting enough wind, solar and other energy sources to power our facilities with 100% renewable energy by 2035. We power around 46% of our operations with renewable energy.
- Zeroing out emissions from all of our vehicles, including long-haul trucks, by 2040.
- Transitioning to low-impact refrigerants for cooling and electrified equipment for heating in our stores, clubs, data centers and distribution centers by 2040.

We're also working with our suppliers to avoid 1 gigaton of greenhouse gas emissions by 2030.

A Focus on Nature

Protect, manage or restore at least 50 million acres of land and

Protect, manage or restore at least 1 million sq miles of ocean

By 2030

To help reverse nature loss, along with the Walmart Foundation, we aim to protect, manage or restore critical landscapes by:

- Continuing support of efforts to preserve at least one acre of natural habitat for every acre of land we develop in the U.S.
- Driving the adoption of regenerative agricultural practices, sustainable fisheries management and forest protection and restoration.
- Investing in, and working with, our suppliers to source place-based efforts that help preserve natural ecosystems and improve livelihoods.
- We're expanding our forest policy by aiming to source palm oil, beef, soy, pulp, paper and timber 100% deforestation-free by 2025.

Excerpt from Amazon's Climate Statement

This is an excerpt from a multi-page website of information and statements.
Copied from <https://sustainability.aboutamazon.com/> November 15, 2022

Environment

Operating sustainably is no longer a choice—it's an imperative. Making meaningful progress to address climate change takes unprecedented action across all industries and societies. We recognize this and acknowledge that the ways we do business have impacts far beyond our own company. There's no time to waste, and that's why we're investing in efforts to protect the environments of the people and communities we serve—both now and in the future.

Renewable Energy

Transitioning to renewable energy is one of the highest-impact ways to immediately lower emissions. Amazon is the world's largest corporate purchaser of renewable energy and is on a path to powering our operations with 100% renewable energy by 2025—five years ahead of our original target of 2030.

In 2021, we reached 85% renewable energy across our business, and announced renewable energy projects across 18 countries.

Our first solar projects in South Africa and the United Arab Emirates came online, and we announced new projects in Singapore, Japan, Australia, and China. Our projects in South Africa and Japan are the first corporate-backed, utility-scale solar farms in these countries.

We also announced two new offshore wind projects in Europe, including our largest renewable energy project to date. As of December 2021, we had enabled more than 3.5 gigawatts of renewable energy in Europe through 80 projects, making Amazon the largest purchaser of renewable energy in Europe.

Our Global Renewable Energy Projects

Since 2014, we have invested in global renewable energy generation to decarbonize our business across our worldwide operations.

Our projects supply renewable energy for a variety of Amazon facilities, including corporate offices, fulfillment centers, data centers, and physical stores, which collectively serve millions of customers globally.

Our renewable energy projects help meet Amazon's commitment to produce the clean energy equivalent of the electricity used by every customer's Echo device.

We're making additional large-scale investments in wind and solar farm capacity, which will produce the clean energy equivalent to the electricity used by all Echo, Fire TV, and Ring devices worldwide by 2025.

Excerpt from Meta's Climate Statement

This is an excerpt from a multi-page website of information and statements.
Copied from <https://sustainability.fb.com/climate/> November 15, 2022

Climate

Science tells us that the next 10 years will be the defining decade for dramatic emissions reductions to limit the worst impacts of climate change.

We are committed to tackling this urgent issue through our global operations, value chain and beyond.

Reducing Our GHG Emissions

In 2021, we announced our goal to expand our net zero goal to include our value chain in 2030.

Our climate program is aligned with the Science Based Targets initiative (SBTi) and guided by the latest science on what is necessary to transition to a zero-carbon future. We will continue to reduce our Scope 1 and Scope 2 emissions in line with climate science by increasing the efficiency of our operations and maintaining 100 percent renewable energy.

In 2020, we achieved net zero GHG emissions in our direct operations (Scopes 1 and 2) by reducing our emissions by 94% compared to 2017 levels.

Supporting Carbon Removal Projects

Recognizing that some of our emissions will be very difficult to reduce by 2030, we will support projects that remove carbon equivalent to the emissions we are not able to reduce by then. Our carbon removal projects are verified by a third party; prevent any adverse impacts; and prioritize climate justice and equity.

In 2021, we supported carbon removal projects in Kenya and Mexico that represent over 200,000 tons of carbon sequestration via forests and soil.

This year, our contribution to the Frontier advance market commitment will help catalyze a market for technological carbon removal credits and unlock the opportunity to learn from global scientific leaders on emerging carbon removal technologies.

Energy

Meta is one of the largest corporate buyers of renewable energy. We are driving the transition to renewable energy in our communities by selecting projects that are on the same electricity grids as our data centers.

At the end of 2021, we had contracts in place for more than 7,500 megawatts (MW) of solar and wind energy across our global portfolio. Of that, over 4,900 MW of new renewable energy is now operating. 4,900 MW of renewable energy is enough to power 3.6 million U.S. homes.

Excerpt from Nike's Climate Statement

This is an excerpt from a multi-page website of information and statements.
Copied from <https://about.nike.com/en/impact/focus-areas/protecting-the-planet>
November 15, 2022

Innovation for the Future of Sport

Since 1972 Nike has tenaciously innovated so everyone can perform at their best. Innovation, however, is about more than record-breaking shoes or iconic apparel. Climate change is one of the biggest risks for the planet and for sport, and its impacting athletes worldwide. That's why we're reimagining everything we do through the lens of sustainability. We're focused on carbon, waste, water and chemistry because we know these are the areas where we can make the biggest difference. We've set bold, science-based targets to create a better future, built on more than 30 years of trial, error and success. Most important, we know this work is collective—we're partnering across our industry and beyond to innovate and create solutions that help us all accelerate our efforts to protect the planet.

Reducing Our Carbon Footprint

To help protect the future for athletes* everywhere, everyone needs to do their part to keep global warming below 1.5C. That means collectively cutting the world's GHG emissions in half this decade, and reaching net zero by 2050.

At NIKE's size, these aims are ambitious so we're getting after them across our entire business, from what we make and how we make it to how we operate. We have set bold, ambitious Science-Based Targets to reduce our carbon footprint by 2030, with an absolute reduction of Scope 1 and 2 emissions by 65% and Scope 3 emissions by 30%.

Creating and scaling low-carbon materials throughout NIKE products is a key initiative because materials account for approximately 70% of NIKE's carbon footprint. In footwear, we are focused on sourcing better alternatives and innovating around recycled options for polyester, rubber and leather. In apparel, we are scaling recycled polyester and 100% of the cotton we use is certified organic, recycled, or Better Cotton-sourced through the Better Cotton Initiative.

Our extended value chain includes material production, manufacturing and finishing, and finished goods manufacturing. It represents the largest part of our carbon footprint. We work with manufacturing suppliers to increase the efficiency of their facilities through efforts like increased use of onsite and offsite renewable energy and eliminating coal in Tier 2 suppliers. We also support suppliers in setting more ambitious climate goals through our Supplier Climate Action Program (SCAP), by providing climate risk assessment and mitigation tools, and helping them identify strategic opportunities sparked by the shift to a lower carbon economy.

Today I Learned About Carbon Offsets

“Most of the forest projects are being credited not for doing something, but for not doing something; not deforesting and not aggressively harvesting [trees]. And that means it's very easy to tell a story of a high risk of deforestation and harvesting, so you can generate lots of credits early on.”

*Dr. Barbara Haya, Goldman School of Public Policy, University of California Berkeley
TILclimate podcast: Today I Learned About Carbon Offsets*

Investigating Deforestation and Reforestation

Many carbon offset projects make claims about preventing deforestation or promoting reforestation. Forests are *carbon sinks* – that is, they absorb more carbon dioxide than they release (under normal conditions). However, forests are large and complex. Scientists still don't have exact measures for precisely how much CO₂ they are “breathing” in and out. Using satellite data, direct measurement tools, and models, scientists can approximate the effect of planting, protecting, or demolishing forests on the climate.

1. Visit <https://www.globalforestwatch.org/map/>
2. Turn off the three layers that are automatically on when you first visit the site. (Click **legend** and the **x** next to each layer to do this.)
3. Click through the options under Forest Change, Land Cover, Land Use, Climate, and Biodiversity.

Explore

As you see different datasets, what are you curious about? What questions do you have?



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Investigating Deforestation and Reforestation

4. Under **Forest Change**, turn on **Tree cover loss by dominant driver**.

Color	Driver	Definition
Red	Commodity-driven	Large-scale deforestation linked primarily to commercial agricultural expansion.
Yellow	Shifting agriculture	Temporary loss or permanent deforestation due to small- and medium-scale agriculture.
Green	Forestry	Temporary loss from plantation and natural forest harvesting, with some deforestation of primary forests.
Brown	Wildfire	Temporary loss, does not include fire clearing for agriculture.
Purple	Urbanization	Deforestation for expansion of urban centers.

Observe

What patterns do you notice across the world?

5. Choose a region of the world of interest. This data set is best viewed zoomed to 3-5. (Find the zoom level in the bottom right-hand corner of the screen)

Describe

What do you notice? What is the most common reason for this area to lose tree cover?

6. Turn off **Tree cover loss by dominant driver** and turn on **Tree cover gain** for the same region.

Describe

What do you notice? Are trees being replanted in this area at the same rate as they are being lost?

Analyze

If a carbon offset program was claiming to prevent deforestation in this area, what questions would you have?

What if they were claiming to support reforestation?

Extend

What other questions do you have? How could you use this tool to answer them?