IN THE COMMONWEALTH COURT OF PENNSYLVANIA

No. 247 MD 2022

BOWFIN KEYCON HOLDINGS, LLC; CHIEF POWER FINANCE II, LLC; CHIEF POWER TRANSFER PARENT, LLC; KEYCON POWER HOLDINGS, LLC; GENON HOLDINGS, INC.; PENNSYLVANIA COAL ALLIANCE; UNITED MINE WORKERS OF AMERICA; INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS; and INTERNATIONAL BROTHERHOOD OF BOILERMAKERS, IRON SHIP BUILDERS, BLACKSMITHS, FORGERS AND HELPERS,

Petitioners,

v.

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION and PENNSYLVANIA ENVIRONMENTAL QUALITY BOARD,

Respondents,

BRIEF OF PENNSYLVANIA SCIENTISTS AS *AMICI CURIAE* IN SUPPORT OF PENNSYLVANIA JOINING THE REGIONAL GREENHOUSE GAS INITIATIVE (RGGI) AND IN SUPPORT OF RESPONDENTS AND OPPOSING PETITIONERS' APPLICATION FOR A PRELIMINARY INJUNCTION

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I. INTRODUCTION

This brief supports the position of the Respondents in this matter, and opposes the Petitioners' application for a preliminary injunction preventing the Respondents from implementing, administering, or enforcing the rulemaking for the Commonwealth Pennsylvania to become part of the Regional Greenhouse Gas Initiative ("RGGI"). To that end, this brief outlines the scientific facts regarding the nature, cause, and urgency of climate change, including global warming,[1] to aid the Court in deciding whether to enjoin the Commonwealth's entry into RGGI. In particular, the facts presented herein demonstrate that the Petitioners cannot meet their burden to establish the requirements for a preliminary injunction. These facts have been reported by the leading authority worldwide on climate change—the Intergovernmental Panel on Climate Change ("IPCC"), a United Nations body responsible for assessing the science related to climate change. The IPCC represents the work of thousands of scientists and many universities, colleges, and other scientific research organizations worldwide.

In brief, according to the latest IPCC Report (the Sixth Assessment Report), "there is at least a greater than 50% likelihood that global warming will reach or

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[1] "Global warming" refers to the rise in global temperatures due mainly to the increasing concentrations of greenhouse gases in the atmosphere. "Climate change" refers to the increasing changes in the measures of climate over a long period of time, including precipitation, temperature, and wind patterns (usgs.gov/faqs/what-difference-between-global-warming-and-climate-change).

exceed 1.5°C [or 2.7°F above pre-industrial levels, defined as 1850-1900] in the near-term," which is defined as 2021-2040.[2] Earth's average surface air temperature has increased by about 1°C (1.8°F) since 1900, with over half of the increase occurring since the mid-1970s.[3] In other words, it is more likely than not that within 20 years of today there will be *at minimum* an additional 0.5°C (0.9 °F) of global warming and, critically, *the temperature will continue to rise*. We emphasize 1.5°C as the minimum warming expected by 2040; as discussed below there is substantial reason for concern that, even if there are massive reductions in greenhouse gas ("GHG") emissions soon, it will be hard to limit warming to 2°C by 2040.

Continuing warming of the planet is highly problematic because "[h]uman-induced climate change, including more frequent and intense extreme events, has [already] caused widespread adverse impacts and related losses and damages to nature and people…."[4] "Approximately 3.3 to 3.6 billion people live in contexts that

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[2] IPCC, 2022: Summary for Policymakers, Climate Change 2022: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (hereinafter, "IPCC WGII SPM, 2022") (available at report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf), SPM.1, at 10.

[3] IPCC, 2021: Summary for Policymakers, Climate Change 2021: The Physical Science Basis, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (hereinafter, "IPCC WGI SPM, 2021") (available at ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf), A.1.3 at 5 and Figure SPM.1 at 6.

[4] IPCC WGII SPM, 2022, B.1 at 11.

are highly vulnerable to climate change (high confidence)," and a "high proportion of species is vulnerable to climate change (high confidence)."[5] "Global warming, reaching 1.5°C [above pre-industrial levels] in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (very high confidence)."[6] "Near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems, compared to higher warming levels, but cannot eliminate them all (very high confidence)."[7]

These scientific findings strongly suggest the need for near-term actions that limit global warming to close to 1.5°C or at most 2°C. The key to limiting global warming to close to 1.5°C or 2°C is to substantially reduce greenhouse gas ("GHG") emissions worldwide. As the IPCC states: "Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO_2 and other greenhouse gas emissions occur in the coming decades."[8] We suggest that the Commonwealth of Pennsylvania has a responsibility under Article I Section 27 of the Pennsylvania Constitution to contribute to these reductions to protect its citizens from the impending threats due to climate change.

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[5] *Id*. B.2 at 14.
[6] *Id*. B.3 at 15.
[7] *Id*.
[8] IPCC WGI SPM, 2021, B.1 at 14.

Achieving the reductions in GHG emissions necessary to limit warming close to 1.5°C or even 2°C above pre-industrial levels will require concerted efforts by governments, private organizations, and people worldwide. Pennsylvania played a leading role not only in the founding of our country, but also in the Industrial Revolution and the rise of fossil fuels as a resource for humans. Now Pennsylvania has an important part to play in helping to achieve the GHG reductions necessary to avoid the devastating consequences expected if warming is not limited to close to 1.5°C or 2°C.

The GHG emissions reductions necessary to achieve the goal must come from a variety of different sectors, and among these is electricity generation from burning fossil fuels, which RGGI is designed to address. Reducing emissions from the power generation sector is a highly logical place to begin GHG emissions reductions in Pennsylvania, because, as acknowledged in the preamble to the rulemaking, Pennsylvania ranks fourth nationwide in the amount of CO_2 emitted from the electricity generation sector.

It is critically important to the future of Pennsylvania and its citizens (as well as people everywhere) that GHG emissions be substantially reduced in Pennsylvania and elsewhere. Pennsylvania joining RGGI will represent a key step in the Commonwealth's efforts to achieve a substantial reduction in GHG emissions. Pennsylvania joining RGGI will pave the way for other measures to reduce GHG emissions in Pennsylvania. It will also set an example for other state governments (and governments everywhere) to embark on ambitious programs to reduce GHG emissions within their jurisdictions. *Amici* hope that climate change science, set forth herein, will help to persuade the Court that a preliminary injunction preventing Pennsylvania from going forward with joining RGGI would not serve the public interest.

II. INTERESTS OF *AMICI CURIAE*

Amici curiae (listed below) are Ph.D. and M.D. scientists and academics who live, work, study, conduct research, and/or teach in Pennsylvania. *Amici* have an interest in ensuring that the Court receives accurate information about the nature, cause, and urgency of the phenomenon known as climate change. *Amici* wish to make the Court aware that there is a broad scientific consensus that the Earth is warming at a rate unprecedented in human history, that a principal cause of the warming is GHG emissions caused by human activities including burning fossil fuels, that the warming is predicted to increase by several degrees in the coming decades unless strong action is taken to limit GHG emissions, that substantial effects of warming are already being felt globally and in Pennsylvania, that these effects include many consequences that can only be considered adverse for the natural world including humans, that these effects will continue and accelerate during the lifetime of anyone reading these words, and that for these reasons *Amici* strongly support measures (such as Pennsylvania joining RGGI) that are designed to substantially reduce GHG emissions in Pennsylvania.

Amici[9] all live and/or work in Pennsylvania. Here is a list of *Amici*,[10] their areas of scientific research and study, and, where applicable, their current employer for those who are affiliated with an academic research institution.[11]

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9 In compliance with Pa. R.A.P. 531(b)(2), no other person or entity other than *Amici* or their counsel paid for or authored this brief.

10 The scientific content of this brief was prepared by Drs. Muto, Latham, Chapman, and Langley and approved by all *Amici*.

11 The views expressed herein are those of *Amici* and not necessarily those of their affiliated academic institutions.

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III. ARGUMENT

CLIMATE CHANGE IS A REAL AND GROWING CONCERN THAT WILL HAVE DEVASTATING EFFECTS ON HUMANS AND ECOSYSTEMS IN THE COMING DECADES UNLESS GREENHOUSE GAS EMISSIONS ARE SUBSTANTIALLY REDUCED VERY SOON.

Under Pennsylvania law, the person seeking a preliminary injunction has the burden of establishing the "essential prerequisites" for obtaining such relief *Warehime v. Warehime*, 860 A.2d 41, 46-47 (Pa. 2004). For the reasons set forth below, the Petitioners have failed to meet at least two of those "essential" requirements: "(2) that greater injury would result from refusing an injunction than from granting it, and, concomitantly, that issuance of an injunction will not substantially harm other interested parties in the proceedings"; and "(6) that a preliminary injunction will not adversely affect the public interest." *Id*. The scientific facts set forth herein make clear that the allowing the Commonwealth to go forward with joining RGGI will result in clear and measurable benefits to Pennsylvania, the country, and the world, in the form of substantially reduced GHG emissions, as detailed below, and that enjoining Pennsylvania from joining RGGI would be inimical to the public interest.

a. <u>Human-Caused Greenhouse Gas Emissions Are Causing the Earth's Recent, Rapid Warming.</u>

Earth's temperature is modulated by a balance between incoming and outgoing energy. The incoming energy, solar radiation, is partly absorbed at Earth's surface and partly reflected into space by the atmosphere and surface. The energy absorbed at Earth's surface warms the planet, then is reemitted. Some of this reemitted energy passes through the atmosphere and escapes into space, but some is absorbed by gasses in the atmosphere and then reemitted back toward Earth's surface, further warming it. This is called the greenhouse effect and, if the incoming and outgoing energy are in equilibrium, the planet is maintained at a moderate temperature that sustains life. Atmospheric gasses responsible for the greenhouse effect, mainly carbon dioxide (CO_2) and methane (CH_4) are called greenhouse gasses or GHGs. GHGs block energy from leaving the Earth's atmosphere (Figure 1). The more GHGs in the atmosphere, the warmer Earth gets.

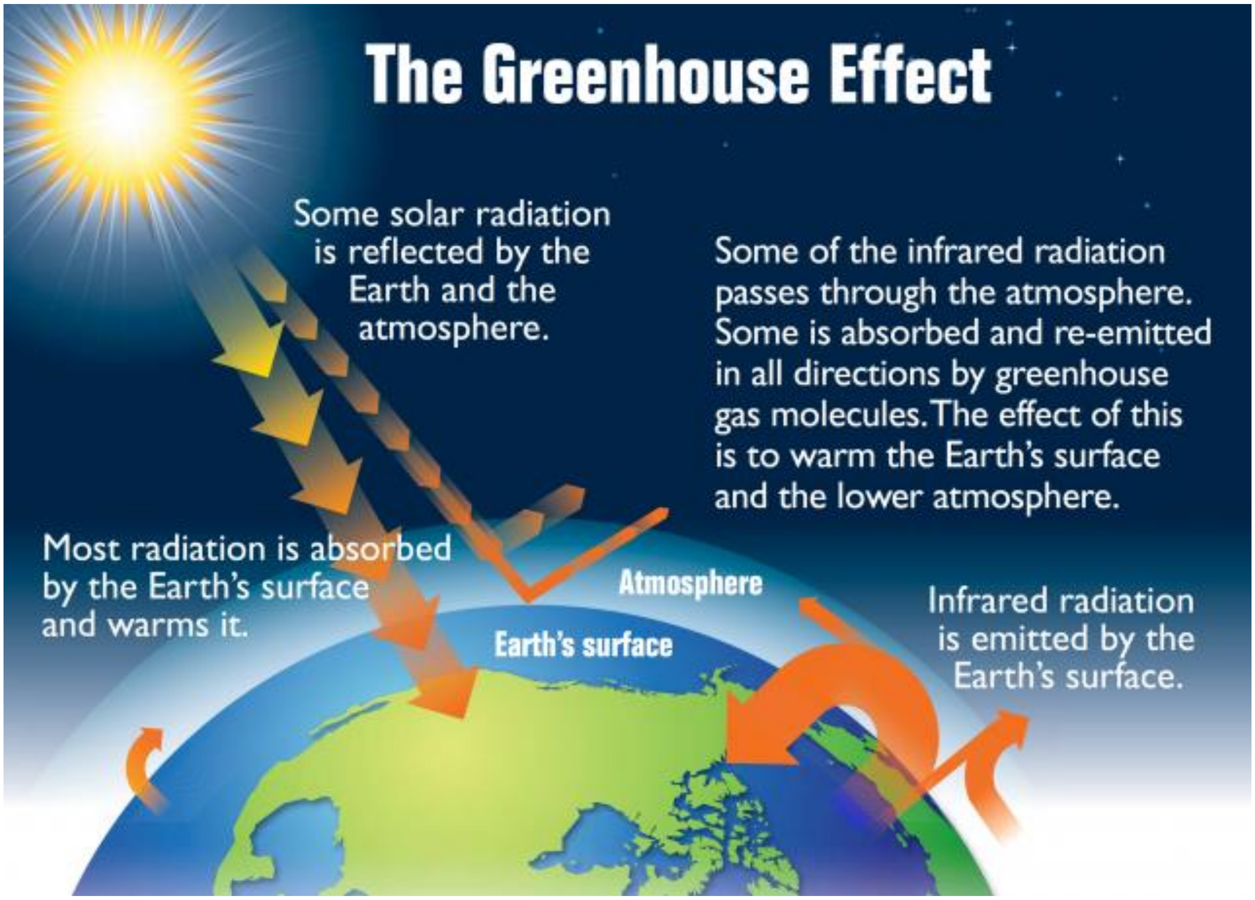

Figure 1. Schematic diagram of the greenhouse effect. From epa.gov/climatechange-science/basics-climate-change, last visited 4/15/22.

The greenhouse effect of CO_2 was first quantified and its influence on Earth's climate was suggested by the Swedish scientist Svante Arrhenius, one of the founders of the science of physical chemistry, and a Nobel Prize winner, in 1895. As Arrhenius and many subsequent scientists have predicted and found, Earth's climate has fluctuated together with the atmospheric concentrations of GHGs, mainly CO_2. Today, the best record of historical temperature and CO_2 fluctuations come from ice cores extracted from the Antarctic ice sheet. They show that, at least over the last 800,000 years, Earth's temperature went up when CO_2 concentrations went up, and vice versa (Figure 2). Periods with lower CO_2 concentrations and temperature are the glacial periods (ice ages) and periods with higher CO_2 concentrations and temperature are called interglacial periods.

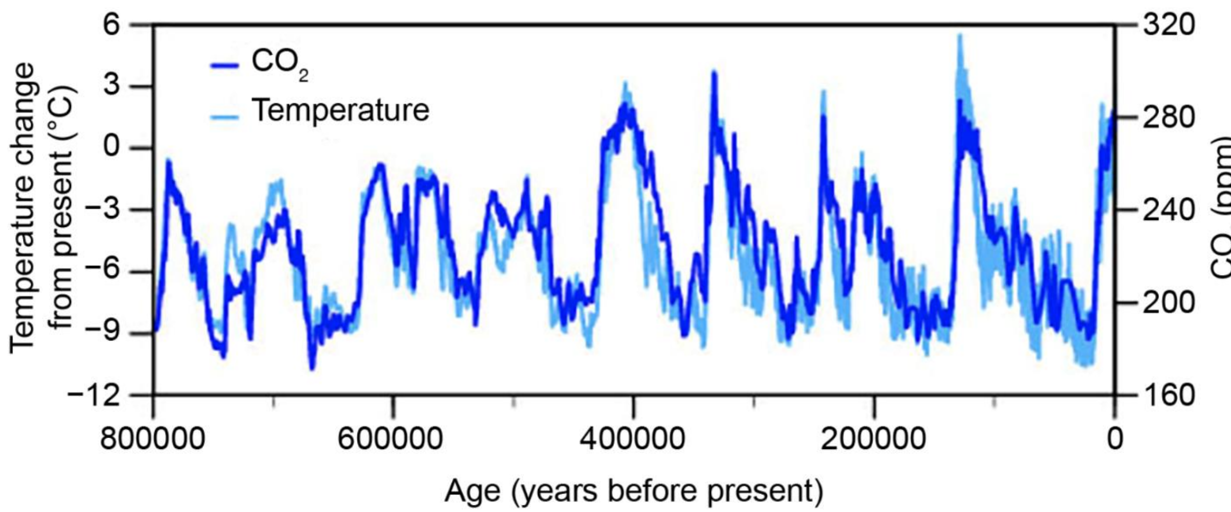

Figure 2. Temperature change (light blue) and carbon dioxide change (dark blue) measured from the EPICA Dome C ice core in Antarctica [12,13]*. From https://www.ncdc.noaa.gov/global-warming/temperature-change, last visited 4/16/22.*

Over the last 800,000 years, glacial and interglacial periods occurred repeatedly at a periodicity of approximately 100,000 years. This is well explained by the changes in the amount of solar energy reaching Earth (solar irradiance) due

[12] Jouzel, J., Masson-Delmotte, V., Cattani, O., et al. (2007). Orbital and millennial Antarctic climate variability over the past 800,000 years. Science. 317, 793–796. doi.org/10.1126/science.1141038

[13] Luthi, D., Le Floch, M., Bereiter, B., et al. (2008). High-resolution carbon dioxide concentration record 650,000-800,000 years before present. Nature. 453, 379–382. doi.org/10.1038/ nature06949

to variation in the shape of Earth's orbit around the Sun. Called eccentricity, this departure of Earth's orbit from a perfect circle results in slight variations in the distance between the Sun and Earth, and hence the solar irradiance, on a 100,000-year cycle. Other orbital cycles include obliquity (the tilt of Earth's axis of rotation) and precession (the wobble of Earth's axis of rotation), which have 45,000-year and 26,000-year periodicities, respectively, and also contribute to variation in solar irradiance. It is now evident that the long-term changes in Earth's climate are controlled by solar irradiance variations due to the combined cycles of eccentricity, obliquity, and precession. These sequences in Earth's orbital parameters are called Milanković cycles, named after Serbian scientist Milutin Milanković, who first hypothesized the role of orbital parameters in glacial-interglacial cycles.

On the shorter time scale of decades to centuries, Earth's climate is affected not only by Milanković cycles, but also by the total energy output from the sun (solar activity). Also, large volcanic eruptions can inject aerosols into the stratosphere that can then spread over a large area of the planet and block some of the solar irradiance, contributing to shorter-term cooling, ranging from annual to century time scales. For example, a cool period known as the Little Ice Age between about 1650 and 1850 is thought to have been caused by a decrease in solar activity together with increased volcanic activity.[14]

Variation in Earth's climate due to natural causes has recently been eclipsed by unprecedented rapid warming. Since the 1880s, Earth has warmed by 1°C (1.8°F)[15], and each of the last four decades has been successively warmer than any decade that preceded it since 1850.[16] This rapid rate of warming cannot be explained only by the natural causes discussed above. Solar irradiance has been on a decreasing trend since about the 1960s, but the Earth's temperature has continuously increased during the same period (Figure 3). This warming can only be explained by the increase in the atmospheric concentrations of GHGs, mainly CO_2 from human use of fossil fuels.[17]

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[14] Miller, G.H., Geirsdóttir, Á, Zhong, Y., et al. (2012). Abrupt onset of the Little Ice Age triggered by volcanism and sustained by sea-ice/ocean feedbacks, Geophys. Res. Lett., 39, L02708, doi.org/10.1029/2011GL050168.

[15] IPCC WGI SPM, 2021, A.1.3 at 1.

[16] IPCC WGI SPM, 2021, A.1.2 at 1.

[17] IPCC WGI SPM, 2021, Figure SPM.2.

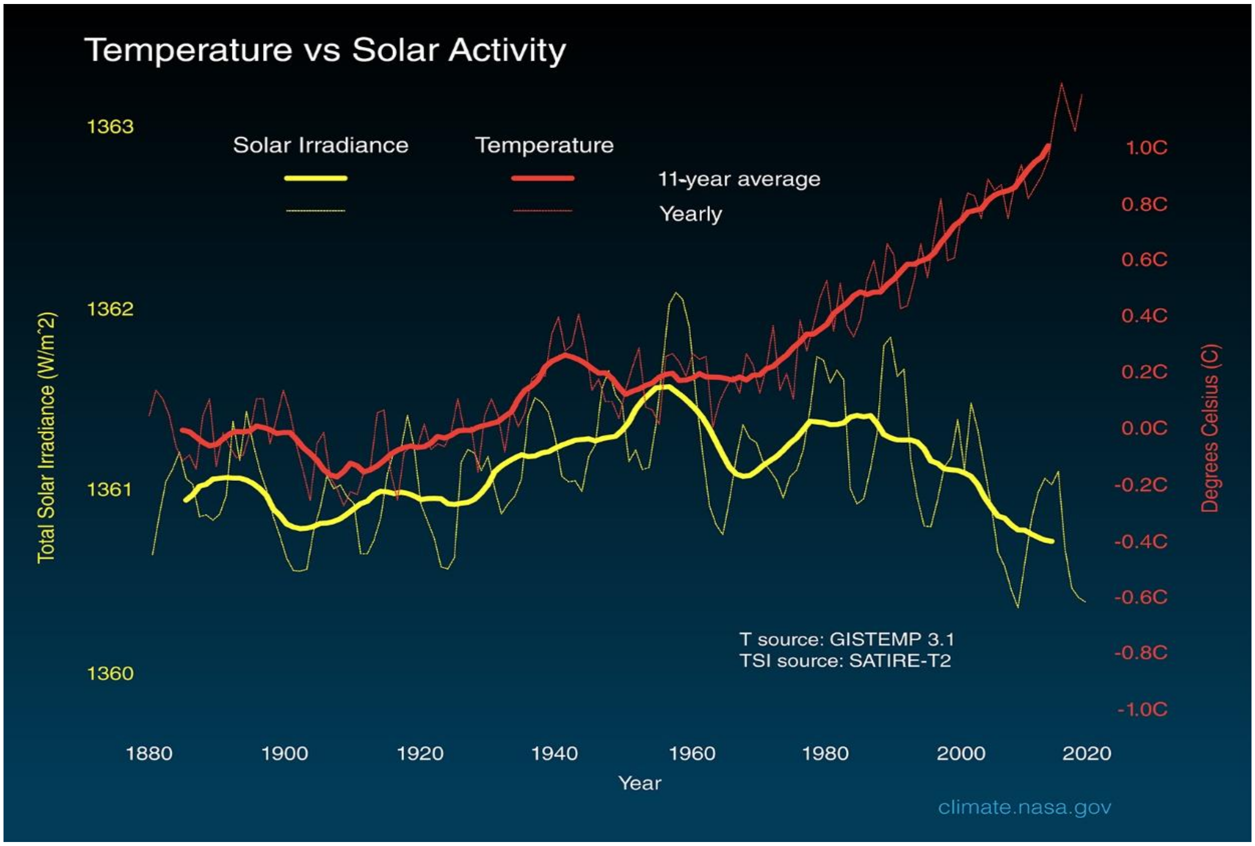

Figure 3. The global surface temperature changes (red line) and the Sun's energy that Earth receives (yellow line) in watts (units of energy) per square meter since 1880. The lighter/thinner lines show the yearly levels while the heavier/thicker lines show the 11-year average trends. Eleven-year averages are used to reduce the year-to-year natural noise in the data, making the underlying trends more visible. From climate.nasa.gov/causes, last visited 4/18/22.

The atmospheric concentrations of CO_2 have been increasing due to the burning of fossil fuels since the Industrial Revolution. Since 1750, increases in CO_2 concentrations far exceed the natural multi-millennial changes between glacial and interglacial periods over the past 800,000 years.[18] In 2020, CO_2 concentrations reached 412.5 parts per million (ppm), which is more than 100 ppm higher than the

[18] IPCC WGI SPM, 2021, A.2.1 at 2.

previously known highest value within the last 800,000 years (Figure 4). As explained earlier, the more GHGs in the atmosphere, the warmer Earth gets. In fact, there is high confidence now that there is a near-linear relationship between cumulative anthropogenic CO_2 emissions and the global warming they cause.[19]

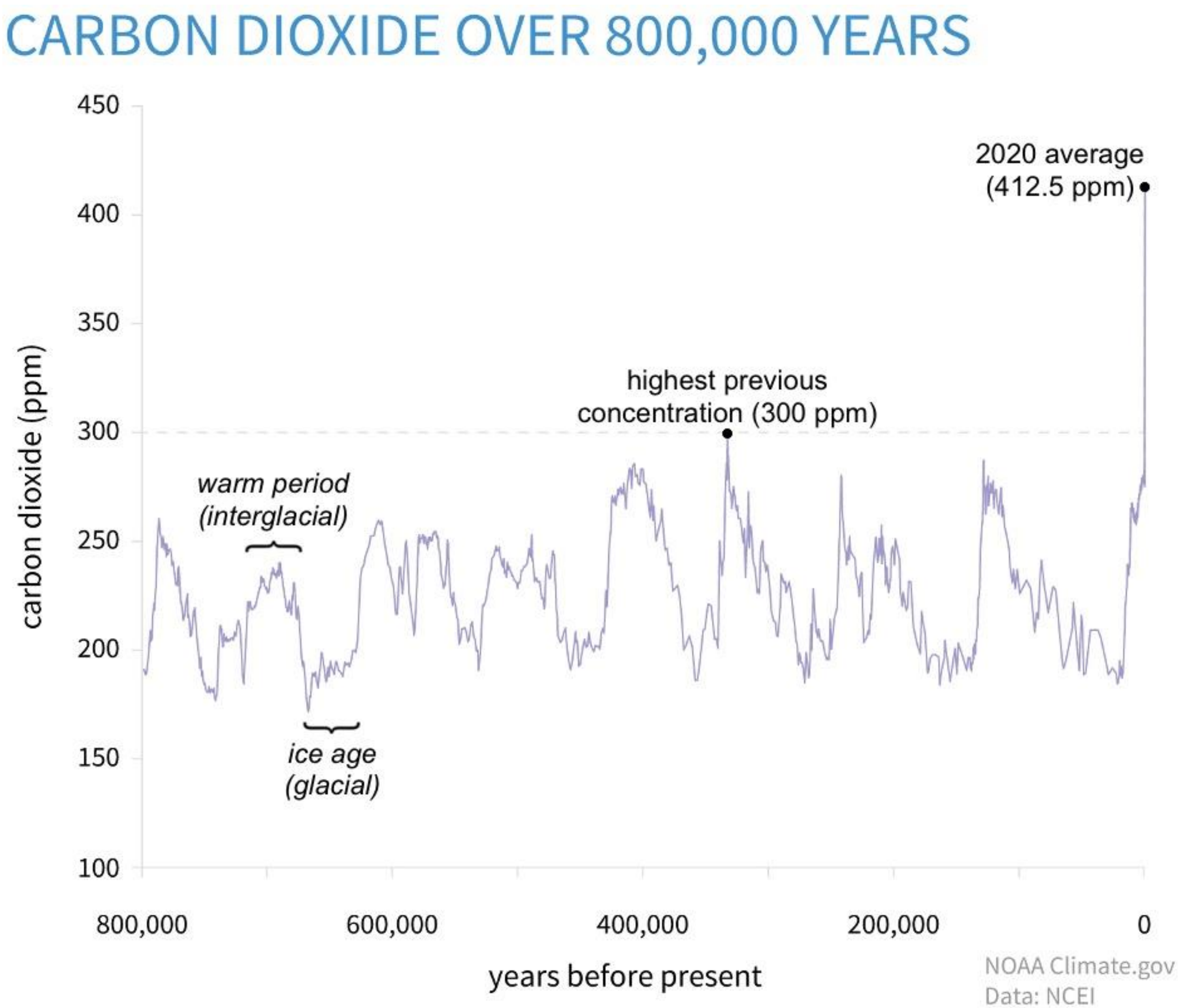

Figure 4. Global atmospheric carbon dioxide concentrations (CO_2) in parts per million (ppm) for the past 800,000 years. Adapted from graph by NOAA Climate.gov based on data from Lüthi et al., 2008, provided by the NOAA NCEI Paleoclimatology Program. From drupal-www.climate.woc.noaa.gov*, last visited 4/16/22.*

[19] IPCC WGI SPM, 2021, D.1.1 at 1.

b. <u>The Extent of Warming Will Depend Upon the Level of Greenhouse Gas Emissions.</u>

Based on the CO_2-warming relationship and similar relationships found for other GHGs, the amount of warming expected from different GHG emission scenarios has been projected using climate models. It has been well established that a certain amount of future warming is already locked in due to past GHG emissions. According to one study, more than 2°C (3.6°F) above preindustrial levels is already locked in.[20] In assessing global warming over the remainder of this century, the IPCC has considered five illustrative emissions scenarios (or "pathways")[21]: *very high* where the CO_2 emissions double the 2015 level by 2050 (SSP5-8.5); *high* where the emissions double from the 2015 level by 2100 (SSP3-7.0); *intermediate* where emissions remain around the 2015 level until the middle of the 21st century (SSP2-4.5); *low* where the emissions decline to net zero around or after 2050 (SSP1-2.6);

[20] Zhou, C., Zelinka, M.D., Dessler, A.E. et al. Greater committed warming after accounting for the pattern effect. Nat. Clim. Chang. 11, 132–136 (2021). doi.org/10.1038/s41558-020-00955-x

[21] These scenarios are referred to in the most recent IPCC Reports as "Shared Socioeconomic Pathways" or "SSPs." The SSPs "span a range of futures in terms of the socioeconomic challenges they imply for mitigating and adoption to climate change." K. Riahi, et al., Global Environmental Change 42 (2017), at 157. Mitigation in the context of climate change means reducing and stabilizing the levels of GHG emissions and adaption means adapting to the climate change that has already occurred or is inevitable based on past and present GHG emissions. Prior to the Sixth Assessment Report, published by the IPCC in 2021 and 2022, the IPCC in its earlier reports used a slightly different but complementary concept of "Representative Concentration Pathways" or "RCPs" to model future climate effects based on potential future emissions scenarios.

and *very low* with net negative CO_2 emissions (SSP1-1.9). In all five scenarios, warming is expected to continue until at least mid-century because of the cumulative effect of what has been emitted *already* (Figure 5). What happens thereafter differs greatly depending on future emissions, from warming of almost 5°C (9°F) above the preindustrial (1850-1900) levels by 2100 in the very high emissions scenario to keeping global temperature at or below 1.5°C (2.7°F) by 2100 in the very low emissions scenario with deep reductions in GHG emissions.

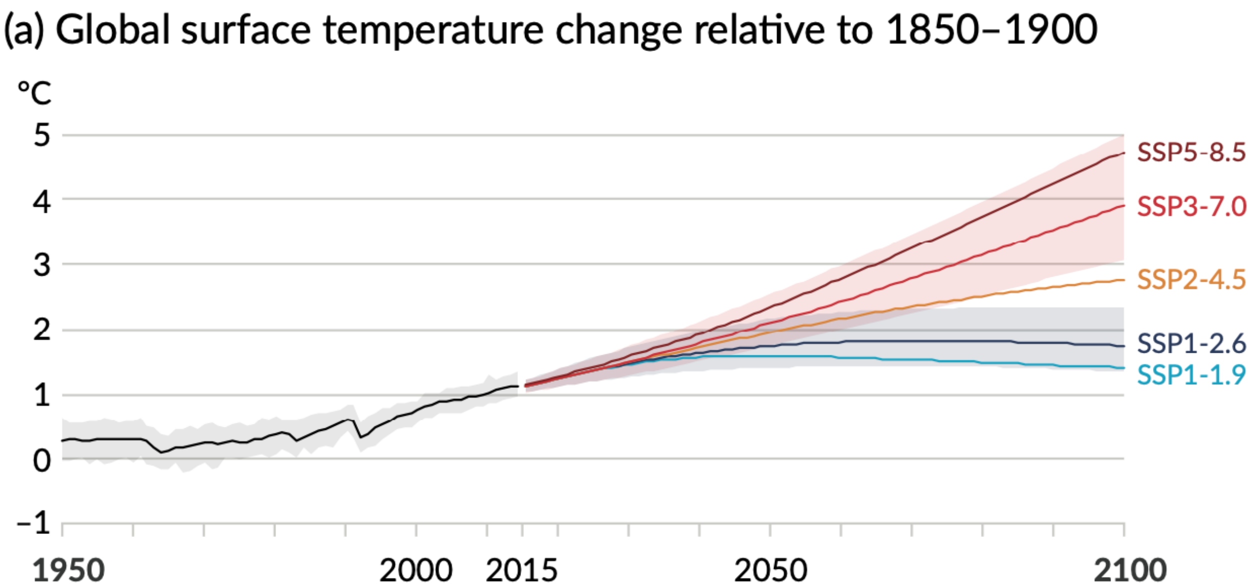

Figure 5. Global surface temperature changes in °C relative to 1850–1900. Up to 2015, these changes are from observations; after 2015, they are from model simulations. Very likely ranges are shown for SSP1-2.6 and SSP3-7.0. From IPCC (2021) WGI SPM (2021), Figure SPM.8 at p.22.

c. <u>Limiting Warming to 1.5°C or 2°C is Very Ambitious But Necessary to Avoid Projected Losses and Damages to Human Systems and Ecosystems.</u>

"Human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability."[22] Heat waves and heavy precipitation events have become more frequent and intense since the 1950s; the proportion of major (Category 3-5) hurricanes has increased over the last four decades; and global sea level is rising because of thermal expansion of oceans and melting of glaciers and ice sheets.[23] Even in the most optimistic GHG emissions scenario resulting in 1.5°C warming above the preindustrial level by 2100, increases in these adverse impacts are expected. For example, a 10-year heat wave (extreme temperature event that occurs once in 10 years on average in a climate without human influence) will likely occur 4.1 times per 10 years and be 1.9°C (3.4°F) hotter in the 1.5°C warming scenario (Figure 6) [24]. However, many changes in the climate system become larger in direct relation to increasing global warming. For 2°C (3.6°F) and 4°C (7.2°F) of warming, the frequency of a once-in-10-year heat wave

[22] IPCC WGII SPM, 2022, B.1 at 1.
[23] *See*, IPCC WGI SPM, 2021, at p.8.
[24] *See*, IPCC WGI SPM, 2021, Figure SPM.6 at p.18.

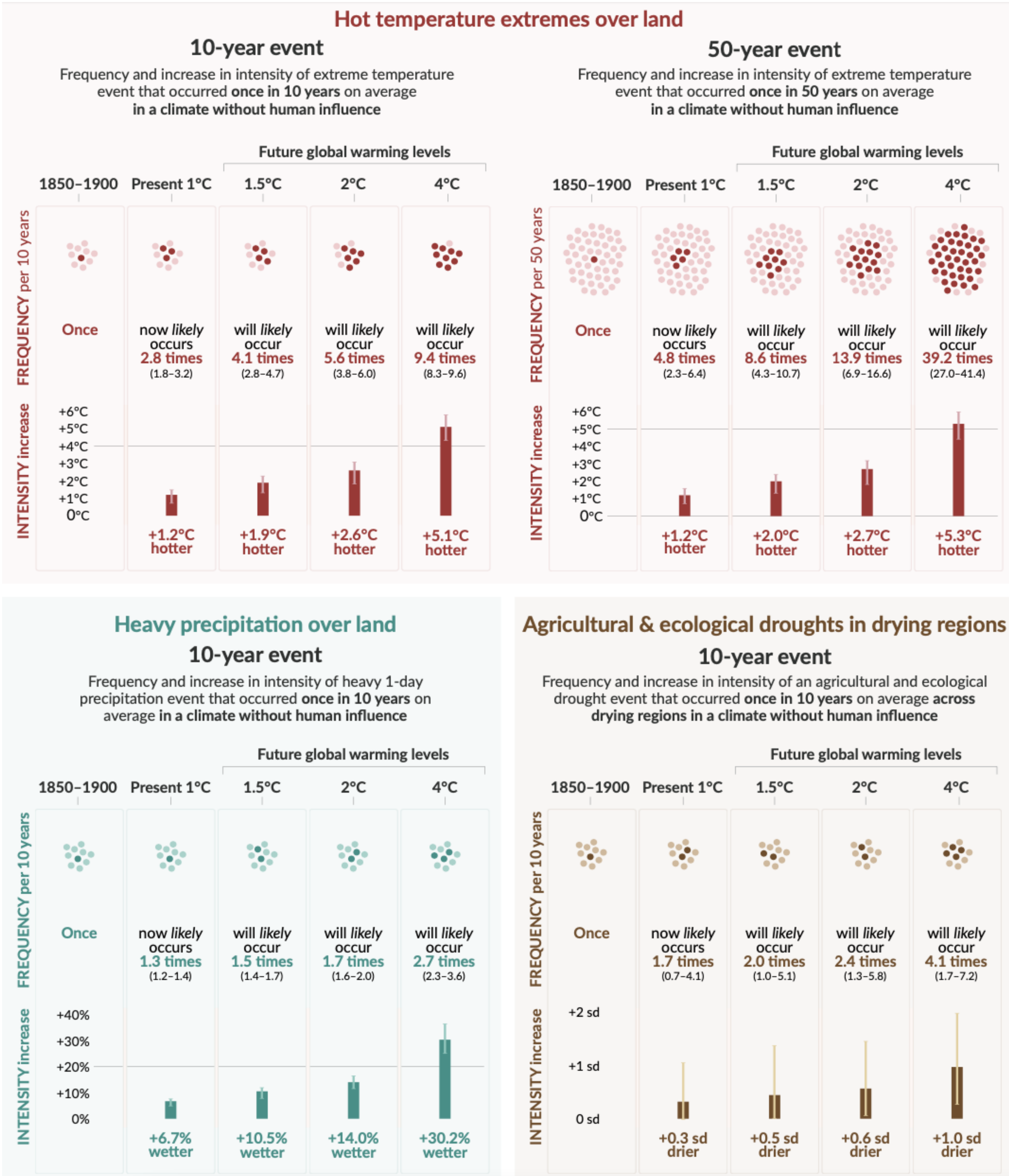

Figure 6. Projected changes in the intensity and frequency of hot temperature extremes over land (heat waves), extreme precipitation over land, and agricultural and ecological droughts in drying regions. From IPCC WGI SPM (2021), Figure SPM.6, at p.18.

would increase to 5.6 and 9.4 times per 10 years, respectively, and be 2.6°C (4.7°F) and 5.1°C (9.2°F) hotter, respectively (Figure 6).[25]

Research on such impacts is turning up new and dire discoveries at an alarming rate. A study published less than two weeks ago in *Nature*[26] predicts a growing onslaught of viral diseases jumping from bats and other mammals to humans, in the same way SARS, MERS, and COVID-19 have done, as wildlife species long isolated from dense human habitation shift their ranges with rising temperatures (see Figure 7).

Limiting global warming to close to 1.5°C above the preindustrial level would substantially reduce projected losses and damages in human systems and ecosystems, compared to higher warming levels.[27] In terrestrial ecosystems, 3 to 14% of species assessed will likely face very high risk of extinction at warming levels of 1.5°C, increasing up to 18% at 2°C, 29% at 3°C, 39% at 4°C, and 48% at 5°C. Increases in frequency, intensity and severity of droughts, floods and

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[25] *Id*.

[26] Carlson, C.J., G.F. Albery, C. Merow, C.H. Trisos, C.M. Zipfel, E.A. Eskew, K.J. Olival, N. Ross, and S. Bansal. 2022. Climate change increases cross-species viral transmission risk. Nature. doi.org/10.1038/s41586-022-04788-w (last accessed 2022-05-05)

[27] IPCC WGII SPM, 2022, B3 at 4.

heatwaves, and continued sea-level rise will increase risks to food security in vulnerable regions from moderate to high between 1.5°C and 2°C warming level.[28]

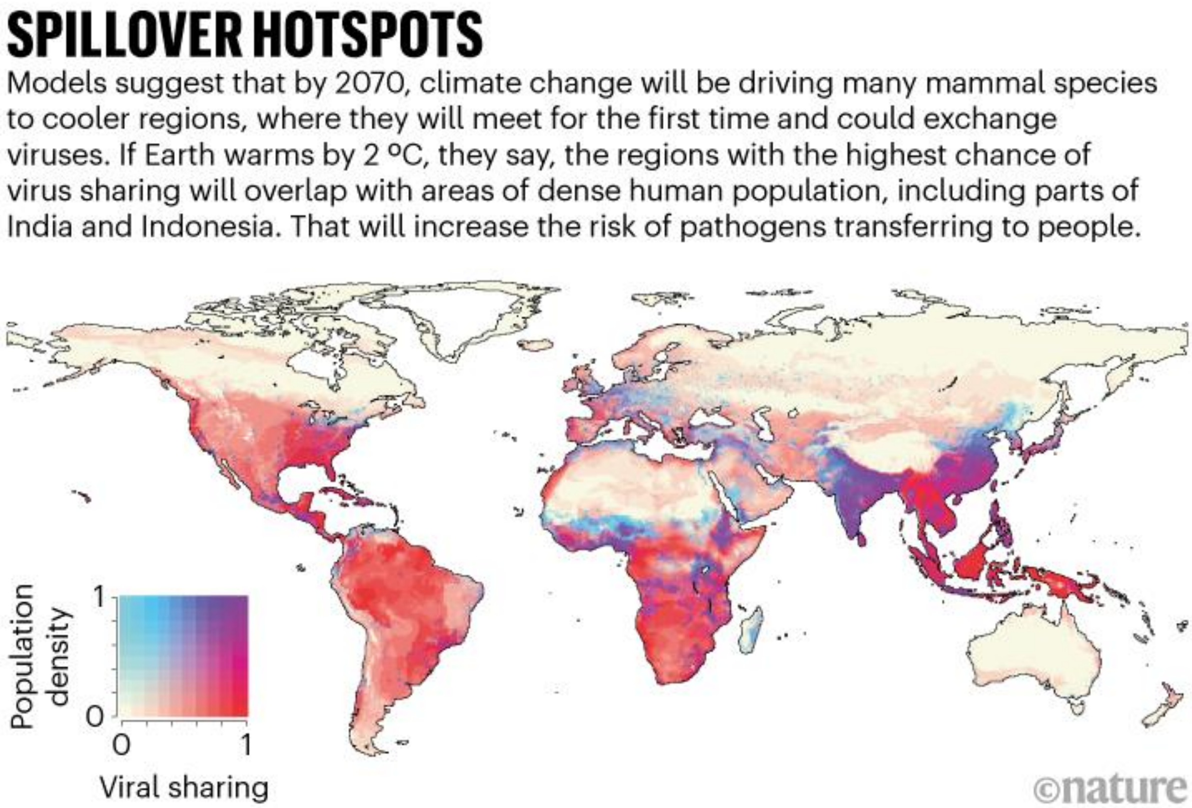

Figure 7. Map modeling increased risk of animal pathogens transferring to people as climate warms.

Limiting global warming to 1.5°C above the preindustrial level by 2100 is an ambitious, but nevertheless vital, goal. The projection that results in 1.5°C warming by 2100 (SSP1-1.9) is the one that not only requires immediate and deep cuts in emissions but also some CO_2 removal. In fact, projected cumulative future CO_2 emissions over the lifetime of existing and currently planned fossil fuel

[28] *See*, IPCC WGII SPM, 2022, at p.16.

infrastructure without additional abatement exceed the total cumulative net CO_2 emissions in pathways that limit warming to 1.5°C[29] and are approximately equal to total cumulative net CO_2 emissions in pathways that limit warming to 2°C.[30] Thus, limiting the warming to 2°C above the preindustrial level by 2100 is attainable, but only if immediate, deep cuts in CO_2 emissions are made.

The conclusions of the IPCC expressed in the Sixth Assessment Report have been endorsed by the leading scientific organizations in the world. For example, the Royal Society (British) issued a statement in April 2022 as follows: "The IPCC's declaration that, without immediate and deep emissions reductions across all sectors, limiting global warming to 1.5°C is beyond reach, must be taken extremely seriously. Every fraction of a degree of extra warming increases the risk of devastating climate change and severe weather events that have been set out by the IPCC and others."[31] The Australian Academy of Science issued a statement that it "strongly supports the message of the latest report from the Intergovernmental Panel on Climate Change (IPCC)—humanity has the tools to reduce greenhouse gas emissions and arrest catastrophic climate change, but we need to act now."[32] The National Academies of Sciences (American) has said this: "The current greenhouse

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[29] IPCC WGIII SPM, 2022, B7 at 1.
[30] *Id* at 4.
[31] royalsociety.org/news/2022/04/response-ipcc-sixth-assessment-report (last visited 4/27/22).
[32] science.org.au/news-and-events/presidents-statement-ipcc-working-group-iii-report (last visited 4/27/22).

gas induced warming of Earth is essentially irreversible on human timescales. The amount and rate of further warming will depend on how much more CO_2 is added to the atmosphere. A sharp reduction in CO_2 emissions is needed to slow climate change and avoid the most severe impacts on weather extremes, ecosystems, human health, and infrastructure."[33]

d. <u>**The Effects of Climate Change Are Already Being Felt in Pennsylvania and Will Increase in Coming Decades; the Extent of Future Changes Will Depend on GHG Emissions**</u>.

The Commonwealth of Pennsylvania through the Department of Environmental Protection, with support from the Pennsylvania State University, prepared the Pennsylvania Climate Impacts Assessment 2021 (the "PA Assessment").[34] The PA Assessment projects changes in the future temperature in Pennsylvania from a baseline period of 1971-2000 for the period 2011-2040 (present), 2041-2070 (midcentury), and 2070-2099 (end-of-century).[35] It provides these projections for two different emissions scenarios: RCP 8.5 and RCP 4.5.

[33] nap.nationalacademies.org/resource/other/dels/net-zero-emissions-by-2050/#page-top (last visited 5/1/22).

[34] depgreenport.state.pa.us/elibrary/GetDocument?docId=3667348&DocName=PENNSYLVANIA%20CLIMATE%20IMPACTS%20ASSESSMENT%202021.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c/span% (last visited 4/24/22).

[35] *Id*. at 3.

RCP 8.5 "represents a global "baselines" scenario without additional efforts to reduce emissions."[36] RCP 4.5 represents an intermediate scenario higher than RCP 2.6, the "scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures."[37] The RCP 8.5 emissions pathway is the most appropriate for conducting assessments of climate change impacts by 2050,[38] because it assumes that no efforts are being undertaken to reduce GHG emission substantially very soon. In contrast, RCP 4.5 "assumes that climate policies, in this instance the introduction of a set of global greenhouse gas emissions prices, are invoked to achieve the goal of limiting emissions…"[39] That is not currently happening and thus RCP 4.5 (which would not limit warming to near 1.5°C or 2°C) seems quite unrealistic now.

According to the PA Assessment, Pennsylvania can expect average annual temperature to "rise 9.3°F (5.2°C) by end-of-century [2070-2099] under RCP 8.5,

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36 *Id*. at 4.

37 IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, at 8 and Figure SPM.5a. ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf (last visited 4/24/22).

38 Schwalm, C.R., S. Glendon, and P.B. Duffy. RCP8.5 tracks cumulative CO_2 emissions. Proceedings of the National Academy of Sciences, 2020; 202007117 DOI: 10.1073/pnas.2007117117.

39 Thomson, A.M., K.V. Calvin, S.J. Smith, G.P. Kyle, A. Volke, P. Patel, S. Delgado-Arias, B. Bond-Lamberty, M.A. Wise, L.E. Clarke, and J.A. Edmonds. 2011. $RCP_{4.5}$: a pathway for stabilization of radiative forcing by 2100. Climatic Change 109:77-94, at 2. doi.org/10.1007/s10584-011-0151-4.

but only 5.5°F (3.1°C) under RCP 4.5…"[40] Under all the RCPs, the PA Assessment reports Pennsylvanians can expect a rise of at least 1°C by 2050 and more after that.[41] The extent to which the temperature rises beyond 2050 varies depending upon which RCP will best approximate ongoing emissions, which in turn will depend critically on the success of efforts to reduce emissions.

Consequence → / Hazard ↓	Human health	Environ-mental justice & equity	Agriculture	Recreation & tourism	Energy & other economic activity	Forests, ecosystems & wildlife	Built infra-structure	Overall risk rating
Increasing average temperatures	12	12	8	12	8	16	4	10.7
Heavy precipitation & inland flooding	12	8	12	8	8	8	12	9.9
Heat waves	16	12	8	4	8	4	8	9.3
Landslides	3	6	3	3	6	3	12	5.6
Sea level rise	3	3	3	3	6	6	12	5.6
Severe tropical & extra-tropical cyclones	6	4	6	4	4	4	8	5.3

Risk level
Extreme
High
Medium
Low

Figure 8. Overall risk for each climate change hazard and consequence category (adapted from Pennsylvania Climate Impacts Assessment 2021, Pennsylvania Department of Environmental Protection, ICF, Penn State, and Hamel Environmental Consulting). Values represent the product of the year 2050 likelihood rating and each consequence score and are based on IPCC RCP 8.5.

The PA Assessment outlines the consequences in Pennsylvania for 2050 and beyond. It predicts sharply rising temperatures in coming years and decades. Direct and indirect effects include increasing average temperatures, heavy precipitation and inland flooding, and heat waves—all of which will be high risks by mid-century.[42]

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40 PA Assessment at 4.

41 *Id*. at 4 and Figure 5.

42 PA Assessment at xii. Heavy precipitation and inland flooding are already a high risk in Pennsylvania. *Id*.

The PA Assessment examines the severity of these effects on human health; environmental justice and equity; agriculture; recreation and tourism; energy and other economic activity; forests, ecosystems, and wildlife; and built infrastructure (Figure 8). The preamble to the rulemaking summarizes this subject well; *Amici* agree with those statements.

Beyond the most notable direct and indirect effects will be many smaller but nonetheless profound effects in Pennsylvania. "The state's downhill ski and snowboard resorts are not expected to be economically viable past mid-century."[43] Pennsylvania already has the highest incidence of Lyme disease in the nation; the number of Lyme disease cases in Pennsylvania is projected to grow by 20% in coming decades.[44] Pennsylvania is already in the northern range for the Asian tiger mosquito, "an invasive species with substantial biting activity [and] high disease vector potential"; the land area in Pennsylvania that is suitable for the mosquito is expected to "increase from the current 5% to 16% in the next two decades to 43%-49% by the end of the century."[45] "[E]leven species [of songbirds] are expected to shift their range out of Pennsylvania in the coming decades while only three species

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43 PA Assessment at 45.

44 Dumic, I. and E. Severnini. 2018. "Ticking bomb": the impact of climate change on the incidence of Lyme disease. Canadian Journal of Infectious Diseases and Medical Microbiology 2018:5719081. doi.org/10.1155/2018/5719081.

45 Rochlin, I., D.V. Ninivaggi, M. L. Hutchinson, and A. Farajollahi. 2013. Climate change and range expansion of the Asian tiger mosquito (Aedes albopictus) in northeastern USA: implications for public health practitioners. PLoS ONE 8:e60874. doi.org/10.1371/journal.pone.0060874

are expected to increase in the state."[46] The hybrid zone that runs across the eastern United States in which Carolina chickadees from the south meet and interbreed with black-capped chickadees is moving north at a rate of 0.7 miles a year over the past decade.[47] The range of the snowshoe hare has already contracted in Pennsylvania and is expected to contract much more by 2050.[48] Several invasive plant species will likely expand their range into Pennsylvania, including privet and kudzu.[49]

These are just a few examples of the many consequences that can be expected in Pennsylvania from rising air temperature in coming decades. *Amici* refer the Court to the PA Assessment summarized in the rulemaking preamble for a more complete discussion of effects that are now being felt and will be felt in the future in Pennsylvania.

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[46] Cullen, E., E. Yerger, S. Stoleson, and T. Nuttle. 2013. Climate change impacts on Pennsylvania forest songbirds against the backdrop of gas development and historical deer browsing. Pennsylvania Department of Conversation and Natural Resources, Wild Resource Conservation Program (WRCP-010376).

[47] Taylor, S.A., T.A. White, W.M. Hochachka, V. Ferretti, R.L. Curry, and I. Lovette. 2014. Climate-mediated movement of an avian hybrid zone. Current Biology 24:671-676. doi: 10.1016/j.cub.2014.01.069.

[48] Diefenbach, D.R., S.L. Rathbun, J.K. Vreeland, D. Grove, and W.J. Kanapaux. 2016. Evidence for range contraction of snowshoe hare in Pennsylvania. Northeastern Naturalist 23:229–248.

[49] Bradley, B.A., D.S. Wilcove, and M. Oppenheimer. 2009. Climate change increases risk of plant invasion in the eastern United States. Biological Invasions 12:1855–1872. DOI 10.1007/s10530-009-9597-y.

e. Pennsylvania Joining RGGI Would Have a Huge Positive Impact on the Public Good in Pennsylvania and Beyond.

As explained above, the undisputed facts show that (1) climate change is a very real, serious, and urgent problem bearing down on human society in Pennsylvania and everywhere else, and (2) the key to preventing substantial harm as much as possible is to substantially reduce GHG emissions in Pennsylvania and elsewhere as quickly as possible. The scientific community has been reporting these facts for many years. As far back as 1990, the IPCC in its First Assessment Report reported that GHG emissions (primarily CO_2) from human activities were substantially increasing the atmospheric concentrations of GHGs, resulting in an additional warming of the Earth's surface, and that under a "business as usual" scenario, global mean temperature would increase by about 0.3 °C per decade during the [21st] century.[50] These findings are entirely consistent with all the IPCC reports since then.

During this time—more than thirty years—the dire future effects of climate change have been reported in the news repeatedly and calls for urgent action to reduce global GHG emissions have been made by world leaders including, for example, by Pope Francis in a 2015 encyclical letter.[51] The calls for urgent action

[50] IPCC, 1990: Report Prepared for IPCC by Working Group I (available at ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_I_full_report.pdf), at xi, xxii-xxiii, Figures 8 and 9).

[51] vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html.

led to an international treaty in 2015, the Paris Agreement, signed by 196 countries including the United States.[52] Its goal is to limit global warming to well below 2°C, preferably to 1.5°C, by having all the signatory nations implement policies to reduce their respective GHG emissions contributions.[53] According to a report issued in November 2021, many of the signatories, including the United States, are not implementing policies to reduce GHG emission that are needed to meet their individual targets and unless this happens the world will not meet the goal of limiting global warming to well below 2°C.[54] If so, this will present substantial problems for humans and ecosystems in the coming decades and beyond.

The problem, reduced to a word, is inaction. Not enough governments are implementing policies to reduce emissions. In the United States, efforts by the federal government to reduce emissions have produced nothing to date. The U.S. Environmental Protection Agency in the last two presidencies pursued competing approaches, neither of which is currently being pursued, while a case that could affect the federal government's authority to regulate GHG emissions is currently pending before the U.S. Supreme Court.[55]

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[52] unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
[53] *Id*.
[54] Climate Action Tracker | Warming Projections Global Update - November 2021 (available at climateactiontracker.org/documents/997/CAT_2021-11-09_Briefing_Global-Update_Glasgow2030CredibilityGap.pdf), at i.
[55] Tollefson, J., This US Supreme Court Decision Could Derail Biden's Climate Plan, Controversial lawsuit has put the US government's ability to slash carbon

Effective policies for reducing GHG emissions are being pursued, however, by the sovereign states, including, notably, California[56] and all the states that have already joined RGGI: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia. By joining RGGI, Pennsylvania could act as the keystone that will not only begin the process of reducing emissions in Pennsylvania but could set an example for other states to take similar actions.

A journey of a thousand miles begins with a single step, goes the Chinese proverb, and this is true of GHG emissions reductions as well. As noted in the preamble to the Rulemaking, CO_2 emissions from the power sector alone in Pennsylvania in 2018 were greater than all CO_2 emissions for entire countries that same year, including Greece, Sweden, Israel, Singapore, Austria, Peru, and Portugal. Pennsylvania is responsible for a disproportionate share of GHG emissions, and it must begin the process of reducing emissions, and the sooner the better, given the urgency of the problem.

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emissions on the line, 603 Nature (available at media.nature.com/original/magazine-assets/d41586-022-00618-1/d41586-022-00618-1.pdf), at 376. The case pending before the U.S. Supreme Court is *West Virginia v. Environmental Protection Agency*, No. 20-1530, et al. It was argued on February 28, 2022.

[56] California has been at the forefront of emissions reductions. See c2es.org/content/california-cap-and-trade/#:~:text=California's%20system%20is%20a%20central,below%201990%20levels%20by%202050.

Thus, putting aside questions about the amount and timing of Pennsylvania emissions reductions that will be achieved by RGGI, a subject best left for the parties to address, from *Amici's* perspective what is important is that Pennsylvania *begin* the process of substantially reducing emissions. Joining RGGI would clearly do this. This first step is hugely important and stopping it would cause immense harm.

A party seeking a preliminary injunction must show "that greater injury would result from refusing an injunction than from granting it, and, concomitantly, that issuance of an injunction will not substantially harm other interested parties in the proceedings," and must also show "that a preliminary injunction will not adversely affect the public interest." *Warehime v. Warehime*, 860 A.2d 41, 46-47 (Pa. 2004). For the reasons explained above, the proponents of a preliminary injunction here cannot make the required showing of no negative effect on the public interest, and, accordingly, the requested preliminary injunction should be denied.

IV. CONCLUSION

From a scientific perspective, the key to minimizing Earth's warming and the many consequences that will follow from it is to substantially reduce GHG emissions as soon as possible. The window to limit warming to 1.5°C or even 2°C is rapidly closing. Even if limiting warming to 1.5°C or 2°C becomes unobtainable, it will still be critically important to limit further warming to minimize the effects on humans and ecosystems. The Commonwealth of Pennsylvania has an important part to play in minimizing climate change and its effects by taking measures to reduce GHG emissions in Pennsylvania. Pennsylvania joining RGGI, which will set Pennsylvania on a path toward substantial emissions reductions, is a critically important first step toward protecting citizens in Pennsylvania from the adverse consequences of climate change, and the sooner it happens the better in terms of reducing climate change and its adverse effects. *Amici* therefore join the Respondents in asking that the requested injunction be denied.

Respectfully submitted.

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CERTIFICATE OF COMPLIANCE WITH LENGTH LIMITATIONS

In accordance with Pa. R.A. P. 2135(d), I hereby certify that this brief complies with length limitation in Pa. R.A.P. 531(b)(3) in that it contains fewer than 7,000 words, excluding the supplementary matter exempted by Pa. R.A.P. 2135(b), as determined by the word counting function in the word processing system used to prepare the brief, Microsoft Word.

CERTIFICATE OF COMPLIANCE

I certify that this filing complies with the provisions of the *Case Records Public Access Policy of the Unified Judicial System of Pennsylvania* that require filing confidential information and documents differently than non-confidential information and documents.

Dated: May 9, 2022

/s/ Stephen G. Harvey
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