Managing the threats of climate change in Pennsylvania

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The Pennsylvania State University
Mifflin County Public Library
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https://www.nasa.gov/topics/earth/images/index.html
Geology.com
We cannot explain observed warming with natural drivers ...

Fourth National Climate Assessment, Hayhoe et al. (2018)

The greenhouse effect in three steps:

2. Earth’s radiation absorbed in atmosphere.
3. Atmosphere’s radiation further warms Earth—by 60 °F.
The greenhouse effect is well established

1824: Joseph Fourier describes natural greenhouse effect

1858–1861: Eunice Foote and John Tyndall identify greenhouse gases

1896: Svante Arrhenius estimates greenhouse effect of fossil fuel CO₂

1938: Guy Callendar documents warming and CO₂ increase
“Many lines of evidence demonstrate that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.”

“For the period extending over the last century, there are no convincing alternative explanations supported by the extent of the observational evidence.”

Fourth National Climate Assessment, Wuebbles et al. (2017)

Native bees in Northeast US are arriving in spring 10 days earlier than they used to.


The ratio of snow to total precipitation is mostly decreasing in the Northeast US

1949–2005 trend
- Decreasing
- Increasing


Photo credit: L. S. Mills research photo by Jaco and Lindsey Barnard, University of Montana Mills Research Lab.
Three possible emissions futures ...

... lead to very different climate futures

Summers in Pennsylvania will feel like those of the Southeast US by mid-century if heat trapping emissions trends continue.
Emissions really matter, especially in the long run

Expect summers to be drier ... ... and winters to be wetter

The wooly adelgid harms the Eastern Hemlock tree (PA state tree)
In Millbrook, NY, warming has led to an earlier larval peak of the blacklegged (deer) tick, the major Lyme disease transmitter.

Opportunities
Renewables are cheap!

Costs of new installations in dollars per megawatt-hour

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2017</th>
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<tbody>
<tr>
<td>Coal</td>
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<tr>
<td>Solar</td>
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</tbody>
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Department of Energy data
Graphic from NY Times:
... and reducing electricity costs

Department of Energy data
Graphic from NY Times:
Food systems are responsible for one-quarter of greenhouse gas emissions

http://lfs-teg-collab.sites.olt.ubc.ca/files/2015/12/Slide5.jpg

Less fossil fuel, less nitrogen pollution, fewer harmful algal blooms, fewer dead zones

• $4.32 per person per year in Medicare savings for every 1% increase in forest cover
• Up to $9 billion in savings per year for the US


Image: Getty Images;
Get your energy from a renewable source

https://www.papowerswitch.com/
Join climate action groups and support emissions reductions policies

https://citizensclimatelobby.org/energy-innovation-and-carbon-dividend-act/
Support the Paris Agreement

Agreement to keep global warming well below 2.0 °C (3.6 °F)

Image source: www.cop21paris.org/
We have cleaned up our own messes before
“Smog episodes”

October 1948: Pollution from zinc mills in Donora, PA combined with a temperature inversion, leads to 20 deaths

Source: Donora Smog Museum
The Clean Air Act reduced emissions and created $170 - $430 billion per year in health benefits—all while energy use went up and costs went down!

Take-home messages

1. Pennsylvania has followed the global warming trend
2. Impacts are already being felt
3. Human-induced climate change will continue to occur regardless of emissions scenario; further adaptation is necessary.
4. The climate of the mid century and beyond is very sensitive to the emissions scenario.
5. Solving the climate crisis is an opportunity to make the world better
6. Good science and good policy has gotten us out of environmental messes before