

Climate and
Rural Systems
Partnership



CLIMATE CONVERSATIONS STARTER GUIDE

for the Laurel Highlands of Pennsylvania



ABOUT THIS GUIDE

This resource is for educators or anyone working with the public who wants to talk about climate change in the Laurel Highlands. This is not intended to be public-facing on its own. The goal of this guide is to provide you with information and confidence to open up conversations about climate change using locally relevant information.



Figure 1. Some of the members of the Laurel Highlands CRSP network at Powdermill Nature Reserve in September 2021. Image: Mary Ann Steiner.

This document was developed by the Laurel Highlands Climate and Rural Systems Partnership (CRSP, Fig. 1) in the summer and fall of 2021. It was co-produced by educators and other professionals in the Laurel Highlands, scientists and educators at the Carnegie Museum of Natural History, and researchers at the University of Pittsburgh Center for Learning in Out of School Environments (UPCLOSE). CRSP is supported by National Science Foundation Awards #1906774 and 1906368. Please send us your questions or feedback on this resource by using the contact form at the bottom of this page: <https://carnegiemnh.org/educator/crsp-2/>.

Cover image: Kayla Duhon via Unsplash.



People talking. Image: Priscilla Du Preez on Unsplash.

CLIMATE CONVERSATIONS STARTER GUIDE

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"The bottom line is this: climate change is affecting you and me right here, right now, in the places where we live. But by working together, we can fix it. Sure, it's a daunting problem. Nobody knows that more than us climate scientists. But we can't give in to despair. We have to go out and actively look for the hope that we need, that will inspire us to act. And **that hope begins with a conversation today.**" -Dr. Katharine Hayhoe, climate scientist

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A FEW TIPS FOR TALKING ABOUT CLIMATE

Old-fashioned climate communication tried to scare us into caring about climate change. This hasn't worked.

In CRSP we've co-developed the following guidelines based on climate communication literature and our experiences talking about climate change and climate action in the Laurel Highlands.



Focus on climate action

Instead of focusing on climate change as a problem, keep the focus on what we can do about it as a community (see the next page for 6 things you can do about it).



Feelings are real

Acknowledge the emotions connected to climate change as they arise in conversation. Be transparent. Create space for vulnerability. But be ready to move a conversation stuck in hopelessness or fear into reasons for hope and actions we can take.



Break the silence

Despite what might seem like silence on climate change, 60-70% of adults in rural western PA [think climate change is happening](#)¹.



Help others join in

"But what can I do about it?" is a common question. Provide an opportunity for people to take climate action, start with something that is an easy lift. Tell a personal story about an action you have taken.



Redefine success

Your goal for climate conversations doesn't have to be to change the mind of a skeptic. There are lots of folks in the middle who haven't heard enough about climate change or don't know what climate actions they can take. Success can be just bringing up climate change.



De-bunk misinformation

As you get more comfortable with climate conversations, work toward de-bunking misinformation when you hear it. This skill is beyond the scope of this guide but we recommend [The Debunking Handbook 2020](#)² and [Climate Myths vs What the Science Says](#)³.

¹<https://climatecommunication.yale.edu/visualizations-data/ycom-us/>

²<https://www.climatechangecommunication.org/debunking-handbook-2020/>

³<https://skepticalscience.com/argument.php>

The icons on this page were created by unlimicon, Bharat, TTHNga, Nithinan Tatah, Kimmi Studio, and Kamin Ginkaew (respectively) from the Noun Project <https://thenounproject.com>.

Power transmission lines. Image: Casey Horner via Unsplash.



6 CLIMATE ACTIONS YOU CAN START DOING TODAY

When talking about climate actions it's important to be mindful that everyone does not have equal access to all solutions.

Re-think Energy

Consumption & production

Choose a renewable energy supplier at <https://www.papowerswitch.com>. Improve energy efficiency with insulation, smart thermostats, and LED lighting. Renters and homeowners might qualify for PA's Weatherization Assistance Program <https://dced.pa.gov/programs/weatherization-assistance-program-wap/>.

Eat more plants

Choose a more plant-rich diet

Livestock production is a major contributor of heat-trapping gases to the atmosphere. Eating more plant-based foods is healthy for you and the planet. Reducing food waste and composting in your community helps mitigate climate change, too. Organize a program in your neighborhood, school, or workplace.

Transportation

Make sustainable choices

Organize carpools. Have kids take the school bus. If you can afford it, consider an e-car or hybrid model for your next car or vehicle fleet. As we transition the grid to renewable energy, electrification helps us ditch fossil fuels. Currently, in much of western PA 12% of our energy comes from coal and 45% from natural gas¹.

Vote

Get involved in policy

System change often happens at the policy level. Write to and call your local, state, and/or federal representatives to let them know that climate action is important to you. Join groups advocating for climate policy. Consider running for office!

Reduce consumption

Be an informed consumer

Refuse, reduce, reuse, rot, recycle (in that order)! Learn about zero waste living². When you have to buy vote with your wallet—buy products manufactured in socially just and environmentally sustainable ways.

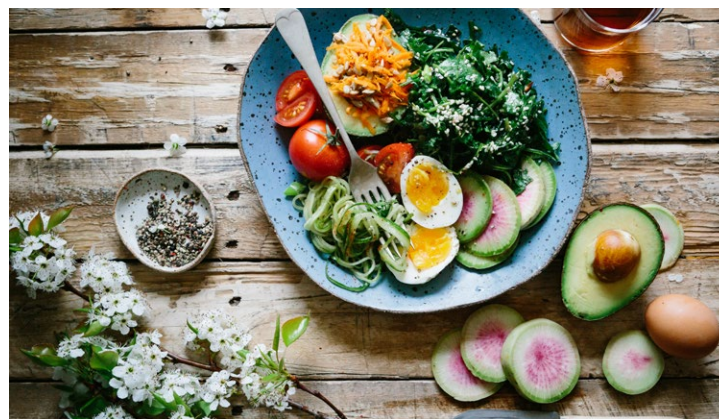
Talk about it!

Break the silence

Use this guide to start a conversation about climate change today!

¹<https://www.epa.gov/egrid/power-profiler#/RECE>

²Here is one place to start: <https://www.goingzerowaste.com>



A vegetarian meal. Image: Brooke Lark on Unsplash.

CLIMATE CHANGE BASICS

Answers to commonly asked questions

What's the difference between weather and climate?

Weather is what is happening day to day. Climate is long-term averages in weather measured over several decades¹. In other words, weather is like your mood, and climate is like your personality.

What is climate change?

Climate change is the long-term alteration of temperature and precipitation and typical weather patterns over a long period of time. Today, the climate change that is observed on Earth is driven by human activities.

99% of climate scientists agree that the observed warming of the Earth over the last century stems primarily from humans burning fossil fuels². Burning fossil fuels puts more heat-trapping gases (like carbon dioxide, CO₂) into the atmosphere than were there before. This increase in heat-

Natural cycles cannot explain the rapid climate change we are seeing today.

trapping gases warms the Earth via the Greenhouse Effect (Fig. 2).

The atmosphere is like a blanket and putting more heat trapping gases in the atmosphere is like thickening the blanket. This excess heat is changing the Earth's climate, meaning for example, warmer oceans contribute to stronger hurricanes, and warmer air draws more moisture into the atmosphere producing both heavier rain events and more droughts³.

What's the difference between climate change and global warming?

In everyday conversations the two are used interchangeably. Technically, "global warming" refers to the heat trapping gases produced by human activity that are warming the global average temperature⁴. "Climate change" refers to the change in the climate system as a result of the increase in the global average temperature.

¹https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html

²<https://climate.nasa.gov/scientific-consensus/>

³<https://www.globalchange.gov/climate-change>

⁴<https://climate.nasa.gov/faq/12/whats-the-difference-between-climate-change-and-global-warming/>

In the last century, human activities such as burning fossil fuels and deforestation have caused a jump in the concentration of greenhouse gases in the atmosphere. The result: extra trapped heat and higher global temperatures.

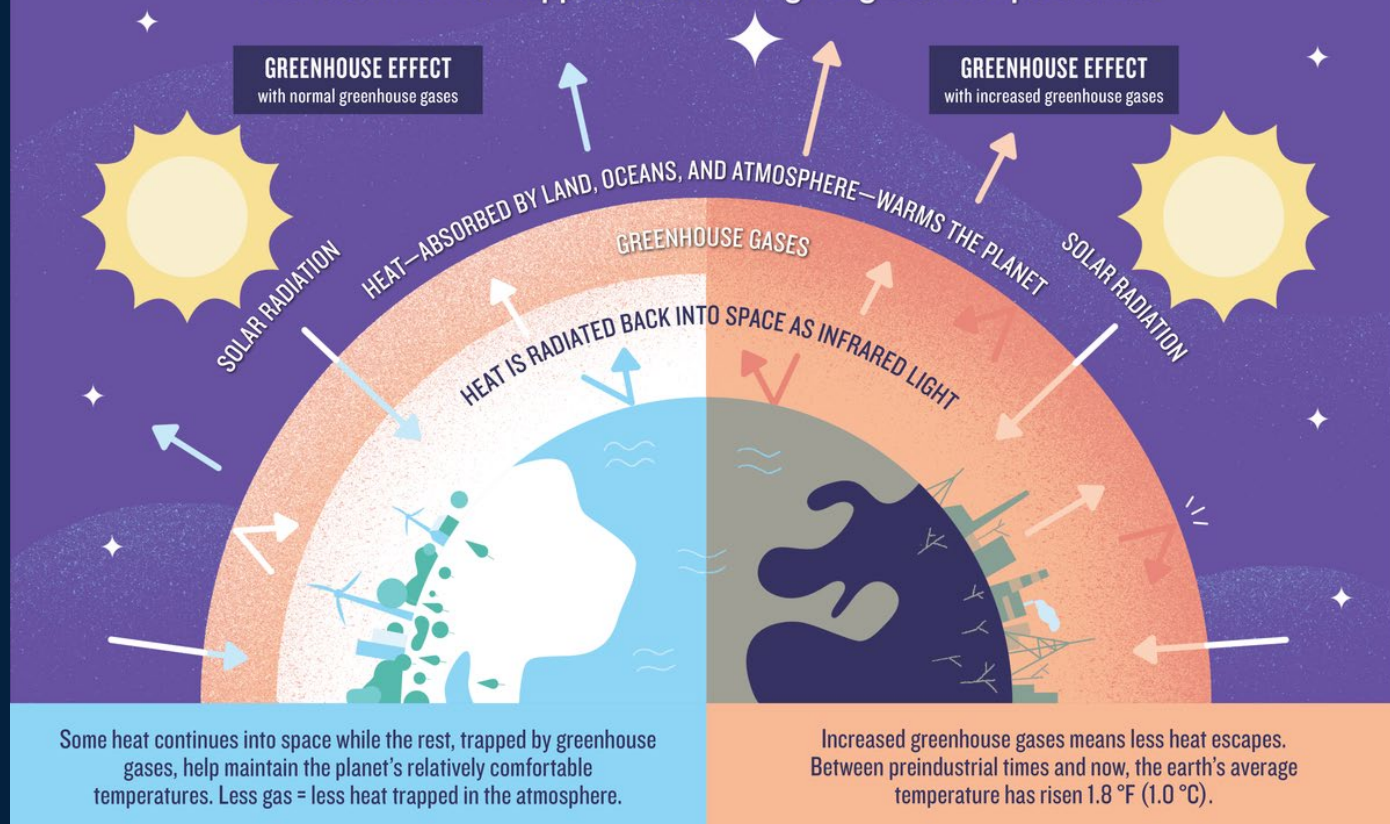


Figure 2. The greenhouse effect before (left) and after (right) humans started burning fossil fuels as part of industrialization rapidly increases the CO_2 into the atmosphere. This results in less heat leaving the atmosphere. Notice more heat escaping the upper atmosphere on the left and less heat escaping the upper atmosphere on the right. Image: Michal Bednarski for NRDC used with permission <https://www.nrdc.org/stories/greenhouse-effect-101>

Isn't climate change a natural occurrence?

Natural cycles cannot explain the rapid climate change we are seeing today.

The climate has changed throughout Earth's long history due to changes in the sun's energy and the Earth's axis and orbit. This produces slow changes, over tens of thousands of years. These natural changes are cyclical. The Earth should be heading into a global cooling period. Human activities have overridden the natural cycle, warming the Earth instead⁵. There are many kinds of evidence that show that the Earth is warming unusually fast including global average temperature, sea level rise,

ocean warming, land-based ice melt, and Arctic sea ice melt⁶. The only explanation for this rapid warming is the addition of human produced greenhouse gases to the atmosphere. "Climate change" refers to the change in the climate system as a result of the increase in the global average temperature .

How do you know humans are causing climate change?

Scientists have understood the basic physics of the Greenhouse Effect and the impact of burning fossil fuels on the atmosphere since the late 1800s. Today we know a lot more. Some of the most

⁵<https://www.carbonbrief.org/explainer-how-the-rise-and-fall-of-co2-levels-influenced-the-ice-ages>

⁶<https://science2017.globalchange.gov/chapter/1#section-2>

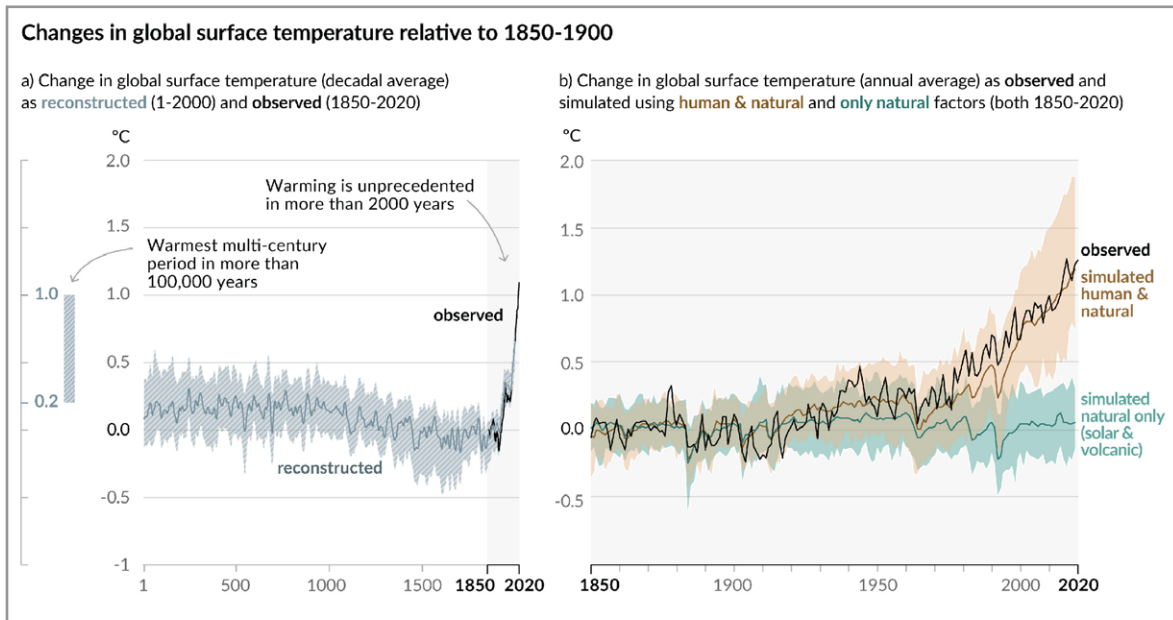


Figure 3. History of global temperature change and causes of recent warming. Image: Intergovernmental Panel on Climate Change (IPCC) Working Group I. Summary for Policy Makers 2021. <https://www.ipcc.ch/report/ar6/wg1/#SPM>

definitive evidence comes from advances in computing and Global Climate Models. When scientists compare observed (past) global average temperatures with projections from climate models for the same time period, only the climate models that include heat-trapping gas emissions from human activities match the observed temperatures (Fig. 3b, note the brown vs. green lines). Climate models that include only natural forces of climate change do not match observed changes in global temperature⁷.

Additionally, fossil fuels are the only source of carbon (representing millions of years of plant-stored carbon) large enough to explain the observed increase in atmospheric CO₂. The carbon isotopes in the CO₂ match the carbon isotopes of fossil fuels⁸. Burning fossil fuels produces CO₂ and consumes oxygen, and scientists have measured a decrease in atmospheric oxygen in step with the CO₂ increase⁹. Our atmosphere is 21% oxygen and 0.04% CO₂ so the change in oxygen is small relative to its concentration and not a problem, but the change in CO₂ is much greater relative to its concentration and has major ramifications (climate change).

What can people do to stop climate change? Is it too late?

No, it's not too late, but governments, industries, and communities need to act now. People and communities acting individually and working together can have a huge impact on the direction of future climate change. Humans can adapt to some global warming, but there is a limit to how much we can adapt to. It is never too late to shift to a sustainable path. For actions see "6 things you can start doing today" on page 5 and "Have you noticed..." on pages 11-13.

What about China and other countries?

The US has 4% of the human population, but we have contributed 25% of the cumulative human-caused heat trapping gases in Earth's atmosphere. This is more than 2X what China has contributed (Fig. 4), despite China's much larger population¹⁰. Given how people in the US have benefited greatly from being allowed to contribute 25% of the emissions to the atmosphere, what the people of the US do now to stop emitting will trigger action and respect in the rest of the world. The sooner we take decisive action in the US to mitigate

⁷<https://science2017.globalchange.gov/chapter/3#section-1>

⁸<https://www.climate.gov/news-features/climate-qa/how-do-we-know-build-carbon-dioxide-atmosphere-caused-humans>

⁹<https://scrippsco2.ucsd.edu>

¹⁰<https://ourworldindata.org/co2/country/china?country=CHN-USA>

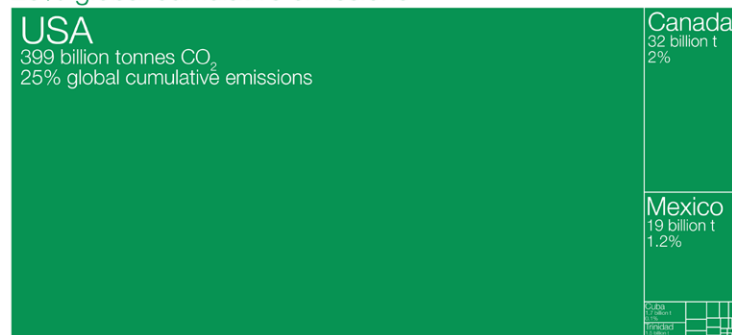
Who has contributed most to global CO₂ emissions?

Our World
in Data

Cumulative carbon dioxide (CO₂) emissions over the period from 1751 to 2017. Figures are based on production-based emissions which measure CO₂ produced domestically from fossil fuel combustion and cement, and do not correct for emissions embedded in trade (i.e. consumption-based). Emissions from international travel are not included.

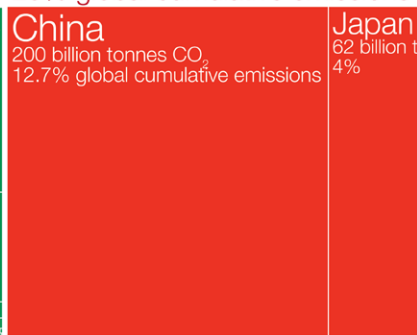
North America

457 billion tonnes CO₂
29% global cumulative emissions



Asia

457 billion tonnes CO₂
29% global cumulative emissions

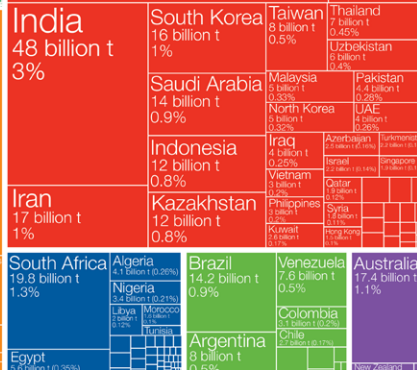


EU-28
353 billion tonnes CO₂
22% global cumulative emissions



Europe

514 billion tonnes CO₂
33% global cumulative emissions



Africa 43 billion tonnes CO₂
3% global emissions

South America 40 billion tonnes CO₂
3% global emissions

Oceania
20 billion tonnes CO₂
1.2% global emissions

Figures for the 28 countries in the European Union have been grouped as the 'EU-28' since international targets and negotiations are typically set as a collaborative target between EU countries. Values may not sum to 100% due to rounding.

Data source: Calculated by Our World in Data based on data from the Global Carbon Project (GCP) and Carbon Dioxide Analysis Center (CDIAC). This is a visualization from OurWorldInData.org, where you find data and research on how the world is changing.

Licensed under CC-BY by the author Hannah Ritchie.

Figure 4. Cumulative CO₂ emissions 1751-2017 by country. Image: Our World in Data <https://ourworldindata.org/co2-emissions>.

the production and consumption of heat-trapping gases by advancing our technology and culture, the better the odds that our children will be able to have a standard of living and a well-being similar to what we have today.

What's the difference between mitigation and adaptation?

Mitigation is any action that reduces climate change. One way to reduce climate change is to minimize or eliminate sources of heat trapping gases to the atmosphere, for

example, transitioning to renewable energy. The other way to reduce climate change is to enhance the capacity of the ocean, forests, and soils to pull CO₂ out of the atmosphere and store (sink) it for centuries to millennia¹¹, e.g., protecting and restoring forests and wetlands is climate mitigation.

Adaptation is adjusting to actual or expected future climate to reduce vulnerability to the harmful effects of climate change¹¹, e.g., farmers planting drought-tolerant crop varieties, investing in pervious pavement to reduce stormwater flow, and moving to escape flooding.

¹¹<https://www.climaterealityproject.org/blog/climate-adaptation-vs-mitigation-why-does-it-matter>



CLIMATE CONVERSATION STARTERS

This section covers 8 topics for starting conversations about climate change and climate actions relevant to Laurel Highlands. They all start with the question "Have you noticed...?"

*People at a campfire.
Image: Mike Erskine on
Unsplash.*

HAVE YOU NOTICED MORE SOLAR PANELS GOING UP IN PA?

Growing the state's solar energy capacity

Solar has been growing in Pennsylvania! In 2018, PA had 17,000 registered solar systems with a combined capacity of 329 MW of energy. By the end of 2021 our state had a capacity of 855 MW—enough to power about 112,000 homes¹². In the last five years prices for solar in PA have fallen 11%¹². In the Laurel Highlands we have at least ten solar installation companies.

Renewable energy jobs are growing, too. At the end of 2020, PA had about 50,000 fossil fuel workers¹³ making up about 1% of the state's workforce and about 90,000 clean energy (solar and other renewables) workers¹⁴. In the economy-wide job losses in 2019 caused by the pandemic, fossil fuel industry jobs declined by 11-14% while solar sector jobs declined by less than 0.5%¹⁴.

Residential solar by the numbers: The average residential solar system is 4-8 kilowatts (kW), produces ~7,700 kWh per year, will cost about \$3/W (or \$12,000-\$24,000) before applying federal tax credits and other incentives, and typically takes 4-12 years to earn the cost of the system back through energy savings and net metering¹⁵. Net metering enables residents to sell excess solar energy back to the grid.¹⁶

Solar energy fact: Yes, the life cycle of a solar panel does produce carbon emissions, but the amount is significantly less than coal. In fact, the lifetime greenhouse gas emissions from Solar PV are about 40 g CO₂ equivalents per kWh and from coal are about 1,000 g CO₂ equivalents per kWh¹⁷.

Solar energy fact: Yes, western PA gets enough sunlight for solar to be economical. The average home installation here may only need two additional photovoltaic (PV) panels to be equivalent to an installation in sunny Arizona¹⁸.



A solar array. Image: Derek Sutton on Unsplash.

What's a solar panel made of?

Photovoltaic (PV) panels are made of non-toxic materials: an aluminum frame, tempered glass, encapsulated ethylene vinyl acetate (EVA), solar cells made of silicon and trace amounts of either boron or phosphorus, polymer backsheet, and a junction box¹⁹. Their enclosed structure means the materials aren't released into the environment. Panels pass hail tests and are used to generate electricity in Antarctica. Solar panel recycling is in its infancy with growing interest²⁰.

¹²<https://www.seia.org/state-solar-policy/pennsylvania-solar>

¹³https://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/2021EnergyReport/2021_PAEER.pdf

¹⁴https://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/2021EnergyReport/2021_PACEIR.pdf

¹⁵https://www.solarunitedneighbors.org/wp-content/uploads/2018/01/CPN_GoSolarGuide-2021.pdf

¹⁶<https://www.solarunitedneighbors.org/pennsylvania/learn-the-issues-in-pennsylvania/net-metering-in-pennsylvania/>

¹⁷<https://www.nrel.gov/docs/fy13osti/56487.pdf>

¹⁸<https://pasolarcenter.org/get-solar/frequently-asked-questions/>

¹⁹<https://www.cleanenergyreviews.info/blog/solar-panel-components-construction>

²⁰<https://www.mass.gov/doc/ground-mounted-pv-guide/download>

HAVE YOU NOTICED HOW COOL FORESTS ARE?

The forests of the Laurel Highlands are a natural climate solution.

Forests provide important climate change mitigation and adaptation services. Forests remove CO₂ from the atmosphere and lock it away from the atmosphere for decades to centuries in the trees and soils. An average forested acre in PA stores about 250 tons of carbon, about 40% of which is in the soil, 37% in living trees, and 23% in leaf litter and woody debris²¹. So that means that, long term, each acre is storing the rough equivalent to the annual CO₂ emissions of 160 typical passenger vehicles²².

Forests also absorb precipitation reducing runoff and flooding downstream, provide refuge for biodiversity, and keep local temperatures cooler—all important for adapting to climate change impacts. For example, PA experiences about 4 days per year on average above 90°F. Climate scientists have high confidence by mid-century we will have 35 days above 90°F²³.



The forests of the Laurel Highlands support biodiversity, including spring ephemeral wildflowers such as this Trillium found at the Bear Run Nature Reserve. Image: Bonnie McGill.



ACTION

Plant trees! If you are a property owner plant native trees and shrubs that provide food and habitat for native birds (see <https://www.audubon.org/PLANTSFORBIRDS>) and consider tree species that are well suited for the future climate (<https://www.dcnr.pa.gov/GoodNatured/pages/Article.aspx?post=83>). Work with your community to plant trees in public spaces including in towns, at schools, and at abandoned mine lands.

²¹<https://www.dcnr.pa.gov/GoodNatured/pages/Article.aspx?post=82>

²²<https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>

²³<https://tinyurl.com/48h5xb2b> —Pennsylvania Climate Impacts Assessment 2021, see page 67.

8 STATE
PARKS

2 STATE
FORESTS

120,000

ACRES OF FORESTED

MOUNTAINS AND VALLEYS

Additional forested acres are held privately and in state gamelands, including the 5,100 acre Bear Run Nature Reserve (background photo), which is owned and managed by the Western Pennsylvania Conservancy and open to the public for hiking, camping and other opportunities. Image: Bonnie McGill.



HAVE YOU NOTICED MORE TICKS?



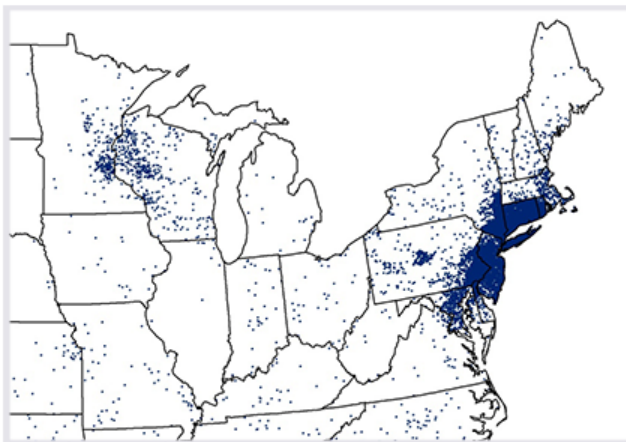
Figure 6. Adult female Black-legged (Deer) Tick. Image: University of Rhode Island.

The life cycle and prevalence of ticks are strongly influenced by temperature. In the northeastern US, winters have warmed three times faster than summers²⁴. Studies provide evidence that warmer winters brought about by climate change have expanded the geographic range of ticks (Fig. 5), enabled their earlier emergence, and, thus, fostered larger population sizes²⁵.

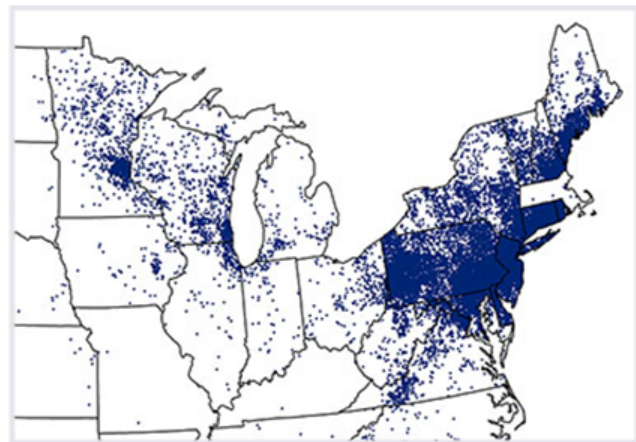
More ticks increase humans' risk of Lyme disease. As climate change intensifies, Lyme disease transmission season will occur 1-3 weeks earlier by 2065-2080²⁶.

The prevalence of black-legged ticks (the ticks that carry Lyme disease, Fig. 6) is also driven by acorns, an important food source for mice who are carriers of Lyme disease. Some years oak trees produce a small crop of acorns, other years they synchronously produce a large crop. Longer growing seasons seem to support more frequent bumper crops from oak trees²⁷.

Reported Lyme Disease Cases in 1996 and 2018



1996



2018

Data source: CDC (Centers for Disease Control and Prevention). 2019. Lyme disease maps: Historical data. Updated November 22, 2019. Accessed January 2021. www.cdc.gov/lyme/stats/maps.html.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Figure 5. Expansion of Lyme disease cases in the northeast and midwest US. Image: US EPA www.epa.gov/climate-indicators.

²⁴<https://nca2018.globalchange.gov/chapter/18#key-message-1>

²⁵<https://www.epa.gov/climate-indicators/climate-change-indicators-lyme-disease>

²⁶<https://nca2018.globalchange.gov/chapter/18#key-message-4>

²⁷<https://grist.org/science/its-not-just-your-imagination-ticks-are-out-of-control-this-year/>



Figure 7. Trout Lilies in bloom. Image: Bonnie McGill.

HAVE YOU NOTICED EARLIER BLOOMS?

Many native wildflowers have been blooming earlier and trees have been leafing out earlier as spring warms up faster than it did in the past.

For example, a study of the spring ephemerals (some of the first plants to emerge and bloom in early spring) Cutleaf Toothwort and Yellow Trout Lily (Fig. 7) in West Virginia found that Cutleaf Toothwort now blooms on average 6 days earlier and the Yellow Trout Lily blooms on average 5 days earlier than they did in the 1970s.

Both trends were driven by warmer spring temperatures and elevation²⁸. Average April temperatures in the Laurel Highlands are projected to warm by 4-5°F by 2050²⁹ (more information next page).



ACTION

Renewable energy reduces emissions of heat trapping gases that cause climate change and warmer springs. In Indiana, PA homeowners have come together to form “solar co-ops” who bargain as a group to get competitive pricing on solar panels and installation.

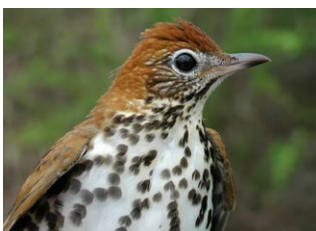
²⁸<https://doi.org/10.1007/s11258-019-00956-7>

²⁹ <https://tinyurl.com/2p8w75f>. —The Climate Explorer page for Westmoreland County, PA. The Climate Explorer home page is <https://crt-climate-explorer.nemac.org>

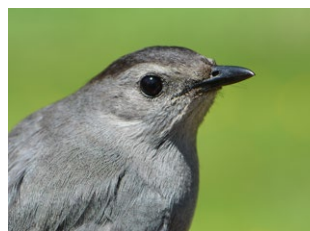
HAVE YOU NOTICED EARLIER MIGRATORY BIRDS?

Figure 8 (opposite page). Cut out this CRSP infographic about climate change and the Wood Thrush in the Laurel Highlands. Cut along the gray lines and tape the left piece above the right piece. Hang it up somewhere it can start conversations. You can also find this online at <https://carnegiemnh.org/educator/signs-of-climate-change-in-migratory-songbirds-of-pennsylvania/>. Image: Bonnie McGill.

Migratory songbirds nesting in the Laurel Highlands earlier than they did in the 1960s:



Wood Thrush: 24 days earlier (± 4)



Gray Catbird: 10 days earlier (± 3)



Cedar Waxwing: 16 days earlier (± 4)



Scarlet Tanager: 25 days earlier (± 5)

Images: Powdermill Avian Research Center

According to scientists at Powdermill Avian Research Center at the Carnegie Museum of Natural History's research facility in Rector, PA (Westmoreland County) many migratory songbirds are arriving and nesting in the Laurel Highlands earlier than they did in the 1960s due to warmer, earlier springs. For example, the Wood Thrush now arrives, on average, 5 days earlier and nests 24 days earlier than in the 1960s³⁰ (Fig. 8).

The birds might be nesting earlier to take advantage of trees leafing out earlier and the caterpillars that feed on the leaves, all in response to earlier warm temperatures. Average April temperatures in Westmoreland County are projected to warm by 4-5°F by 2050³¹.

Scientists at Powdermill Avian Research Center observed the following species and their changes (or no changes) in breeding time in response to warmer springs over time:

- **No change:** Ruby-throated Hummingbird, Eastern Phoebe, Red-eyed Vireo, House Wren, Field Sparrow, Rose-breasted Grosbeak, Indigo Bunting, American Goldfinch
- **10-14 days earlier:** Gray Catbird, American Redstart, Common Yellowthroat, Northern Cardinal
- **15-19 days earlier:** Song Sparrow, Cedar Waxwing, Ovenbird
- **20-25 days earlier:** Hooded Warbler, Black-capped Chickadee, Wood Thrush, Yellow Warbler, Scarlet Tanager
- **32 days earlier:** American Robin

³⁰McDermott, ME and LW DeGroot. 2016. Long-term climate impacts on breeding bird phenology in Pennsylvania, USA. *Global Change Biology* 22:3304-3319.

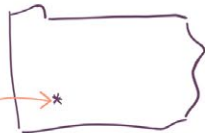
³¹https://crt-climate-explorer.nemac.org/climate_graphs/?city=Westmoreland%2BCounty%2C+PA&county=Westmoreland%2BCounty&area-id=42129&fips=42129&zoom=7&lat=40.2353963&lon=-79.4703885

SIGNS of CLIMATE CHANGE in MIGRATORY SONGBIRDS of Pennsylvania



Follow along with the Wood Thrush, who teaches us how climate change is happening in Pennsylvania.

Since 1961 scientists at the Carnegie Museum of Natural History's **Powdermill Avian Research Center (PARC)** in Pennsylvania's Laurel Highlands have been monitoring birds. They have banded over **600,000 birds!** These long-term data allow scientists to study how birds respond to the warming climate. The **Wood Thrush** story demonstrates how most birds are responding.



The Laurel Highlands region is named for this plant, the Mountain Laurel.

AVERAGE APRIL TEMPERATURES ARE PROJECTED TO WARM BY 4-5°F BY 2050.



They have already increased by 2°F since the 1960s. Warmer springs trigger earlier plant budburst. Insects, especially caterpillars, feast on buds and young leaves, which have fewer toxins than older leaves.

Caterpillars are the breakfast of champions (among birds). So, migratory songbirds need to arrive early, according to the calendar, to be on time, according to the food web. **The early bird literally catches the worm.**

Many migratory songbird species are responding to the warmer, earlier springs in **TWO** ways.



1) ARRIVE EARLIER
Wood Thrushes arrive from Central America

5 DAYS EARLIER

than they did in the 1960s.

2) EAT LOVE NEST (IN A HURRY)

Wood Thrushes nest



24 DAYS EARLIER

than they did in the 1960s.

BUT BIRDS WON'T ALWAYS BE ABLE TO KEEP PACE WITH CLIMATE CHANGE. BIRDS NEED OUR HELP.

Already we've lost **3 billion North American birds since 1970** (www.3billionbirds.org). Individuals and communities can help birds by mitigating climate change:



Conserve habitat: Habitat provides food and shelter for birds while removing and storing carbon away from the atmosphere. Reduce lawn and plant native plants, too. Wood Thrushes and many birds like to eat spicebush, elderberry, and black cherry fruits. Learn more: www.audubon.org/plantsforbirds.



Renewable energy: A Just Transition* to renewable energy sources like properly-sited wind** and solar will reduce greenhouse gas emissions, provide local jobs, improve air quality, and help protect birds from climate change.

*www.bluegreenalliance.org/work-state/pennsylvania/

**www.audubon.org/news/wind-power-and-birds



Eat your vegetables: A more plant-based diet is an impactful way to reduce our greenhouse gas footprints. Learn more: www.drawdown.org

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Wet conditions can lead to foot rot in dairy cows and other livestock. Image: Andy Kelly on Unsplash.



Climate change is increasing the frequency and intensity of both floods and droughts. Image: Daniel Acker.



HAVE YOU NOTICED EFFECTS OF CLIMATE CHANGE ON FARMS?

Some farmers are able to benefit from the lengthening growing season, but climate change is also increasing the frequency and intensity of both floods and droughts.



Canada Geese in a flooded field in Illinois in 2019. Image: Scott Olson/Getty Images via Newsweek.com.

According to the 2018 (most recent) National Climate Assessment, the northeastern US is seeing increased frequency of heavy rains prior to the last frost³². Farmers in our area are finding fewer days in the spring when the soils are not too wet to plant. And wet falls mean commodity crops dry out more slowly and can develop mold before harvest.

According to CRSP's analysis of long term weather stations in the Laurel Highlands region, **3 of the 5 wettest springs since 1940 happened since 2000** ('17, '04, and '02). And **4 of the 5 wettest falls on record happened since 1990** ('18, '96, '03, and '93).



ACTION

Transitioning to no-till and adding cover crops to cropping systems can improve a soil's water infiltration for wet times and water holding capacity during dry times via soil organic matter, which is a form of carbon sequestration. Learn more from Penn State University <https://extension.psu.edu/planting-green-101-penn-state-research-summary>. For folks who are not farmers, buy local meat and produce grown on farms using no-till, cover crops, and management-intensive grazing. Consider telling your elected officials to support policies that incentivize sustainable conservation practices like these on farms.

³²<https://nca2018.globalchange.gov/chapter/18#key-message-1>

HAVE YOU NOTICED TOMATO BLOSSOM DROP?

Blossom drop is when your tomato flowers turn brown and drop before producing fruit (Fig. 9). A variety of factors can lead to blossom drop (humidity, excess nitrogen, strong winds) but temperature appears to be the most influential³³.

Tomatoes prefer daytime temperatures of 70- 85°F. When daytime temperatures exceed 90°F several days in a row and nighttime temperatures remain above 72°F, pollen can become nonviable.

According to CRSP's analysis of long-term weather stations in the Western PA region, the lowest night time temperatures in the summer have increased 4.8 (± 0.17) °F since 1960 (Fig. 10). CRSP also found that the top five warmest summers in the Laurel Highlands have occurred since 1990.



ADAPTATION

Climate change is affecting and will affect what kind of food we can grow locally. Growing early maturing tomato varieties, like "Early Girl" or heat-tolerant tomato varieties like "Heatwave" can help farmers and home gardeners adapt to this climate change impact. Agroforestry can provide shade for cows in the field (Fig. 11) and buildings.



Figure 9. You can spot blossom drop when a tomato flower suddenly turns brown and falls off the tomato plant before producing any fruit. Image: ugao.com

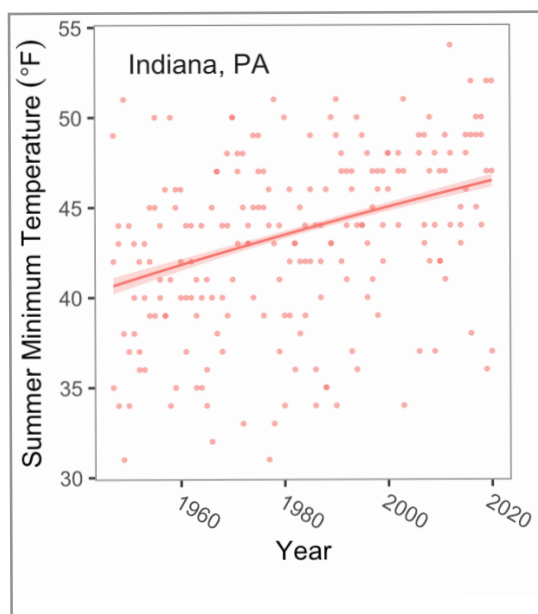


Figure 10. The lowest night time temperatures (AKA minimum temperatures) in the summer have steadily increased since the 1960s in the Laurel Highlands; this graph shows Indiana, PA records as an example. The trendline shows how the night time temperatures across the region have increased by 4.8 (± 0.17)°F since the 1960s. Night time temperatures also decline with elevation across the region. The effect of elevation is less than the effect of time (climate change) on night time temperatures. Data source: National Oceanic and Atmospheric Administration (NOAA)³⁴. Image: Bonnie McGill.

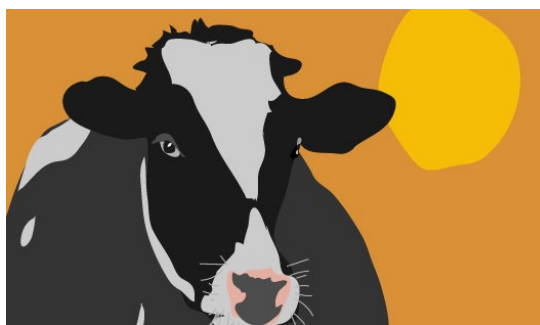


Fig. 11. Warm summer nights are also problematic for livestock, like dairy cows who rely on cool summer nights to get relief from hot days. Dairy farmers in western PA have seen their milk production go down during hot periods. Image: Bonnie McGill.

³³<https://extension.psu.edu/programs/master-gardener/counties/northampton/news/2018/why-are-my-tomato-flowers-drying-up-without-forming-fruit>

³⁴<https://www.ncdc.noaa.gov/cdo-web/datatools/records>



Figure 12. Skier at Seven Springs. Image: Seven Springs Ski Resort via pittsburghmagazine.com.

HAVE YOU NOTICED LESS SNOW?

Have you noticed the growing proportion of winter precipitation falling as rain rather than snow? According to the National Climate Assessment (2018) the proportion falling as rain will continue to rise in both low- and high-emission scenarios³⁵.

Have you noticed the, on average, shorter snow (and ski, Fig. 12) season? This is due to more rain and fewer days below freezing³⁵. Because of the unreliable snow season, Seven Springs Mountain Resort relies on 1,200 snow making machines on

285 acres³⁶. Learn more about changes in climate and skiing: <https://www.climate.gov/news-features/climate-and/climate-skiing>. Snow making machines use water and energy.



ACTION

Protect Our Winters (POW) is an alliance of outdoor recreation enthusiasts and industries advocating for climate action. Maybe you're the person who will start the Pennsylvania or Appalachian Alliance in the POW network? Learn more: <https://protectourwinters.org/our-work/about-pow/>. Also see this write up about them in *EOS*, Science News of the American Geophysical Union: <https://eos.org/features/how-the-ski-industry-stopped-worrying-and-learned-to-love-climate-activism>.

³⁵<https://nca2018.globalchange.gov/chapter/18#key-message-1>

³⁶<https://www.post-gazette.com/sports/other-sports/2018/11/15/No-snow-No-problem-as-ski-areas-install-state-of-the-art-snowmaking-this-season/stories/201811150003>



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Carnegie Museum of Natural History
4400 Forbes Ave.
Pittsburgh PA 15213

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Questions and feedback

We'd love to hear from you. Please send us your questions and feedback using the link above—there is a contact form at the bottom of that page.