Solutions to Climate Change

"The most important thing you can do to stop climate change is to talk about it." - Katharine Hayhoe

In the following module, there is a list of activities that can be utilized to map and have conversations about climate change solutions. There are 4 activities embedded within the module: 1) EN-ROADS Climate Simulation; 2) Project Drawdown Solutions; 3) Carbon Footprint, Individual Solutions and Corporate Responsibility; and 4) Citizens' Climate Lobby: Writing LTEs.

Activity 4.1 - EN-ROADS

EN-ROADS is a climate change simulator that helps people visualize connections between climate change and human activities. Within the simulator, people can forecast climate change scenarios based on enacting certain environmental policies such as highly taxing non-renewable resources or electrifying the transportation sector. The following activity was created to educate students on various climate change impacts while also opening conversations around climate change solutions. The activity covers carbon pricing and energy efficiency simulations, and also allows for students to create their own solution simulations.

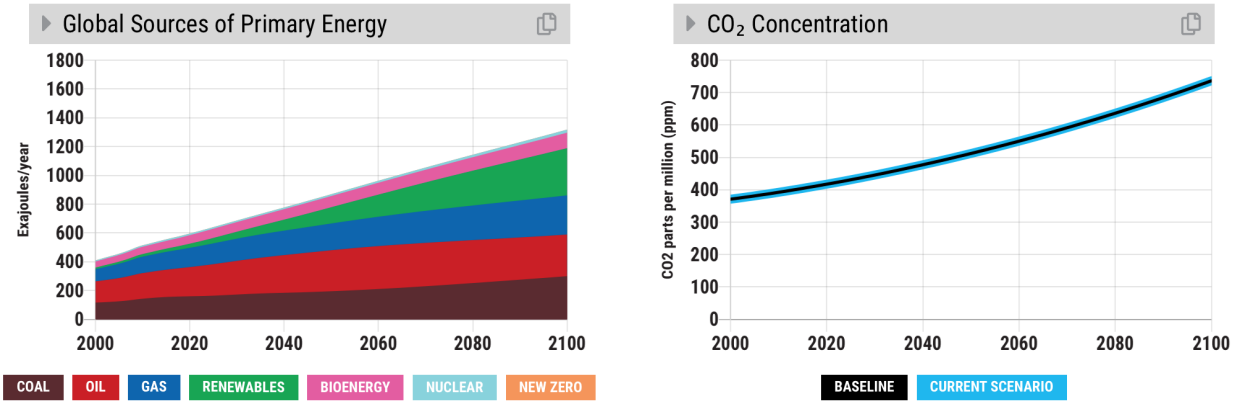
The following activity is adapted from a lab created by Travis Rector, an astronomer at the University of Alaska. Within the activity, students explore climate change solutions using the EN-ROADS Climate Simulator. To start the simulator, click here.

The goal of the activity is to use EN-ROADS to find ways to reduce our carbon footprint so that the temperature doesn't increase by 2100 to more than 2.0°C (3.6°F). This is an important goal because scientists believe we can avoid the worst consequences of climate change if we can keep the temperature below that level. If we continue with "business as usual" (i.e., continue to do things as we are doing them now) it is estimated that the temperature increase will be more than 4°C. This increase would cause multiple issues for the planet and human society at large. By graphing different outcomes, we can see how our societal choices can have a huge impact on the severity of climate change.

Once you open the simulator, you will see two graphs at the top of the screen. Click on the ‘Simulation’ menu at the upper left-hand corner and select ‘reset policies and assumptions.’ If you get stuck throughout the activity, this action will allow you to reset the simulation to its normal state.

Then, click on the ‘Graphs’ menu next to the Simulation menu. Select ‘Impacts’ then select ‘CO2 concentration.’

The two graphs on your screen should look like the ones below.



The left-hand graph shows the global sources of primary energy. Here, we see that coal, oil, and gas make up a significant amount of primary energy, with renewables, bioenergy and nuclear making up a lesser amount.

The right-hand graph shows the CO2 concentration of the atmosphere based off of the emissions that our current global sources of primary energy produce.

1. Looking at the right-hand graph, what will the CO2 concentration be in 2100 if we don’t make any changes? What will the temperature increase by 2100 be if we don’t make any changes?

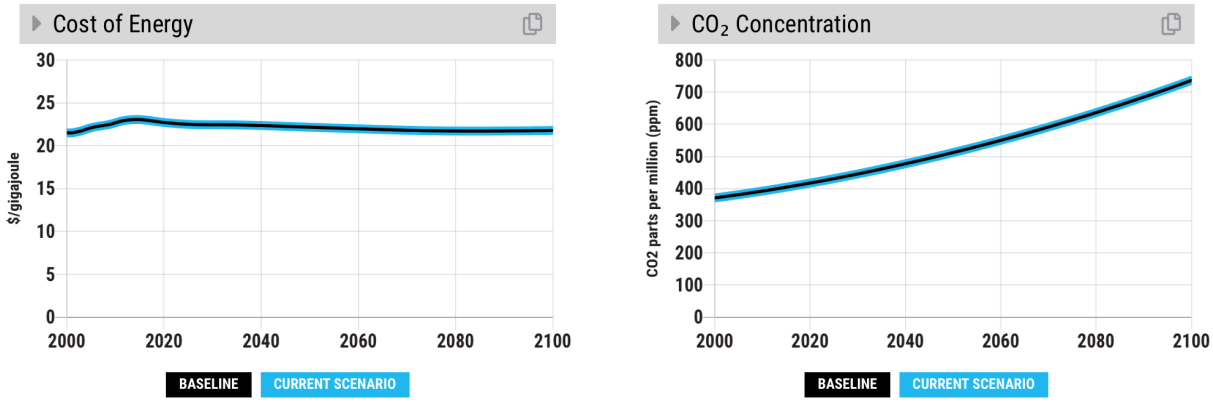
<u>Carbon Pricing</u>

Carbon pricing is a strategy utilized that captures the external costs of greenhouse gas emissions, such as damage to crops and/or the environment, health ailments due to heat waves, and loss of property from flooding and sea level rise, and factors the external costs into their emission sources. For example, coal as a resource produces greenhouse gas emissions. If coal were to be a part of a carbon pricing scheme, then the price of coal would reflect the potential damage its emissions might cause to the environment and to humans. In this sense, the price of coal would go up, and energy companies may choose

low-carbon energy sources such as renewables or bioenergy as an alternative.

Click on the ‘Graphs’ menu and select ‘Financial’. Then, select ‘Cost of Energy.’ The two graphs on your screen should look like the ones below.

The graph on the left-hand side shows the cost of energy in $ per gigajoule. One gigajoule is equivalent to the amount of energy in eight gallons of gasoline.



2. Looking at the left-hand graph, what will the cost of energy be in 2100 if we don’t enact carbon pricing?

At the bottom left-hand side of your screen, there is a list of different energy sources and policies under ‘Energy Supply.’ Take the sliding scale under ‘Carbon Price’ and move it all the way to the right. The Carbon Price should have moved from ‘status quo’ to ‘very high.’

1. If a ‘very high’ carbon pricing scheme is put in place, what will happen to the cost of energy from 2020 to 2100?
2. What happens to the CO2 concentration from 2020 to 2100?
3. Did enacting carbon pricing decrease the amount of temperature increase by 2100? If so, why?

Move the sliding scale under ‘Carbon Price’ back to status quo. Then, take Coal, Oil, and Natural Gas and move them to the left to ‘highly taxed.’

4. If coal, oil, and natural gas are ‘highly taxed’, what will happen to the cost of energy from 2020-2100? Is it similar or different to carbon pricing being enacted?
5. Is the temperature increase more or less than the temperature increase under carbon pricing? Why might this be the case?

To reset the graphs, click on the house icon at the top middle of the screen.

To reset the simulation, click on 'Simulation' at the top left-hand corner and select 'reset policies and assumptions'.

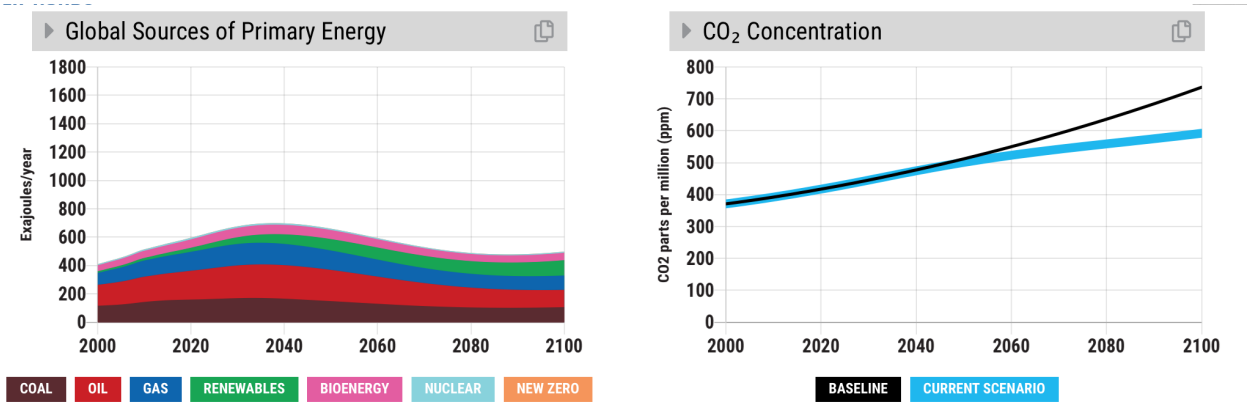
Energy Efficiency

Energy efficiency is a reduction in the amount of energy required to provide the same standard or amount of products and services. For example, over the past few years, light bulbs have become increasingly more efficient, meaning that they have a longer lifespan than a light bulb had previously. Though certain energy efficient bulbs have a higher cost, their efficiency over their lifecycle saves consumers energy costs in the long run.

Here, we are going to see how a change in energy efficiency via 'Transport' and Buildings and Industry' might affect CO2 concentrations and temperature rise by 2100.

Click on the 'Graphs' menu next to the Simulation menu. Select 'Impacts' then select 'CO2 concentration.' Below, move the sliding scale of 'Energy Efficiency' under 'Transport' all the way to the right to where it says 'Highly increased.' Then, move the sliding scale of 'Energy Efficiency' under 'Buildings and Industry' all the way to the right where it says 'Highly increased.'

The two graphs on your screen should look like the ones below.



1. How did the exajoules per year change from 2020 to 2100 on the left-hand graph? How did the CO2 concentration change on the right-hand graph?
2. Did changing the energy efficiency in these two sectors [transport and buildings and industry] change the temperature increase by 2100? In what way?

Now, move the sliding scale of 'Electrification' to 'highly incentivized' for both 'Transport' and 'Buildings and Industry' as well.

3. What impact did the electrification of these two sectors have on both the CO2 concentration and temperature increase? Are you surprised by this?
4. Are there any other sectors that you can think of that can be more energy efficient or electrified?

To reset the graphs, click on the house icon at the top middle of the screen. To reset the simulation, click on 'Simulation' at the top left-hand corner and select 'reset policies and assumptions'.

Making Your Own Scenario

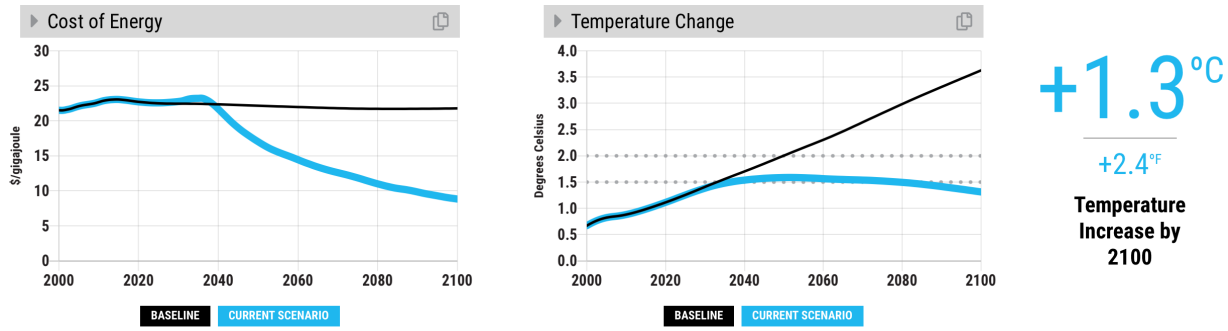
As shown with the above scenarios, there is no one 'silver bullet' for fixing climate change. Each action poised to fix climate change has other implications for society at large. For example, if carbon pricing is utilized, how might those policies affect the economy? We'd like to keep the cost of energy down for the economy to grow, but what would a high increase in cost of energy do? Would it keep temperatures from increasing? These are all questions that should be addressed when thinking about climate change fixes.

In the following activity, **you are tasked with adjusting the sliding scales until the temperature increase is below 2 C and the cost of energy stays near or below what it is now**.

Click on the 'Graphs' menu next to the Simulation menu. Select 'Impacts' then select 'Temperature change.'

Click on the 'Graphs' menu next to the Simulation menu. Select 'Financial' then select 'Cost of Energy.'

Move the sliding scales to create future climate change scenarios. Below is an example of a scenario in which the cost of energy stays near or below what it is now, and the temperature increase is below 2 C.



Once you have figured out your own scenario, click on the ‘Share Your Scenario’ button in the upper right-hand corner and select ‘Copy Scenario Link.’

1. Post your scenario link here.
2. What did you have to do in order to fit the scenario? Are you surprised by certain actions working and others not?

Activity 4.2 - Project Drawdown

Project Drawdown is a nonprofit organization with the goal of creating the 100 most substantive solutions to reverse global warming. Based on research by leading scientists and policymakers from around the world, Project Drawdown seeks to 'drawdown' the amount of CO2 and other greenhouse gases within the atmosphere. Each of the solutions presented by Project Drawdown is deployable on a global scale and is ranked based on their feasibility and economic viability.

The following activity is based on land use solutions. We will look at two solutions from Project Drawdown: *Temperate Forest Restoration* and *Afforestation*. We will also use the Atlas of Forest and Landscape Restoration Opportunities created by the World Resources Institute to visualize forest cover changes.

Read 'Land Use: Temperate Forests' in Project Drawdown and answer the following questions:

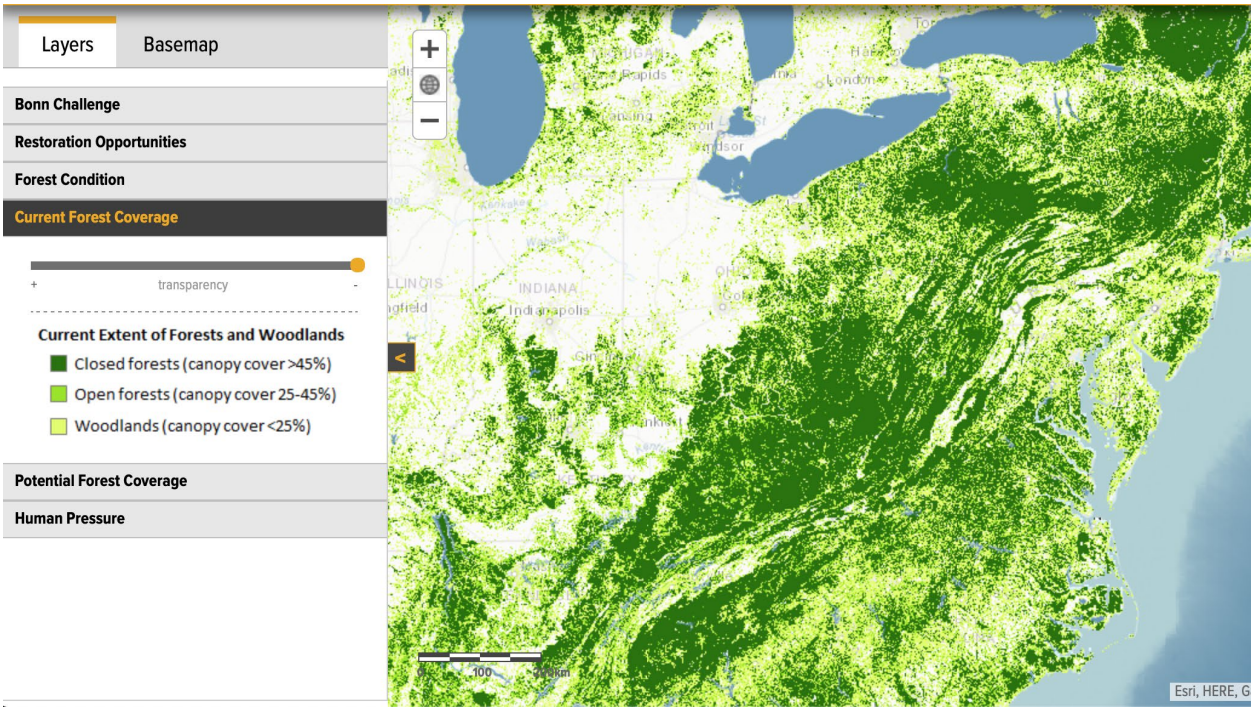
1. What percentage of temperate forests has been altered in some way, through timbering, conversion to agriculture, and/or development?
2. How do temperate forests act as a 'net-carbon sink'? Roughly how many gigatons of carbon can these ecosystems absorb in a given year?
3. Why have large swaths of farmland been abandoned in the past few decades? How might this abandonment aid forest restoration?
4. Why is preventing loss of forest better than trying to restore forest?

Next, we will use the interactive map to look at current and potential forest cover in the United States. To access the Atlas of Forest and Landscape Restoration Opportunities, click here.

Click on 'Current Forest Cover' and zoom in to the United States.

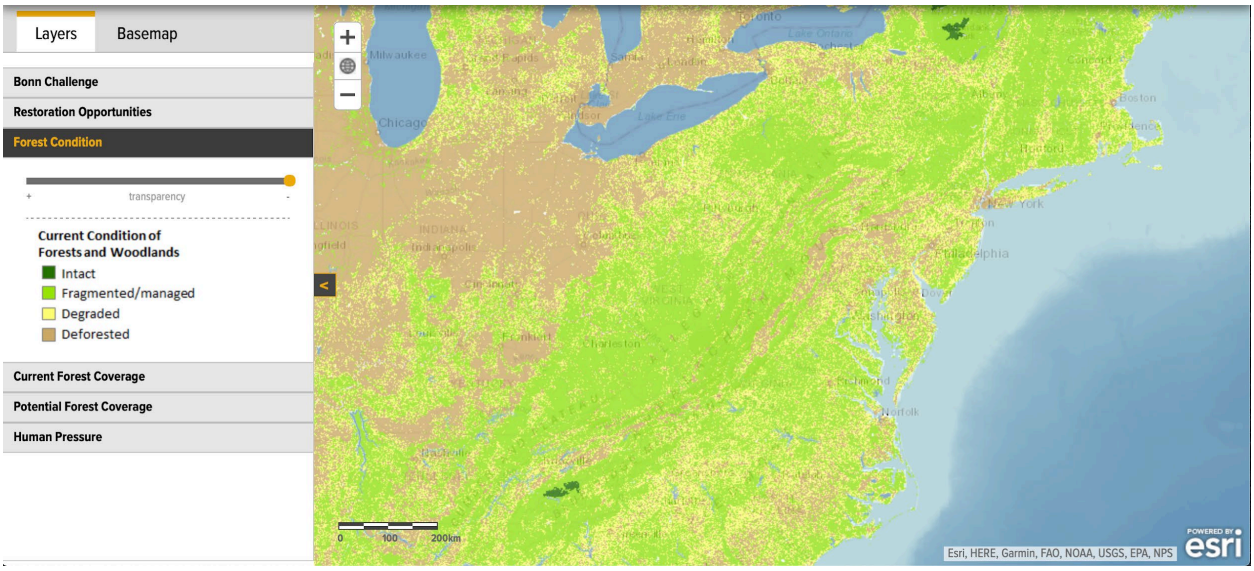
5. Where is the current extent of forest cover and woodlands located in the United States? Is the extent mostly closed forests (canopy cover > 45%), open forests (canopy cover 25-45%), or woodlands (canopy cover < 25%)?

Zoom in on West Virginia and use the transparency slider on the left-hand side to visualize the current forest cover across the state.



6. Describe the forest cover of West Virginia. Why might the forest cover in West Virginia be higher than other states? Think geography, population, terrain, and climate.

Click on ‘Forest Condition’ and visualize the current condition in West Virginia.



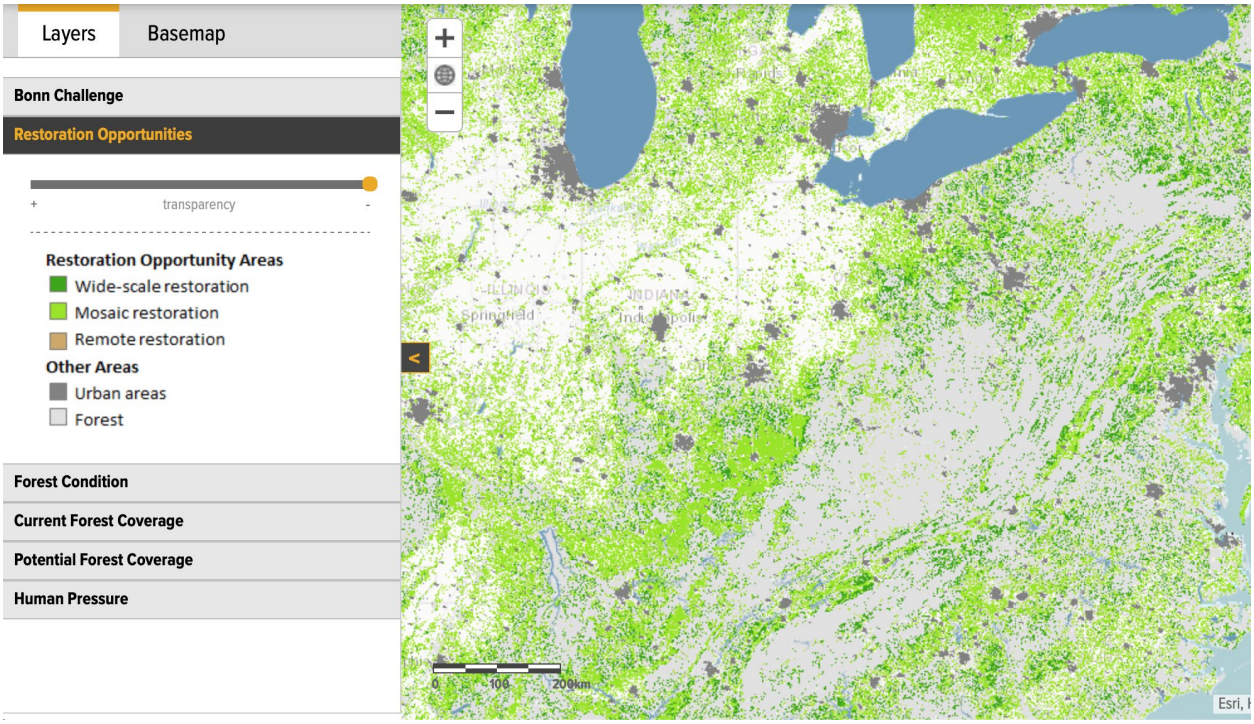
Then, click on ‘Human Pressure’ and visualize where pressure is located in West Virginia.

7. What is the current condition of forests and wetlands in West Virginia?

Why might most areas be fragmented / managed? Think about forest management practices in the United States at large.

8. Why might certain sectors of West Virginia be deforested?
9. Where is the most human pressure in the state? What human activities might cause the pressure on forests to be increased?

Click on ‘Restoration Opportunities’ and use the transparency slider on the left-hand side to visualize areas for restoration in West Virginia.



10. Describe opportunity areas in West Virginia. Where are they located across the state?
11. Look at the neighboring state of Ohio. Are there most opportunities for restoration here? Hypothesize why this might be.

Read ‘Land Use: Afforestation’ in Project Drawdown and answer the following questions.

12. Name 3 places that are suited for afforestation.
13. What are some sources of vulnerability for forests? How might afforestation projects be more successful?
14. How might afforestation projects such as China’s Three North Shelter Program [aka the ‘Green Wall’] negatively impact local and indigenous communities?
15. What is the ‘Miyawaki method’? How might this method create self-

sustaining forests?

Activity Summary

16. How do we balance economic activities, such as logging and forestry, with ‘drawing down’ CO2 in the atmosphere via forest restoration?
17. Who or what would benefit from forest restoration activities?

Activity 4.3 - Carbon Footprint, Individual Solutions, and Corporate Responsibility

A carbon footprint is the amount of carbon, a greenhouse gas, emitted to the atmosphere that is caused by an individual, organization, service, or product. For example, CO2 is released into the atmosphere by the burning of fossil fuels.

In the following activity, we will use an online carbon footprint calculator to discuss the ways in which our individual habits influence climate change.

To access the online carbon footprint calculator, click here. Once finished calculating your carbon footprint, answer the following questions.

1. Earth Overshoot Day is the date when humanity's demand for ecological resources and services in a given year exceeds what the Earth can regenerate. The term 'overshoot' refers to the level at which the human population exceeds its amount of resources on Earth.
    a. When is your Earth Overshoot Day? Are you surprised by this? Why or why not.
2. How many 'Earths' would be needed to necessitate your lifestyle for everyone on Earth?
3. Which category did you emit the most? (Food, housing, transportation)
    a. How can you reduce your emissions in this category?
4. Why is understanding your individual carbon footprint important? How can others be made aware of this importance?
5. What does your ideal world look like?

Corporate Responsibility
https://www.theguardian.com/sustainable-business/2017/jul/10/100-fossil-fuel-companies-investors-responsible-71-global-emissions-cdp-study-climate-change

Activity 4.4 - Citizens' Climate Lobby: Writing Letters to the Editor (LTEs)

Citizens' Climate Lobby is an international grassroots organization that trains students and volunteers to build relationships with their elected representatives in order to influence climate policy. Citizens' Climate Lobby works with both Republican and Democrat representatives in the U.S. House of Representatives and the Senate to pass climate legislation, mostly in the form of enacting carbon dividends.

The following activity outlines resources to write effective and meaningful LTEs. LTEs are a great way to get others in your community involved in issues of climate change and the environment.

To access CCL's information on writing effective LTEs, click here.

Read through the training materials and answer the following questions.

1. Why is writing LTEs important? List 2 reasons.
2. What are some topics that can be coupled with climate change action? An example topic could include the recent transition of power and Biden's commitment to the Paris Climate Agreement.
3. Name 1 thing you should "do" in your LTE and name 1 thing you should not do in your LTE.

Follow the basic formula below (referenced from CCL) to draft your own LTE:

- Reference something in the news or a specific part (line, thought, etc.) of a news story. A short reference praising the writer or paper works well.
- Transition into how it relates to climate change.
- Identify a solution.
- Present a call to action.
- Close creatively by employing a rhetorical device such as repetition, a play on words or closing the circle from the letter's beginning.

See example of an LTE posted here.

4. Figure out what excites you the most about writing an LTE. Is there a particular topic you are interested in surrounding climate change or the environment?
    a. How might your work or education factor into your topic of choice?