
PETITION

of

Ashley Funk

to the

**Pennsylvania Environmental Quality Board
Pennsylvania Department of Environmental Protection**

For the promulgation of a rule to strictly limit and regulate fossil fuel carbon dioxide emissions, and to establish an effective emissions reduction strategy that will achieve safe atmospheric concentrations of carbon dioxide by 2100.

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On behalf of

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SECRETARY'S OFFICE

SEP - 6 2013

**DEPARTMENT OF
ENVIRONMENTAL PROTECTION**

September 5, 2013

September 4, 2013

E. Christopher Abruzzo, Acting Secretary
Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

Michele Tate, Regulatory Coordinator
Environmental Quality Board
P.O. Box 8477, Harrisburg, PA, 17105-8477

Re: Petition For Promulgation of a Rule to Regulate Fossil Fuel Carbon Dioxide Emissions and to Establish an Effective Emissions Reduction Strategy That Will Achieve a Concentration of 350 ppm Atmospheric Carbon Dioxide by 2100.

On behalf of my client, Ashley Funk, I hereby submit the following Petition for Rulemaking.

Article I, Section 27 of the Pennsylvania Constitution provides: “The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania’s public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.”

Article I, Section 27 is an explicit recognition that the state holds the air in trust for all Pennsylvanians. This is an affirmative obligation that Pennsylvania’s legislature cannot abrogate. For example, in *San Carlos Apache Tribe v. Superior Court*, 193 Ariz. 195, 199, 972 P.2d 179, 215 (1999), the Arizona Supreme Court recognized that “the public trust doctrine is a constitutional limitation on legislative power to give away resources held by the state in trust for its people.” The legislature cannot destroy the constitutional limits on its authority. This is especially true in Pennsylvania where the public trust doctrine is enshrined in the constitution. In short, Article I, Section 27 imposes a duty on the state of Pennsylvania to protect the state’s air – a duty that may not be abrogated by the legislature.

The Pennsylvania Department of Environmental Protection (DEP or Department) denied two earlier versions of this petition citing 35 P.S. §4004.2,¹ which prohibits the Environmental Quality Board (EQB) from adopting an ambient air quality standard for a

¹ The denial letter cited §4002.2(d) but we believe the letter was actually referring to §4004.2.

specific pollutant that is more stringent than an air quality standard adopted by the U.S. EPA. While the previous versions and this Petition have not and do not seek the imposition of an ambient air quality standard but rather reductions in carbon dioxide emissions that will meet Pennsylvania's obligation to seek safe atmospheric concentrations of carbon dioxide, DEP's prior reliance on statutory law was and is improper because the legislature cannot legislate away its public trust duty. Using 35 P.S. §4004.2 to deny this petition is unconstitutional as it is inconsistent with Pennsylvania's public trust obligations under Article I, Section 27.

The Pennsylvania Supreme Court has held that Article I, Section 27 of Pennsylvania's Constitution "is a declaration, not of the hope that the Legislature will sanction the rights therein reserved to the people, but that such rights are thereby 'recognized and unalterably established.'" *Commonwealth v. Gettysburg*, 8 Pa.Cmwlth. 231, 243 (1973). The Supreme Court went on to say that the rights declared in Article I remain "inviolable." *Id.*

In short, Article I, Section 27 gives the Pennsylvania Department of Environmental Protection all the authority it needs to protect Pennsylvania's air, even without legislative action. The DEP cannot rely on 35 P.S. §4004.2 to deny this petition, as that would be an unconstitutional application of the statute.

REQUEST FOR ADOPTION OF A RULE

Pursuant to the Pennsylvania State Constitution Article I, Section 20 "[t]he citizens have a right in a peaceable manner to assemble together for their common good, and to apply to those invested with the powers of government for redress of grievances or other proper purposes by petition..."² The petitioners, Ashley Funk and Kids vs Global Warming hereby submit this petition for rulemaking on behalf of themselves, the citizens of the State of Pennsylvania, and present and future generations of minor children. This petition conforms to the rules for petitioning under Pennsylvania Code Ch. 23.1 for the Environmental Quality Board, and uses the form for petitioning supplied by the Department of Environmental Protection.³ Pa. Code 23.1(a). In addition to the form, the first and second page of this substantive petition contain the petitioners' names, addresses, and telephone numbers. Pa. Code 23.1(a)(1). The paragraph following this one has a clear description of the action requested with suggested regulatory language. Pa. Code 23.1(a)(2)(i). Section IA and IB of this petition includes the reasons petitioners are requesting this action with the scientific and factual justifications supporting this request. Pa. Code 23.1(a)(3). Section IC contains the legal principles and justifications for this request. Pa. Code 23.1(a)(3). Finally, section ID includes the types of persons, businesses and organizations that will be affected by this regulation. Pa. Code 23.1(a)(4).

² Pa. Const. art. I, § 20.

³ Pa. Code 23.1, *Environmental Quality Board Policy for Processing Petitions – Statements of Policy*, available at http://www.pacode.com/secure/data/025/chapter23/025_0023.pdf (accessed on 7/20/2012)

Overview of the Proposed Rule

The petitioner respectfully requests that the Pennsylvania Environmental Quality Board promulgate a rule or rules that require the Department to take the following steps in order to protect the integrity of Pennsylvania's and the Earth's climate by ordering actions that will result in safe concentrations of carbon dioxide so as to adequately protect our atmosphere, a public trust resource upon which all Pennsylvanians rely for their health, safety, sustenance, and security. The rule(s) should be designed to achieve this general goal through the following means:

- (1) In connection with the work required by 71 P.S. § 1361.4 (the Pennsylvania Climate Change Act, Act 70), order the Department to determine the amount of carbon dioxide emitted in the Commonwealth by all fossil fuel burning sources in 2012, thereby establishing a Baseline CO₂ Emission Rate.
- (2) Order the Department to determine the amount of carbon dioxide emitted each year from all fossil fuel burning sources in the Commonwealth, thereby establishing an Annual CO₂ Emission Rate for that given year.
- (3) Order the Department to undertake all actions necessary to achieve at least a 6% reduction in the Annual CO₂ Emission Rate for 2013 compared to the Baseline Emission CO₂ Emission Rate, and then at least a 6% reduction in the Annual CO₂ Emission Rate each year compared to the Annual CO₂ Emission Rate for the previous year, through the year 2050. If the reduction is less than 6% for a given year, require the Department to undertake such further actions, including the imposition of greater reductions of CO₂, so that the total reductions of CO₂ emissions will return to the rate imposed by the regulation within 12 months.
- (4) Order the Department to certify the rate of reduction of the Annual CO₂ Emission Rate each year and to make the information used publicly available.*

This Petition does not seek nor would it require the imposition of an ambient air quality standard for carbon dioxide. Rather, it relies upon the best available science which strongly indicates that a program of 6% annual reductions of fossil fuel carbon dioxide emissions starting in 2013 through 2050 will achieve a "safe" concentration of carbon dioxide that will minimize the adverse impacts of climate change spelled out more fully in this Petition. However, time is of the essence for protecting the public trust resource of Pennsylvania's atmosphere. Delay in the imposition of these annual reductions would not only violate the Commonwealth's duties as public trustee, but it also would require even greater annual reductions in order to "catch up" on the path to a "safe" atmosphere.

* See App. I for suggested specific language of the proposed rule.

The Petitioner

Petitioner Ashley Funk resides in Southwestern Pennsylvania in the rural town of Mount Pleasant. Ashley, age 18, has been involved in environmental activism for over four years. Growing up, she has impacted her community by promoting environmental responsibility and health. After implementing a recycling program and anti-litter campaign in her town, Ashley has moved on to making Southwestern Pennsylvania and her nation aware of the larger scale environmental injustices of today. Ashley tells her story in the mini-documentary film *Stories of TRUST: Calling for Climate Recovery (TRUST Pennsylvania)*, attached to this petition.⁴

Living in the area that has been named the "Saudi Arabia of natural gas drilling", she wishes to educate people about the health hazards of practices such as Marcellus Shale hydro-fracturing. In her surrounding area, public health and water resources have been jeopardized by extracting these fossil fuels. In addition to the unsafe practice of hydro-fracking, Ashley wishes to bring an end to other harmful fossil fuel extraction practices such as mountain top removal coal mining. By implementing renewable energy technology across our nation, she believes that we can bring an end to the devastating effects of fossil-fuel extraction and climate change.

Living in Southwestern Pennsylvania, the effects of climate change have impacted her surrounding community. Extreme weather conditions have enveloped the area in the past few years. In the winters, Pennsylvania has been coping with extreme blizzards; in the summers, the area has encountered record high heat waves as well as a series of storms featuring high winds and tornadoes. Ashley believes that if climate change continues to progress, areas across the United States, including her hometown, will be forced to handle extreme weather conditions that worsen with time. Through research and experience, Ashley has recognized that our country's dependence on fossil fuels has dramatically impacted our economy, health, and environment. She believes that by working together, our nation can move forward into a future of sustainable energy. With Pennsylvania and the United States as leaders, nations around the world can work together to solve the energy and climate crisis with our progressing technological solutions. If our society does not adopt a sustainable future, she believes, climate change will continue to irreversibly destroy and disrupt the only planet we have to call home. In 2050, when the worst effects of climate change are projected to be seen, Ashley will be 56.

The petitioner, as a Pennsylvania youth, represents the youngest living generation of public trust beneficiaries, and have a profound interest in ensuring that the climate remains stable enough to ensure their rights to a livable future. A livable future includes the opportunity to drink clean water and abate thirst, to grow food that will abate hunger, to be free from imminent property damage caused by extreme weather events, and to enjoy the abundant and rich biodiversity on this small planet. The petitioner requests the

⁴ *TRUST Pennsylvania* is a part of this petition and should be preserved in all records of this action.

promulgation of the rule herein proposed in order to protect their interests in a livable future, and an inhabitable Pennsylvania.

I. **STATEMENT OF REASONS:** The EQB should grant this petition and promulgate the proposed rule for the following reasons:

A. THE SCIENCE UNEQUIVOCALLY SHOWS THAT ANTHROPOGENIC CLIMATE CHANGE IS OCCURRING AND IS THREATENING THE STABILITY OF THE GLOBAL CLIMATE.

1. According to the United States Global Change Research Program⁵, global warming is occurring and adversely impacting the Earth's climate.⁶ The present rate of global heating is occurring as a result of human activities that release heat-trapping greenhouse gases (GHGs) and intensify the Earth's natural greenhouse effect, at an accelerated rate, thereby changing Earth's climate.⁷ This abnormal climate change is unequivocally human-induced⁸, is occurring now, and will continue to occur unless drastic measures are taken to curtail it⁹. Climate change is damaging both natural and human systems, and if unrestrained, will alter the planet's

⁵ "The U.S. Global Change Research Program (USGCRP) coordinates and integrates federal research on changes in the environment and their implications for society." The organization's vision is to produce "[a] nation, globally engaged and guided by science, meeting the challenges of climate and global change." The organization is comprised of "[t]hirteen departments and agencies [that] participate in the USGCRP...steered by the Subcommittee on Global Change Research under the Committee on Environment and Natural Resources, overseen by the Executive Office of the President, and facilitated by an Integration and Coordination Office." <http://www.globalchange.gov/about>.

⁶ UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM (USGCRP), GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 13 (2009) available at <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf> [hereinafter *Global Climate Change Impacts*] ("Human activities have led to large increases in heat-trapping gases over the past century. Global average temperature and sea level have increased, and precipitation patterns have changed.").

⁷ *Id.* ("The global warming of the past 50 years is due primarily to human-induced increases in heat-trapping gases."); DEUTSCHE BANK GROUP CLIMATE CHANGE ADVISORS, CLIMATE CHANGE: ADDRESSING THE MAJOR SKEPTIC ARGUMENTS 9 (September 2010) available at

<http://www.dbcca.com/dbcca/EN/media/DBCCAColumbiaSkepticPaper090710.pdf>; Intergovernmental Panel on Climate Change (IPCC), *IPCC Fourth Assessment Report: Climate Change 2007 (AR4)*, 1.1 (2007) available at http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html#1-1.

⁸ USGCRP, *Global Climate Change Impacts* at 12 (2009).

⁹ *Id.* ("Future climate change and its impacts depend on choices made today."); IPCC, *AR4 1.1* (2007) ("Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.").

habitability.¹⁰

2. According to the United States Environmental Protection Agency (EPA), “[T]he case for finding that *greenhouse gases in the atmosphere endanger public health and welfare is compelling and, indeed, overwhelming.*”¹¹ The EPA further stated in April 2009 that “[t]he evidence points ineluctably to the conclusion that *climate change is upon us* as a result of greenhouse gas emissions, that *climate changes are already occurring that harm our health and welfare, and that the effects will only worsen over time in the absence of regulatory action.*”¹²
3. We human beings have benefited from living on a planet that has been remarkably hospitable to our existence and provided conditions that are just right for human life to expand and flourish.¹³ The Earth is a “Goldilocks” planet with an atmosphere that has fewer GHGs than that of Venus (which is too hot), and more than that of Mars (which is too cold), which is just perfect for the life that has developed on planet Earth.¹⁴
4. GHGs in the atmosphere act like a blanket over the Earth to trap the heat that it receives from the sun.¹⁵ More GHGs in the atmosphere means that more heat is being retained on Earth, with less heat radiating back out into space.¹⁶ Without this greenhouse effect, the average surface temperature of our planet would be 0°F (-18°C) instead of 59°F (15°C).¹⁷ Scientists have understood this basic mechanism of global warming since the late-nineteenth century.¹⁸

¹⁰ USGCRP, *Global Climate Change Impacts* at 12 (2009) (“Thresholds will be crossed, leading to large changes in climate and ecosystems.”).

¹¹ Proposed Endangerment Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 18886, 18904 (April 24, 2009)(to be codified in 40 C.F.R. Chapter 1) (emphasis added).

¹² *Id.*

¹³ John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN 11, 15-22 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007) (“The earth’s climate system can be thought of as an elaborate balancing act of energy, water, and chemistry involving the atmosphere, oceans, ice masses, biosphere, and land surface.”).

¹⁴ JAMES HANSEN, STORMS OF MY GRANDCHILDREN 224-225 (2009); See John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN at 23.

¹⁵ John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN at 22.

¹⁶ *Id.* at 16-17.

¹⁷ *Id.* at 17.

¹⁸ See *id.* at 35 (describing the efforts of Swedish chemist Svante Arrhenius).

5. Human beings have significantly altered the chemical composition of the Earth's atmosphere and its climate system.¹⁹ We have changed the atmosphere and Earth's climate system by engaging in activities that produce, or release GHGs in to the atmosphere.²⁰ Carbon dioxide (CO₂) is the key GHG, and there is evidence that its emissions are largely responsible for the current warming trend.²¹ Although much of the excess carbon dioxide is absorbed by the oceans, plants and forests, the increase of GHG concentrations resulting from historic and present human activities has altered the Earth's ability to maintain the delicate balance of energy between that which it receives from the sun and that which it radiates back out into space.²²
6. The current CO₂ concentration in our atmosphere is over 390 ppm²³ (compared to the pre-industrial concentration of 280 ppm) and is quickly approaching the dangerous level of 400 ppm.²⁴ Current atmospheric GHG concentrations are likely the highest they have been in the last 800,000 years.²⁵

¹⁹ Naomi Oreskes, *The Scientific Consensus on Climate Change*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN 65, 93 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007) (“We have changed the chemistry of our atmosphere, causing sea level to rise, ice to melt, and climate to change. There is no reason to think otherwise.”).

²⁰ *Id.*

²¹ See James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. 217, 217-231 (2008).

²² John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN 11, 15-22 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007).

²³ NOAA, Atmospheric CO₂: Monthly & Annual Mean CO₂ Concentrations (ppm), March 1958 – Present, available at <http://co2now.org/Current-CO2/CO2-Now/Current-Data-for-Atmospheric-CO2.html> (showing an annual mean atmospheric CO₂ concentration of 391.57 for the year 2011).

²⁴ IPCC, *AR4* at 37 (“The global atmospheric concentration of CO₂ increased from a pre-industrial value of about 280ppm to 379ppm in 2005.”); National Science and Technology Council, *Scientific Assessment of the Effects of Global Change on the United States 2* (May 2008) [hereinafter *Scientific Assessment*], available at <http://www.climate-science.gov/Library/scientific-assessment/Scientific-AssessmentFINAL.pdf> (“The globally averaged concentration of carbon dioxide in the atmosphere has increased from about 280 parts per million (ppm) in the 18th century to 383 ppm in 2007.”); Environmental Protection Agency (EPA), *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act 17* (December 9 2009) [hereinafter *TS Endangerment Findings*].

²⁵ Dieter Lüthi et al., *High-resolution carbon dioxide concentration record 650,000-800,000 years before present* 453 *Nature* 379, 379-382 (May 2008) available at <http://www.nature.com/nature/journal/v453/n7193/full/nature06949.html> (prior to this

7. Concentrations of other GHGs in the atmosphere have also increased from human activities. Atmospheric concentrations of methane, for example, have increased nearly 150% since the pre-industrial period.²⁶ Concentrations of nitrous oxide have also increased.²⁷
8. Humans not only continue to add GHGs into the atmosphere at a rate that outpaces their removal through natural processes,²⁸ but the current and projected CO₂ increase, for example, is about one hundred times faster than has occurred over the past 800,000 years.²⁹ This increase has to be considered in light of the lifetime of greenhouse gases in the atmosphere. In particular, a substantial portion of every ton of CO₂ emitted by humans persists in the atmosphere for as long as a millennium or more.³⁰ The current concentrations of GHGs in the atmosphere therefore, are the result of both historic and current emissions.
9. According to the EPA, in 2009, Pennsylvania was responsible for emitting 243.37 metric million tons of CO₂ from fossil fuel combustion.³¹ Only five percent of that

publication it was accepted atmospheric CO₂ record extended back 650,000 years, but now research indicates that the record can be extended 800,000 years, or two complete glacial cycles).

²⁶ EPA, *TS Endangerment Findings* at 18 (“The global atmospheric concentration of methane has increased from a pre-industrial value of about 715 parts per billion (ppb) to 1732 ppb in the early 1990s, and was 1782 ppb in 2007- a 149% increase from pre-industrial levels.”).

²⁷ *Id.* at 19.

²⁸ *Id.* at ES-2 (“Atmospheric GHG concentrations have been increasing because anthropogenic emissions have been outpacing the rate at which GHGs are removed from the atmosphere by natural processes over timescales of decades to centuries.”).

²⁹ Dieter Lüthi et al., *High-resolution carbon dioxide concentration record 650,000-800,000 years before present* 453 *Nature* 379, 379-382 (May 2008) available at <http://www.nature.com/nature/journal/v453/n7193/full/nature06949.html>.

³⁰ James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 *OPEN ATMOS. SCI.* 217, 220 (2008); See also EPA, *TS Endangerment Findings* at 16 (“Carbon cycle models indicate that for a pulse of CO₂ emissions, given an equilibrium background, 50% of the atmospheric increase will disappear within 30 years, 30% within a few centuries, and the last 20% may remain in the atmosphere for thousands of years.”); John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in *CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN* 11, 29 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007) (“Since CO₂ has a lifetime of over one hundred years, these emissions have been collecting for many years in the atmosphere.”).

³¹ *CO₂ Emissions from Fossil Fuel Combustion – Million /metric Tons CO₂ (MMTCO₂)* http://www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2009.pdf See also *Greenhouse Gas Emissions in the Mid-Atlantic Region*, (Jan. 21, 2012) <http://www.epa.gov/reg3artd/globclimate/ccghg.html#Total Emissions>

carbon is sequestered by the states private and public forests annually.³² Pennsylvania is the third largest CO₂ emitter after Texas and California.³³ At 22.96 metric tons per year, Pennsylvania's per capita emissions were higher than the national average of 21 metric tons per year in 2007.³⁴ Pennsylvania's emissions are projected to increase through 2020 based on historical data through 2005.³⁵

10. One key observable change is the rapid increase in recorded global surface temperatures.³⁶ As a result of increased atmospheric GHGs from human activities, based on fundamental scientific principles, the Earth has been warming as scientists have predicted.³⁷ The increased concentrations of greenhouse gases in our atmosphere, primarily CO₂,³⁸ have raised global surface temperature by 1.4°F (0.8°C) in the last one hundred to one hundred fifty years.³⁹ In the last thirty years, the acceleration of change has intensified as the Earth has been warming at a rate three times faster than that over the previous one hundred years.⁴⁰

³² *Carbon Sequestration*, Pennsylvania Department of Conservation and Natural Resources, <http://www.dcnr.state.pa.us/info/carbon/index.aspx>

³³ *CO₂ Emissions from Fossil Fuel Combustion – Million /metric Tons CO₂ (MMTCO₂)* http://www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2009.pdf

³⁴ Daniel J. Wiess, *The Clean and Clear Winners*, Center for American Progress (October 23, 2008) http://www.americanprogress.org/issues/2008/10/emissions_interactive.html

³⁵ *Inventory and Projections of GHG Emissions*, Pennsylvania Department of Environmental Protection, available at <http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-77715/06%20Chapter%203%20I&F.pdf>

³⁶ National Science and Technology Council, *Scientific Assessment* at 51; IPCC, *AR4* at 30; USGCRP, *Global Climate Change Impacts* at 19; EPA, *TS Endangerment Findings* 26-30; National Aeronautics and Space Administration (NASA) & Goddard Institute for Space Studies (GISS), *Global Surface Temperature*, <http://climate.nasa.gov/keyIndicators/#globalTemp> (illustrating the change in global surface temperatures) (last visited April 7, 2011).

³⁷ IPCC, *AR4* at 39; USGCRP, *Global Climate Change Impacts* at 13; EPA, *TS Endangerment Findings* at 48.

³⁸ EPA, *Climate Change – Science*, available at <http://epa.gov/climatechange/science/index.html> (August 19, 2010) (last visited April 7, 2011); EPA, *TS Endangerment Findings* at ES-1-2.

³⁹ EPA, *TS Endangerment Findings* at ES-2 (“Global mean surface temperatures have risen by 1.3 ± 0.32°F (0.74°C ± 0.18°C) over the last 100 years.”); See J. Hansen et al., NASA & GISS, *Global Surface Temperature Change* (August 3, 2010); NASA, *Climate Change: Key Indicators*, <http://climate.nasa.gov/keyIndicators> (last visited April 7, 2011); John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN 11, 15-22 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007).

⁴⁰ EPA, *TS Endangerment Findings* at 32 (“U.S. average annual temperatures (for the

11. Because of year-to-year variations in these thermometer readings, as with daily readings, scientists compare temperature differences over a decade to determine patterns.⁴¹ Employing this decadal scale, the surface of the planet has warmed at a rate of roughly 0.3 to 0.4°F (0.15 to 0.2°C) per decade since the late 1970s.⁴² Global mean surface temperature has been decidedly higher during the last few decades of the twentieth century than at any time during the preceding four centuries.⁴³ Global surface temperatures have been rising dramatically since 1951, and 2010 tied for the hottest year on record.⁴⁴
12. The dramatic increase of the average global surface temperature is alarming. By comparison, the global surface temperature during the last Ice Age was about 9°F (5°C) cooler than today.⁴⁵ It has become quite clear that the past several decades present an anomaly, as global surface temperatures are registering higher than at any point in the past 400 years (and for the Northern Hemisphere the past 1,000 years).⁴⁶
13. The IPCC has observed that “[w]arming of the climate system is unequivocal”.⁴⁷ The United States EPA has recognized the scientific consensus that has developed on the fact of global warming and its cause; that the Earth is heating up due to

contiguous United States or lower 48 states) are now approximately 1.25°F (0.69°C) warmer than at the start of the 20th century, with an increased rate of warming over the past 30 years. The rate of warming for the entire period of record (1901–2008) is 0.13°F (0.072°C) per decade while the rate of warming increased to 0.58°F (0.32°C) per decade for the period 1979–2008.”); USGCRP, *Global Climate Change Impacts* at 9.

⁴¹ IPCC, *AR4* at 40.

⁴² See NASA, *Climate Change: Key Indicators, Global Land-Ocean Temperature Index*, <http://climate.nasa.gov/keyIndicators/#globalTemp> (last visited April 7, 2011).

⁴³ The National Academies Press (Board on Atmospheric Sciences and Climate), *Surface Temperature Reconstructions for the Last 2,000 Years* 3 (2006), available at http://www.nap.edu/catalog.php?record_id=11676.

⁴⁴ NASA, *Global Climate Change – Global Surface Temperature*, <http://climate.nasa.gov/keyIndicators/index.cfm#globalTemp> (last visited April 10, 2011) (“Global surface temperatures in 2010 tied 2005 as the warmest on record.”); NASA, *Global Climate Change*, <http://climate.nasa.gov/> (last visited April 10, 2011) (“January 2000 to December 2009 was the warmest decade on record.”).

⁴⁵ James E. Hansen & Makiko Sato, *Paleoclimate Implications for Human-Made Climate Change* 5 (January 18, 2011), available at http://www.columbia.edu/~jeh1/mailings/2011/20110118_MilankovicPaper.pdf (last visited April 10, 2011).

⁴⁶ USGCRP, *Global Climate Change Impacts* at 19.

⁴⁷ IPCC, *Summary for Policymakers*, in *CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE*, at 1, 3, 22, 31 (S. Solomon et al. eds. 2007).

human activities.⁴⁸

14. Changes in many different aspects of Earth's climate system over the past century are consistent with this warming trend: based on straightforward scientific principles, human-induced GHG increases lead not only to warming of land surfaces⁴⁹, but also to the warming of oceans⁵⁰, increased atmospheric moisture levels⁵¹, rises in the global sea level⁵², and changes in rainfall⁵³ and atmospheric air circulation patterns that affect water and heat distribution.⁵⁴
15. As expected (and consistent with the temperature increases in land surfaces), ocean temperatures have also increased.⁵⁵ This has led to changes in the ocean's ability to circulate heat around the globe; which can have catastrophic implications for the global climate system.⁵⁶ The average temperature of the global ocean has increased significantly despite its amazing ability to absorb enormous amounts of heat before exhibiting any signs.⁵⁷ In addition, the most significant indicator of the planet's energy imbalance due to human-induced GHG increases, is the long-term increase in global average ocean heat content over the last 50 years, extending down to several thousand meters below the ocean surface.⁵⁸
16. As predicted, precipitation patterns have changed due to increases in atmospheric moisture levels and changes in atmospheric air circulation patterns; just another indicator that the Earth is warming.⁵⁹ As the Earth warms, moisture levels are expected to increase when temperature increases because warmer air generally

⁴⁸ EPA, *TS Endangerment Findings* at ES-2 ("Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. ... Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in *anthropogenic* GHG concentrations.") (emphasis added).

⁴⁹ IPCC, *AR4* at 30.

⁵⁰ *Id.* at 72.

⁵¹ USGCRP, *Global Climate Change Impacts* at 18; B.D Santer et al., *Identification of human-induced changes in atmospheric moisture content*, 104 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, 15248, 15248-15253 (September 25, 2007).

⁵² IPCC, *AR4* at 30.

⁵³ USGCRP, *Global Climate Change Impacts* at 18, 44.

⁵⁴ *Id.* at 42.

⁵⁵ IPCC, *AR4* at 30; EPA, *TS Endangerment Findings* at ES-2.

⁵⁶ USGCRP, *Global Climate Change Impacts* at 26.

⁵⁷ UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP), CLIMATE CHANGE SCIENCE COMPENDIUM 2009 at 26 (UNEP/Earthprint, 2009).

⁵⁸ S. Levitus et al., *Global ocean heat content 1955-2008 in light of recently revealed instrumentation problems* 36 J. GEOPHYSICAL RES. LETTERS L07608 (April 2009).

⁵⁹ USGCRP, *Global Climate Change Impacts* at 13, 17, 21, 36, 42, 74.

holds more moisture.⁶⁰ In more arid regions, however, higher temperatures lead to greater evaporation.⁶¹

17. These changes in the Earth's water cycle increase the potential for, and severity of, severe storms, flooding and droughts.⁶² Storm-prone areas are already experiencing a greater chance of severe storms, and this will continue.⁶³ Even in arid regions, increased precipitation is likely to cause flash flooding, and will be followed by drought.⁶⁴
18. These changes are already occurring: Droughts in parts of the midwestern, southeastern, and southwestern United States have increased in frequency and severity within the last fifty years, coincident with rising temperatures.⁶⁵ In 2009, more than half of the United States received above normal precipitation; yet the southwestern United States (Arizona in particular) had one of its driest periods.⁶⁶
19. Based on the laws of physics and the past climate record, scientists have concluded that precipitation events will increase globally, particularly in tropical and high latitude regions, while decreasing in subtropical and mid-latitude regions,⁶⁷ with longer periods between normal heavy rainfalls.⁶⁸
20. Other changes consistent with climate modeling resulting from global warming have been observed not just in the amount, intensity, and frequency of precipitation but also in the type of precipitation.⁶⁹ In higher altitude and latitude regions, including in mountainous areas, more precipitation is falling as rain rather than snow.⁷⁰ With early snow melt occurring because of climate change, the reduction in snowpack can aggravate water supply problems.⁷¹ In Northern Europe and the northeastern United States, a change in air currents -- caused by the warming Arctic -- brought severe snowstorms during the winters of 2009-2010 and 2010-2011.⁷²

⁶⁰ EPA, *TS Endangerment Findings* at 111.

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.* at 120-121; USGCRP, *Global Climate Change Impacts* at 27.

⁶⁴ EPA, *TS Endangerment Findings* at 115.

⁶⁵ *Id.* at 145, 143, 148.

⁶⁶ *State of the Climate, 2009* at S138.

⁶⁷ EPA, *TS Endangerment Findings* at ES-4, 74.

⁶⁸ EPA, *TS Endangerment Findings* at 74.

⁶⁹ *Id.* at ES-2.

⁷⁰ USGCRP, *Global Climate Change Impacts* at 18, 45.

⁷¹ *Id.* at 33

⁷² NOAA, *Arctic Report Card: Update for 2010*, (December 10, 2010) (last visited April 7, 2011) <http://www.arctic.noaa.gov/reportcard/atmosphere.html>; NOAA, *The Future of Arctic Sea Ice and Global Impacts*,

21. As expected global sea levels have also risen.⁷³ Sea levels have been rising at an average rate of 3.1 millimeters per year based on measurements from 1993 to 2003.⁷⁴ Though sea levels rose about 6.7 inches over the last century; within the last decade, that rate has nearly *doubled*.⁷⁵ Rising seas, brought about by melting of polar icecaps and glaciers, as well as by thermal expansion of the warming oceans, will cause flooding in coastal and low-lying areas.⁷⁶ The combination of rising sea levels and more severe storms creates conditions conducive to severe storm surges during high tides.⁷⁷ In coastal communities this can overwhelm coastal defenses (such as levees and sea walls), as witnessed during Hurricane Katrina.⁷⁸
22. Sea level is not uniform across the globe, because it depends on variables such as ocean temperature and currents.⁷⁹ Unsurprisingly, the most vulnerable lands are low-lying islands, river deltas, and areas that already lie below sea level because of land subsidence.⁸⁰ Based on these factors, scientists have concluded that the threats to the United States from rising seas are the most severe on the Gulf and Atlantic Coasts.⁸¹ Worldwide, hundreds of millions of people live in river deltas and vulnerable coastlines along the southern and western coasts of Asia where rivers draining the Himalayas flow into the Indian and Pacific Oceans.⁸²
23. In a comprehensive review of studies on sea level rise in the 21st century published by the British Royal Society, researchers estimated the probable sea level rise for

http://www.arctic.noaa.gov/future/index_impacts.html#event; See also Climate Science Watch, *Climatologist Ben Santer on the attribution of extreme weather events to climate change*, (December 29, 2010) (last visited April 9, 2011) <http://climateprogress.org/2010/12/29/ben-santer-attribution-extreme-weather-events-to-climate-change/#more>.

⁷³ USGCRP, *Global Climate Change Impacts*, at 9; EPA, *TS Endangerment Findings* at ES-3; IPCC, *AR4* at 30.

⁷⁴ IPCC, *AR4* at 30.

⁷⁵ NASA, *Climate Change: How Do We Know?, Sea Level Rise* (last visited April 9, 2011) <http://climate.nasa.gov/evidence/#no4> (citing J.A. Church & N.J. White, *A 20th Century Acceleration in Global Sea Level Rise* (2006) 33 *Geophysical Research Letters*, L01602, doi: 10.1029/2005GL024826).

⁷⁶ EPA, *TS Endangerment Findings* at ES-7; USGCRP, *Global Climate Change Impacts* at 62-63.

⁷⁷ USGCRP, *Global Climate Change Impacts* at 109; EPA, *TS Endangerment Findings* at 75.

⁷⁸ EPA, *TS Endangerment Findings* at 86, 118.

⁷⁹ USGCRP, *Global Climate Change Impacts* at 25-26, 37.

⁸⁰ EPA, *TS Endangerment Findings* at 121.

⁸¹ *Id.* at 128; USGCRP, *Global Climate Change Impacts* at 57.

⁸² EPA, *TS Endangerment Findings* at 159; IPCC, *AR4* at 52.

this century between .5 and 2 meters (1 ½ to 6 ½ feet), continuing to rise for several centuries after that, depending on future CO₂ levels and the behavior of polar ice sheets.⁸³

24. The IPCC estimates a 0.6-meter rise in sea level by 2100 under a worst-case scenario that does not include contributions from the accelerated flow of major ice sheets.⁸⁴ Some scientists predict a 2-meter rise in sea level by 2100 if present trends continue.⁸⁵ “Today, rising sea levels are submerging low-lying lands, eroding beaches, converting wetlands to open water, exacerbating coastal flooding, and increasing the salinity of estuaries and freshwater aquifers.”⁸⁶ The impacts of rising sea levels can be seen in many coastal locations across the nation; along the Florida coast for instance, sea level is rising about 1 inch every 11-14 years.⁸⁷ This seemingly small rise in ocean levels is contributing to massive erosion, causing many homeowners to remove beachfront property, and has led to a decline in the recreational value of beaches.⁸⁸ Other coastal states (such as Maryland and Louisiana) are also experiencing wetland loss due to rising sea levels.⁸⁹ Scientists have predicted that wetlands in the Mid-Atlantic region of the United States cannot withstand a 7-millimeter per year rise in sea levels.⁹⁰

25. As expected, mountain glaciers, which are the source of freshwater for hundreds of millions of people, are receding worldwide because of warming temperatures.⁹¹ Today, Glacier National Park in Montana has twenty-five glaciers larger than twenty-five acres, down from one hundred and fifty in 1850.⁹² The year 2009

⁸³ R.J. Nicholls et al., *Sea-level rise and its possible impacts given a ‘beyond 4°C world’ in the twenty-first century*, PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY 161-181, 168 (2011).

⁸⁴ IPCC, *AR4* at 45.

⁸⁵ M. Vermeer & S. Rahmstorf, *Global Sea Level Linked to Global Temperature*, 106 PROC. NATL. ACAD. SCI. 21527, 21531 (2009).

⁸⁶ USCCSP, *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region* [hereinafter *Coastal Sensitivity to Sea-Level Rise*] 2 (Jan. 2009), available at http://www.epa.gov/climatechange/effects/coastal/pdfs/ccsp_front.pdf.

⁸⁷ EPA, *Saving Florida’s Vanishing Shores* (March 2002) available at http://www.epa.gov/climatechange/effects/coastal/saving_FL.pdf.

⁸⁸ *Id.*

⁸⁹ USCCSP, *Coastal Sensitivity to Sea-Level Rise* at 3-4.

⁹⁰ *Id.* at 4.

⁹¹ See *TS Endangerment Findings* at 111 (“Glaciers throughout North America are melting, and the particularly rapid retreat of Alaskan glaciers represents about half of the estimated loss of glacial mass worldwide.”).

⁹² United States Geological Survey (Northern Rocky Mountain Science Center), *Retreat of Glaciers in Glacier National Park* (June 2010), http://www.nrmcs.usgs.gov/research/glacier_retreat.htm.

marked the 19th consecutive year in which glaciers lost mass.⁹³ Mountain glaciers are in retreat all over the world, including Mt. Kilimanjaro in Africa, the Himalayas, the Alps (99% in retreat), the glaciers of Peru and Chile (92% in retreat), and in the United States.⁹⁴ In the Brooks Range of northern Alaska, all of the glaciers are in retreat and in southeastern Alaska 98% are in retreat.⁹⁵

26. Although a minor contribution to sea level rise, the melting of mountain glaciers is particularly serious in areas that rely on snow melt for irrigation and drinking water supply.⁹⁶ In effect, a large snow pack or glacier acts as a supplemental reservoir or water tower, holding a great deal of water in the form of ice and snow through the winter and spring and releasing it in the summer when rainfall is lower or absent.⁹⁷ The water systems of the western United States (particularly in California) and the Andean nations of Peru and Chile, among other places, all heavily rely on these natural forms of water storage.⁹⁸ In addition to providing a more reliable water supply, the storing of precipitation as ice and snow helps moderate potential flooding.⁹⁹
27. Yet as temperatures warm, not only will these areas lose this supplemental form of water storage, but also severe flooding is likely to increase (because when rain falls on snow, it accelerates the melting of glaciers and snow packs).¹⁰⁰ Ice is melting most dramatically at the poles.¹⁰¹ Sea ice in the Arctic oceans is expected to decrease and may even disappear entirely in coming decades.¹⁰²

⁹³ National Oceanic and Atmospheric (NOAA), *State of the Climate in 2009*, 91 BULL. AMER. METEOR. SOC. at S13 (2010).

⁹⁴ L. Thompson, *Climate Change: The Evidence and Our Options*, 33 THE BEHAVIOR ANALYST No. 2 (Fall) 153, 155-160 (2010); USGRCP, *Global Climate Change Impacts* at 18.

⁹⁵ L. Thompson, *Climate Change: The Evidence and Our Options*, 33 THE BEHAVIOR ANALYST No. 2 (Fall) 153, 158 (2010).

⁹⁶ IPCC, *AR4* at 49.

⁹⁷ See L. Thompson, *Climate Change: The Evidence and Our Options*, 33 THE BEHAVIOR ANALYST No. 2 (Fall) 153, 164 (2010).

⁹⁸ See *Id.* at 155 – 160, 164.

⁹⁹ EPA, *TS Endangerment Findings* at 111; USGRCP, *Global Climate Change Impacts* at 64.

¹⁰⁰ EPA, *TS Endangerment Findings* at 111.

¹⁰¹ L. Thompson, *Climate Change: The Evidence and Our Options*, 33 THE BEHAVIOR ANALYST No. 2 (Fall) 153, 160 (2010) (“[P]olar ice sheets are slower to respond to temperature rise than the smaller mountain glaciers, but they too, are melting. . . . The loss of ice in the Arctic and Antarctic regions is especially troubling because these are the locations of the largest ice sheets in the world.”).

¹⁰² EPA, *TS Endangerment Findings* at 120; USGRCP, *Global Climate Change Impacts* at 20-21 (“Studies published after the appearance of the IPCC Fourth Assessment Report in 2007 have also found human fingerprints in the increased levels of atmospheric moisture (both close to the surface and over the full extent of the atmosphere), in the

28. Beginning in late 2000, the Jakobshavn Isbrae Glacier (which has a major influence over the mass of the Greenland ice sheet), lost significant amounts of ice.¹⁰³ In August of 2010, an enormous iceberg (roughly ninety-seven square miles in size) broke off from Greenland.¹⁰⁴ Nine Antarctic ice shelves have also collapsed into icebergs in the last fifty years, (six of them since 1996).¹⁰⁵ An ice shelf roughly the size of Rhode Island collapsed in 2002, and an ice bridge collapsed in 2009, leaving an ice shelf the size of Jamaica on the verge of shearing off.¹⁰⁶ The 2002 collapse of the Larsen Ice Shelf, which had existed for at least 11,000 years, was “unprecedented in respect to both area and time.”¹⁰⁷ The “sudden and complete disintegration” of the Larsen Ice Shelf took a *mere 35 days*.¹⁰⁸
29. During the 2007-melt season, the extent of Arctic sea ice (frozen ocean water) declined precipitously to its lowest level since satellite measurements began in 1979.¹⁰⁹ By the end of 2010 Arctic sea ice was at the lowest level in the satellite record for the month of December.¹¹⁰
30. Arctic sea ice plays an important role in stabilizing the global climate, because it

decline of Arctic sea ice extent, and in the patterns of change in Arctic and Antarctic surface temperatures.”).

¹⁰³ GARY BRAASCH & BILL MCKIBBEN, *EARTH UNDER FIRE* 18-20 (2009); *See also* J.E. Box et. al., (NOAA) *Greenland*, ARCTIC REPORT CARD at 55 (Oct. 2010) (“A clear pattern of exceptional and record-setting warm air temperatures is evident at long-term meteorological stations around Greenland.”).

¹⁰⁴ NASA Earth Observatory, *Ice Island Calves Off Petermann Glacier* (Aug. 2010), <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=45112&src=eorss-nh>.

¹⁰⁵ Alister Doyle, *Antarctic Ice Shelf Set to Collapse Due to Warming*, Reuters (Jan. 19, 2009) <http://www.reuters.com/article/idUSTRE50I4G520090119>.

¹⁰⁶ NASA Earth Observatory, *Wilkins Ice Bridge Collapse* (April 2009), <http://earthobservatory.nasa.gov/IOTD/view.php?id=37806>.

¹⁰⁷ U.S. Geological Survey, *Coastal-Change and Glaciological Map of the Larsen Ice Shelf Area, Antarctica: 1940-2005* at 10 (2008)

<http://pubs.usgs.gov/imap/2600/B/Larsenpamphletf2600B.pdf>

¹⁰⁸ *Id.* at 10.

¹⁰⁹ National Snow and Ice Data Center (NSIDC), Press Release, *Arctic Sea Ice Shatters All Previous Record Lows* (October 1, 2007),

http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html (last visited April 9, 2011); EPA, *TS Endangerment Findings* at 27 (“Average arctic temperatures increased at almost twice the global average rate in the past 100 years.”).

¹¹⁰ NSIDC, *Repeat of a negative Arctic Oscillation leads to warm Arctic, low sea ice extent*, ARCTIC SEA ICE NEWS & ANALYSIS, (January 5, 2011), <http://nsidc.org/arcticseaicenews/2011/010511.html> (last visited April 9, 2011).

reflects back in to space much of the solar radiation that the region receives.¹¹¹ In contrast, open ocean water absorbs much more heat from the sun, thus, amplifying human-induced warming and creating an increased global warming effect.¹¹² As arctic sea ice decreases the region is less capable of stabilizing the global climate and may act as a feedback loop (thereby aggravating global warming).¹¹³

31. Scientists have also documented an overall trend of sea-ice thinning.¹¹⁴ The year 2010 also marked a record-low, spring snow cover in the Arctic since satellite observations first began in 1966.¹¹⁵
32. Similarly, there has been a general increase in permafrost temperatures and permafrost melting in Alaska and other parts of the Arctic (particularly in the last five years).¹¹⁶ Scientists in Eastern Siberia and Canada have documented substantial methane releases as the permafrost melts.¹¹⁷ Because much of the Arctic permafrost overlays old peat bogs, scientists believe (and are concerned) that the melting of the permafrost¹¹⁸ may release methane that will further increase global warming to even more dangerous levels.¹¹⁹
33. Changes in these different aspects of Earth's climate system over the last century tell a coherent story: the impacts we see today are consistent with the scientific understanding of how the climate system should respond to GHG increases from human activities and how the Earth has responded in the past (reflected in such evidence as: ice cores that have trapped air from thousands and even a few million years ago, tree rings and seabed sediments that show where sea level was thousands and even millions of years ago).¹²⁰ Collectively, these changes cannot be explained as the product of natural climate variability or a tilt in the Earth's axis

¹¹¹ EPA, *Climate Change Indicators in the United States*, 45 (2010), available at http://www.epa.gov/climatechange/indicators/pdfs/ClimateIndicators_full.pdf [hereinafter *Climate Change Indicators*]; See also EPA, *TS Endangerment Findings* at 40.

¹¹² EPA, *Climate Change Indicators* 52 (2010); USGCRP, *Global Climate Change Impacts* at 39.

¹¹³ EPA, *Climate Change Indicators* 46 (2010).

¹¹⁴ NOAA, *State of the Climate in 2009* at S114.

¹¹⁵ NOAA, *Land*, ARCTIC REPORT CARD 29 (Oct. 2010), available at http://www.arctic.noaa.gov/reportcard/ArcticReportCard_full_report.pdf.

¹¹⁶ *Id.*

¹¹⁷ NOAA, *State of the Climate in 2009* at S116.

¹¹⁸ USGCRP, *Global Climate Change Impacts* at 139, 142 ("The higher temperatures are already contributing to . . . permafrost warming.").

¹¹⁹ See IPCC, 4.4.6 *Tundra and Arctic/Antarctic Ecosystems*, CLIMATE CHANGE 2007: FOURTH ASSESSMENT REPORT, WORKING GROUP II, IMPACTS, ADAPTATION, AND VULNERABILITY 231 (2007).

¹²⁰ USGCRP, *Global Climate Change Impacts* at 26.

alone.¹²¹ A large human contribution provides the best explanation of observed climate changes.¹²²

34. These well-documented and observable impacts from the changes in Earth's climate system highlight that the current level of atmospheric CO₂ concentration has already taken the planet into a danger zone.¹²³ The Earth will continue to warm in reaction to concentrations of CO₂ from past emissions as well as future emissions.¹²⁴ Warming already in the pipeline is mostly attributable to climate mechanisms that slowly heat the Earth's climate system in response to atmospheric CO₂.¹²⁵
35. The Earth's oceans play a significant role in keeping our atmospheric climate in the safe-zone.¹²⁶ The oceans constantly absorb CO₂ and release it back into the atmosphere at rates that maintain a balance.¹²⁷ Because we now release so much CO₂, the oceans have absorbed about one-third of the CO₂ emitted from human activity over the past two centuries.¹²⁸ This capacity has slowed global warming, but at a cost: the added CO₂ has changed the chemistry of the oceans, causing the oceans' average surface pH (a measurement of hydrogen ions) to drop by an average of .11 units.¹²⁹ Although this may seem relatively small, the pH scale is logarithmic, so that a reduction of only one unit means that the solution has in fact become ten times more acidic.¹³⁰ A drop of .1 pH units means that the concentration of hydrogen ions in seawater has gone up by 30% in the past two centuries.¹³¹ If CO₂ levels continue to rise to 500 ppm, we could see a further drop of .3 pH units by 2100.¹³²
36. Ocean acidification harms animals that use calcium to build their shells, as well as

¹²¹ *Id.*

¹²² Susan Solomon et al., *Irreversible climate change due to carbon dioxide emissions*, 106 PNAS 1704, 1704 – 1709 (Feb. 10, 2009), available at www.pnas.org/cgi/doi/10.1073/pnas.0812721106 (last visited April 9, 2011).

¹²³ USGCRP, *Global Climate Change Impacts* at 23.

¹²⁴ EPA, *TS Endangerment Findings* at 26.

¹²⁵ FRED PEARCE, WITH SPEED AND VIOLENCE: WHY SCIENTISTS FEAR TIPPING POINTS IN CLIMATE CHANGE 101-104 (Beacon Press 2007); IPCC, *AR4* at 72.

¹²⁶ See EPA, *TS Endangerment Findings* at 16, 38.

¹²⁷ IPCC, *AR4* at 72.

¹²⁸ Inter-Agency Report, *Impacts of Ocean Acidification* at 1; See also *TS Endangerment Findings* at 38 (“[T]he total inorganic carbon content of the oceans increased by 118 ± 19 gigatonnes of carbon (GtC) between 1750 and 1994 and continues to increase.”).

¹²⁹ EPA, *TS Endangerment Findings* at 38; Inter-Agency Report, *Impacts of Ocean Acidification* at 1.

¹³⁰ HARVEY BLATT, AMERICA'S ENVIRONMENTAL REPORT CARD 158 (MIT Press 2005).

¹³¹ A. Ridgwell & D. Schmidt, *Past constraints on the vulnerability of marine calcifiers to massive carbon dioxide release*, 3 NATURE GEOSCIENCE 196, 196-200 (2010).

¹³² IPCC, *AR4* at 52.

single-celled organisms that are an essential part of the marine food chain.¹³³ This is because the acidified waters affect the structural integrity and survival of shell-building marine organisms such as corals and shellfish by effectively robbing them of the key chemical (carbonate ion) they need to build their skeletons.¹³⁴ It also adversely impacts some kinds of algae and single-celled organisms that use calcification processes for survival.¹³⁵ Some of these organisms comprise magnificent natural features, such as the White Cliffs of Dover.¹³⁶ Coral reefs are major habitats for ocean fauna; and calcifying algae and plankton are key components of the marine food chain.¹³⁷

37. About 55 million years ago, the ocean absorbed a large amount of CO₂, likely due to a release of methane from the ocean floor that caused the Earth's temperatures to rise several degrees and led to the extinction of many species worldwide.¹³⁸ The absorption of so much CO₂ also led to the death of calcifying organisms on the seafloor.¹³⁹ It took over 100,000 years for the ocean to regain its normal alkalinity.¹⁴⁰ The current level of CO₂ being taken in by the ocean decreases the ability of coral and other calcium-based marine life to produce their skeletons, which affects the growing of coral and thus coral reefs.¹⁴¹ Other marine life, such as algae, also exhibit a reduced growing ability.¹⁴² Thus, ocean acidification can disrupt the food chain, give non-calcium based creatures a competitive advantage, and limit the geographic reach of calcium based creatures.¹⁴³ In experiments, "[c]oral reef organisms have not demonstrated an ability to adapt to decreasing carbonate saturation state."¹⁴⁴ Finally, this disruption to the food web "could substantially alter the biodiversity and productivity of the ocean."¹⁴⁵

¹³³ EPA, *TS Endangerment Findings* at 38.

¹³⁴ USGCRP, *Global Climate Change Impacts* at 85.

¹³⁵ *Id.*

¹³⁶ Carl Zimmer, *An Ominous Warning on the Effects of Ocean Acidification*, Yale Environment360, (February 15, 2010), available at <http://e360.yale.edu/feature/an-ominous-warning-on-the-effects-of-ocean-acidification/2241/> (last visited April 9, 2011).

¹³⁷ EPA, *Coral Reef Biological Criteria: Using the Clean Water Act to Protect a National Treasure* 3-1 (July 2010), available at http://www.epa.gov/bioindicators/pdf/EPA-600-R-10-054_CoralReefBiologicalCriteria_UsingtheCleanWaterActtoProtectaNationalTreasure.pdf (last visited April 9, 2011).

¹³⁸ James C. Zachos et al., *Rapid Acidification of the Ocean During the Paleocene-Eocene Thermal Maximum*, 308 SCIENCE 1611, 1611-1615 (June 10, 2005).

¹³⁹ *Id.*

¹⁴⁰ *Id.*

¹⁴¹ Inter-Agency Report, *Impacts of Ocean Acidification* at 69.

¹⁴² "Many of these organisms are important components of the marine food web." *Id.*

¹⁴³ *Id.*

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

38. The warming of oceans also contributes to the bleaching of corals.¹⁴⁶ Corals contain a tiny alga that provides them with food and that accounts for their color.¹⁴⁷ When the oceans warm, the algae give off toxins, and the corals, in order to survive the toxin, expel the algae, thereby bleaching the coral.¹⁴⁸ If the water temperature does not fall enough to permit algae to survive within the coral without releasing the toxin, the corals will eventually die.¹⁴⁹ There have been several severe episodes of coral bleaching in recent years.¹⁵⁰ With continued warming, the coral may not be able to survive.¹⁵¹
39. Changes in water supply and water quality will also impact agriculture in the US.¹⁵² Additionally, increased heat and associated issues such as pests, crop diseases, and weather extremes, will all impact crop and livestock production and quality.¹⁵³ For example, climate change in the United States has produced warmer summers, enabling the mountain pine beetle to produce two generations of beetles in a single summer season, where it had previously only been able to produce one; in Alaska, the spruce beetle is maturing in one year when it had previously taken two years.¹⁵⁴ The expansion of the forest beetle population has killed millions of hectares of trees across the United States and Canada and resulted in millions of dollars lost from decreased timber and tourism revenues.¹⁵⁵
40. Agriculture is extremely susceptible to climate changes and higher temperatures generally reduce yields of desirable crops while promoting pest and weed¹⁵⁶

¹⁴⁶ EPA, *TS Endangerment Findings* at 103; USGCRP, *Global Climate Change Impacts* at 148.

¹⁴⁷ USGCRP, *Global Climate Change Impacts* at 84, 151-52; See EPA, *TS Endangerment Findings* at 138.

¹⁴⁸ USGCRP, *Global Climate Change Impacts* at 84, 151-52.

¹⁴⁹ See *id.*

¹⁵⁰ *Id.* at 84.

¹⁵¹ *Id.*

¹⁵² USGCRP, *Global Climate Change Impacts* at 126; See United States Department of State (USDS), *U.S. Climate Action Report 2010, Fifth National Communication of the United States of America Under the United Nations Framework Convention on Climate Change* [hereinafter *U.S. Climate Action Report*] 87 (June 2010) available at <http://www.state.gov/documents/organization/140636.pdf>.

¹⁵³ USDS, *U.S. Climate Action Report* at 87.

¹⁵⁴ U.S. Climate Change Science Program (USCCSP), *Weather and Climate Extreme in a Changing Climate, Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands* [hereinafter *Weather and Climate Extremes*] 15 (June 2008) available at <http://www.climatechange.gov/Library/sap/sap3-3/final-report/sap3-3-final-all.pdf>.

¹⁵⁵ *Id.*

¹⁵⁶ USCCSP & USDA, *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity*, in *Synthesis and Assessment Product 4.3* at 59 (“Many weeds respond more positively to increasing CO₂ than most cash crops, . . .

proliferation.¹⁵⁷ Global climate change is predicted to decrease crop yields, increase crop prices, decrease worldwide calorie availability, and by 2050 increase child malnutrition by 20%.¹⁵⁸ Climate change threatens global food security and so any effort to mitigate global warming is effectively promoting a secure food supply.¹⁵⁹

41. Glacial and ice cap melting is one of the major causes of global sea level change.¹⁶⁰ When glaciers and ice caps melt, this adds water to the ocean.¹⁶¹ Another cause is that as ocean water warms, it expands and takes up more space; therefore, ocean warming “has been observed in each of the world’s major ocean basins, and has been directly linked to human influences.”¹⁶²
42. Human-caused fossil fuel burning and the resulting climate change are already contributing to an increase in asthma, cancer, cardiovascular disease, stroke, heat-related morbidity and mortality, food-borne diseases, and neurological diseases and disorders.¹⁶³ The World Health Organization has concluded, “the health effects of a rapidly changing climate are likely to be overwhelmingly negative”.¹⁶⁴ Climate change is not only expected to affect the basic requirements for maintaining health (clean air and water, sufficient food, and adequate shelter) but is likely to present new challenges for controlling infectious disease and even “halt or reverse the progress that the global public health community is now making against many of these diseases.”¹⁶⁵
43. As the 2010 Russian summer heat wave graphically demonstrated, heat can

Recent research also suggests that glyphosate, the most widely used herbicide in the United States, loses its efficacy on weeds grown at CO₂ levels that likely will occur in the coming decades.”).

¹⁵⁷ International Food Policy Research Institute, *Food Policy Report: Climate Change-Impacts on Agriculture and Costs of Adaptation* vii (Oct. 2009).

¹⁵⁸ *Id.*

¹⁵⁹ *Id.* at ix (“Climate change will pose huge challenges to food-security efforts. Hence, any activity that supports agricultural adaptation also enhances food security.”).

¹⁶⁰ M. Sharp & G. Wolken, *Glaciers Outside Greenland*, in ARCTIC REPORT CARD 48 (October 18, 2010).

¹⁶¹ USGCRP, *Global Climate Change Impacts* at 18.

¹⁶² *Id.*

¹⁶³ See The Center for Health and the Global Environment, Harvard Medical School, *Climate Change Futures: Health, Ecological, and Economic Dimensions* (November 2005) available at eetd.lbl.gov/emills/pubs/pdf/climate-change-futures.pdf; USGCRP, *Global Climate Change Impacts* at 96-98.

¹⁶⁴ World Health Organization, *Climate and Health Fact Sheet* (July 2005), <http://www.who.int/globalchange/news/fsclimandhealth/en/index.html>.

¹⁶⁵ World Health Organization, *Protecting Health from Climate Change: Connecting Science, Policy, and People* 02 (2009), available at <http://www.who.int/globalchange/publications/reports/9789241598880/en/index.html>.

destroy crops, trigger wildfires, exacerbate air pollution, and cause increased illness and deaths.¹⁶⁶ Similar impacts are occurring across the United States: the “number and frequency of forest fires and insect outbreaks are increasing in the interior West, the Southwest, and Alaska. Precipitation, streamflow, and stream temperatures are increasing in most of the continental United States. The western United States is experiencing reduced snowpack and earlier peaks in spring runoff. The growth of many crops and weeds is being stimulated. Migration of plant and animal species is changing the composition and structure of arid, polar, aquatic, coastal, and other ecosystems.”¹⁶⁷ Up to 30% of the millions of species on our planet could go extinct following just a few tenths of a degree warming above present.¹⁶⁸ Large wildfires in the Western US have quadrupled in recent years, a result of hotter temperatures and earlier snowmelt that contributes to dryer soils and vegetation.¹⁶⁹

44. Similarly, climate change is already causing, and will continue to result in, more frequent, extreme, and costly weather events (such as hurricanes).¹⁷⁰ The annual number of major tropical storms and hurricanes has increased over the past 100 years in North America, coinciding with increasing temperatures in the Atlantic sea surface.¹⁷¹
45. The changing climate also raises national security concerns, as “climate change will add to tensions even in stable regions of the world.”¹⁷² The United States may experience an additional need to accept immigrant and refugee populations as droughts increase and food production declines in other countries.¹⁷³ Increased extreme weather events (such as hurricanes) will also present an increased strain on foreign aid and call for military forces.¹⁷⁴ For instance, by 2025, 40% of the world’s population will be living in countries experiencing significant water shortages, while sea-level rise could cause displacement of tens, or even hundreds,

¹⁶⁶ See NOAA Earth System Research Lab, *The Russian Heat Wave 2010*, (September 2010) <http://www.esrl.noaa.gov/psd/csi/moscow2010/>.

¹⁶⁷ EPA, *TS Document* at 41 (citing USCCSP, Backlund et. al., 2008a).

¹⁶⁸ IPCC, *AR4, Working Group II: Impacts, Adaptation and Vulnerability- Magnitude of Impact*, available at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/spmssp-c-15-magnitudes-of.html.

¹⁶⁹ USGCRP, *Global Climate Change Impacts* at 95.

¹⁷⁰ *Id.* at 27 (“Many types of extreme weather events, such as heat waves and regional droughts, have become more frequent and intense during the past 40 to 50 years.”).

¹⁷¹ National Science and Technology Council, *Scientific Assessment* at 7.

¹⁷² The CNA Corporation, Military Advisory Board, *National Security and the Threat of Climate Change 7* (2007), available at http://securityandclimate.cna.org/report/SecurityandClimate_Final.pdf (last visited April 10, 2011).

¹⁷³ *Id.*

¹⁷⁴ *Id.*

of millions of people.¹⁷⁵

46. Paleoclimate data provides sobering evidence that major climate change can occur in decades, and that the consequences would be much more severe, and even disastrous, if a 2°C (3.6°F) change occurs over decades rather than hundreds of years.¹⁷⁶
47. There are at least three reasons that the present, human-induced global warming is particularly significant. First, past global warming and cooling of a similar magnitude occurred before human civilization existed.¹⁷⁷ Second, global warming is happening far more rapidly than in past occurrences¹⁷⁸, giving both humans and other forms of life only a short time to adapt to the changes. Human civilization and the crops and foods on which it depends have developed within a very narrow set of climatic conditions.¹⁷⁹ With the human population so large, with civilization so complex, centered around coastal cities, and dependent on water supplies fed by distant ice and snow melt, and with the great disparities in wealth between and within countries and regions, it will be nearly impossible to adapt to all of the climate change impacts in the quick time-frame in which they will occur.¹⁸⁰
48. Third, and perhaps most importantly, the climate change we are now experiencing is caused largely by human activity.¹⁸¹ This means that unlike with respect to past climate change events, by changing our activities humans can mitigate or even halt

¹⁷⁵ *Id.* at 16.

¹⁷⁶ See James E. Hansen & Makiko Sato, *Paleoclimate Implications for Human-Made Climate Change* (January 18, 2011), available at http://www.columbia.edu/~jeh1/mailings/2011/20110118_MilankovicPaper.pdf (last visited April 10, 2011).

¹⁷⁷ See James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. 217, 217-231 (2008).

¹⁷⁸ *Id.*

¹⁷⁹ J. Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts* 15, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN (Joseph F. DiMento & Pamela Doughman eds., MIT Press 2007).

¹⁸⁰ See generally United States Agency International Development (USAID), *Adapting to Climate Variability and Change: A Guidance Manual for Development Planning* (August 2007) (discussing difficulty of adapting to climate change)

http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf; See also USGCRP, *Global Climate Change Impacts* at 12 ("Climate change will combine with pollution, population growth, overuse of resources, urbanization, and other social, economic, and environmental stresses to create larger impacts than from any of these factors alone.").

¹⁸¹ See USGCRP, *Global Climate Change Impacts* at 20; EPA, *TS Endangerment Findings* 47-51; IPCC, *AR4* at 39.

this warming before it causes catastrophic and irreversible effects.¹⁸² Stopping, or at least greatly curtailing, the activities that discharge greenhouse gases into the air, such as the burning of fossil fuels and deforestation, and encouraging activities that remove CO₂ from the atmosphere (such as reforestation), can greatly reduce and even end global warming and its accompanying consequences within the lifetimes of today's children.¹⁸³

49. To protect Earth's climate for present and future generations, we must restore Earth's energy balance. The best available science shows that if the planet once again sends as much energy into space as it absorbs from the sun, this will restore the planet's climate equilibrium.¹⁸⁴ Scientists have accurately calculated how Earth's energy balance will change if we reduce long-lived greenhouse gases such as carbon dioxide.¹⁸⁵ Humans have altered Earth's energy balance¹⁸⁶ and are currently causing a planetary energy imbalance of approximately one-half watt¹⁸⁷. We would need to reduce atmospheric carbon dioxide concentrations by about 40 ppm, in order to increase Earth's heat radiation into space by one-half watt, if other long-lived gases stay the same as today.¹⁸⁸ We must reduce atmospheric carbon dioxide concentration to 350 ppm to avoid the threats contained herein.¹⁸⁹

50. The best available science also shows that to protect Earth's natural systems,

¹⁸² USGCRP, *Global Climate Change Impacts* at 107 ("By mid-century and beyond, however, today's emissions choices would generate starkly different climate futures: the lower the emissions, the smaller the climatic changes and resulting impacts.").

¹⁸³ *See Id.* at 12 ("Future climate change and its impacts depend on choices made today.").

¹⁸⁴ John Abatzoglou et al., *A Primer on Global Climate Change and Its Likely Impacts*, in CLIMATE CHANGE: WHAT IT MEANS FOR US, OUR CHILDREN, AND OUR GRANDCHILDREN 11, 15-22 (Joseph F. C. DiMento & Pamela Doughman eds., MIT Press 2007).

¹⁸⁵ JAMES HANSEN, STORMS OF MY GRANDCHILDREN 166 (2009) ("Also our best current estimate for the planet's mean energy imbalance over the past decade, thus averaged over the solar cycle, is about +0.5 watt per square meter. Reducing carbon dioxide to 350 ppm would increase emission to space 0.5 watt per square meter, restoring the planet's energy balance, to first approximation.").

¹⁸⁶ IPCC, *AR4* at 37 ("[T]he global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W/m².").

¹⁸⁷ D.M. Murphy et al., *An observationally based energy balance for the Earth since 1950* 114 J. GEOPHYSICAL RES. LETTERS D17107 (September 2009).

¹⁸⁸ JAMES HANSEN, STORMS OF MY GRANDCHILDREN 166 (2009); *See* James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. 217, 217-231 (2008).

¹⁸⁹ *See* James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. 217, 217 (2008) ("If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, Paleoclimate evidence and ongoing climate change suggest that CO₂ will need to be reduced from its current 385 ppm to at most 350 ppm.").

average global surface heating must not exceed 1° C this century.¹⁹⁰ To prevent global heating greater than 1° C, concentrations of atmospheric CO₂ must decline to less than 350 ppm this century.¹⁹¹ However, today's atmospheric CO₂ levels are about 390 ppm¹⁹² and are rising.

51. Atmospheric CO₂ levels are currently on a path to reach a climatic tipping point.¹⁹³ Absent immediate action to reduce CO₂ emissions, atmospheric CO₂ may reach levels as high as about 1000 ppm¹⁹⁴ and a temperature increase of up to 5° C by 2100.¹⁹⁵ Life on Earth as we know it, is unsustainable at these levels.
52. The Department has the present ability to curtail the environmental harms detailed above. Atmospheric CO₂ concentrations will decrease if people stop (or greatly reduce) their burning of fossil fuels.¹⁹⁶ The environmental harms and threat to human health and safety as described above can only be avoided if atmospheric CO₂ concentrations are immediately reduced. Any more delay risks irreversible and unacceptable consequences for youth and future generations.
53. Fossil fuel emissions must decrease rapidly if atmospheric CO₂ is to be returned to a safe level in this century.¹⁹⁷ Improved forestry and agricultural practices can provide a net drawdown of atmospheric CO₂, primarily via reforestation of degraded lands that are of little or no value for agricultural purposes, returning us

¹⁹⁰ James E. Hansen & Makiko Sato, *Paleoclimate Implications for Human-Made Climate Change* (January 18, 2011), available at http://www.columbia.edu/~jeh1/mailings/2011/20110118_MilankovicPaper.pdf (last visited April 10, 2011); See also IPCC, *AR4* at 48 (“For increases in global average temperature exceeding 1.5 to 2.5°C and in concomitant atmospheric CO₂ concentrations, there are projected to be major changes in ecosystem structure and function, species’ ecological interactions and shifts in species’ geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services, e.g. water and food supply.”).

¹⁹¹ See James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. J. 217, 217-231 (2008); JAMES HANSEN, STORMS OF MY GRANDCHILDREN (2009).

¹⁹² CO₂Now, *Earth’s CO₂ Homepage*, Atmospheric CO₂ for March 2011, <http://co2now.org/> (last visited April 10, 2011).

¹⁹³ JAMES HANSEN, STORMS OF MY GRANDCHILDREN 224 – 230, 260 (2009).

¹⁹⁴ IPCC, *AR4* at 66-67.

¹⁹⁵ IPCC, *AR4* at 46.

¹⁹⁶ HARVEY BLATT, AMERICA’S ENVIRONMENTAL REPORT CARD xiii (MIT Press, 2005) (“How can we stop this change in our climate? The answer is clear. Stop burning coal and oil, the sources of nearly all the carbon dioxide increase.”).

¹⁹⁷ James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 OPEN ATMOS. SCI. 217, 217 (2008) (discussing the need to reduce atmospheric carbon dioxide concentration to 350 ppm).

to 350 ppm somewhat sooner.¹⁹⁸ However, the potential of these measures is limited. Immediate and substantial reductions in carbon dioxide emissions are required in order to ensure that the youth and future generations of children inherit a planet that is inhabitable.

54. Because most fossil fuel CO₂ emissions will remain in the surface carbon reservoirs for millennia, it is imperative that fossil fuel CO₂ emissions be rapidly terminated, if atmospheric CO₂ is to be returned to a safe level in this century.¹⁹⁹ The failure to act promptly will not only increase the costs of future reductions, it will have irreversible adverse effects on the youth and all future generations, as detailed above.
55. To have the best chance of reducing the concentration of CO₂ in the atmosphere to 350 ppm by the end of the century and avoid heating over 1 degree Celsius over pre-industrial temperatures, the best available science concludes that atmospheric carbon dioxide emissions need to peak in 2012 and then begin to decline at a global average of 6% per year between 2013 and 2050 and 5% per year through 2100. In addition, carbon sequestering forests and soils must be preserved and replanted to sequester an additional 100 gigatons of carbon through the end of the century.²⁰⁰ Waiting until 2020 to reduce carbon dioxide emissions would require annual reductions of at least 15% to return atmospheric concentrations to 350 ppm by 2100.
56. A zero-CO₂ U.S. energy system can be achieved within the next thirty to fifty years without acquiring carbon credits from other countries. In other words, actual physical emissions of CO₂ from fossil fuels can be eliminated with technologies that are now available or reasonably foreseeable. This can be done at reasonable cost by eliminating fossil fuel subsidies and creating annual and long-term CO₂ reduction targets. Net U.S. oil imports can be eliminated in about 25 years, possibly less. The result will also include large ancillary health benefits from the significant reduction of most regional and local air pollution, such as high ozone and particulate levels in cities, which is mainly due to fossil fuel combustion.²⁰¹
57. The approaches to transition to a renewable energy system and to phase out fossil fuels by about 2050 include: A single national cap on fossil fuel use that declines to zero by 2050 or a gradually rising carbon tax with revenues used to promote a

¹⁹⁸ *Id.* at 227.

¹⁹⁹ *See id.* at 211.

²⁰⁰ *See* James E. Hansen et al., *Scientific Case for Avoiding Dangerous Climate Change to Protect Young People and Nature* (Jul. 9th, 2012) <http://pubs.giss.nasa.gov/abs/ha08510t.html>.; *See also* *Amicus Curiae* Brief of Dr. James Hansen in *Alec L. v. Jackson*.*

²⁰¹ Arjun Makhijani, *Carbon-Free, Nuclear-Free: A Roadmap for U.S. Energy Policy* (IEER Press and RDR Books, 2007); Declaration of Arjun Makhijani in Support of *Alec L. v. Jackson*, <http://ourchildrenstrust.org/sites/default/files/Makhijani%20Dec.pdf>.

zero-CO₂ emissions energy system and to mitigate adverse income-distribution effects; increasingly stringent efficiency standards for buildings, appliances, and motor vehicles; elimination of subsidies for fossil fuels, nuclear energy, and biofuels from food crops coupled with investment in a vigorous and diverse research, development and demonstration program (including smart grid and storage technologies, electrification of transportation, stationary fuel cells for combined heat and power, biofuels from aquatic weeds like microalgae, use of aquatic weeds like microalgae in integrated gasification combined cycle plants, and use of hydrogen-fueled passenger aircraft); banning new coal-fired power plants; adoption of a policy that would aim to have essentially carbon-free state, local, and federal governments, including almost all of their buildings and vehicles by 2030; and adoption of a gradually increasing renewable portfolio standard for electricity until it reaches 100 percent by about 2050.²⁰²

58. Many of the facts stated in the above paragraphs are also supported by top experts from around the world who have submitted expert testimony to the U.S. District Court in the federal lawsuit *Alec L. v. Jackson*. These expert declarations by the late Dr. Paul Epstein, Ove Hoegh-Guldberg, Sivan Kartha, Pushker Kharecha, David Lobell, Jonathan Overpeck, Camille Parmesan, Stephan Rahmstorf, Steven Running, Kevin Trenberth and Lise Van Susteren are all available at <http://ourchildrenstrust.org/page/91/expert-declarations> and such testimony is incorporated herein by reference.

B. CLIMATE CHANGE IS ALREADY OCCURRING IN THE STATE OF PENNSYLVANIA AND IS PROJECTED TO SIGNIFICANTLY IMPACT THE STATE IN THE FUTURE.

59. Since 1970, annual average temperatures in the Northeast region of the United States have increased by 2 degrees (Fahrenheit) in the summer, and by twice as much in the winter. Temperatures are expected to continue warming, with projected additional increases of approximately 3 degrees in the spring and 4 degrees in the summer, fall and winter months by the middle of the current century.²⁰³
60. By the end of the current century, without significant world-wide decreases in carbon dioxide emissions, it is projected that summer temperatures in the northeastern U.S. could rise by as much as 6-14 degrees above historic averages, and as much as 8-12 degrees in the winter.²⁰⁴

²⁰² See *id.*

²⁰³ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007).

²⁰⁴ See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Union of Concerned

61. Temperatures in Harrisburg, Pennsylvania have increased 1.2 degrees in the last century, and precipitation has increased as much as 20% in many parts of the state. In the next century, it is predicted that temperature at this location will increase a further 4 degrees, with seasonal increases in precipitation between 10-50%.²⁰⁵
62. An increase in frequency of summer temperatures exceeding “extreme heat” (conditions of over 90 degrees) is expected as a result of continued climate change. By the year 2050, it is estimated that southern and eastern Pennsylvania will receive as many as 50 days per year exceeding 90 degrees, and as many as 70 days per year by the end of the century.²⁰⁶
63. The number of days below 32 degrees (freezing) is expected to decrease by half in the next several decades, and disappear in all but the highest altitudes of Pennsylvania by the end of the current century.²⁰⁷
64. It is predicted that warming will lead to an increased growing season in the northeast United States. This resulting lengthening will cause spring to begin three weeks earlier and winter to arrive three weeks later by the end of the current century.²⁰⁸
65. Precipitation has increased by 10% in the last century, and further increases in

Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²⁰⁵ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²⁰⁶ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²⁰⁷ See Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²⁰⁸ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007).

- precipitation by an additional 10-30% are expected within the next century.²⁰⁹
66. As average winter temperatures increase, more precipitation will fall in the form of rain instead of snow, which will reduce snowpack and increase the likelihood of flooding during the winter and spring months.²¹⁰
67. In general, the amount of rainfall received during extremely wet days of the summer and fall months is expected to increase. It is also expected that an increase in the frequency and intensity of summer thunderstorms may occur.²¹¹
68. Increases in winter and spring precipitation (combined with the early melting of snowpack) are expected to shift the timing of peak surface water flows earlier in the spring and cause low-flows in the late summer and early fall. This is of special concern for the tributaries to the Ohio River, where peak flows in the spring are expected to arrive several weeks earlier with a 4-degree increase in average annual temperature.²¹²
69. Climate change and winter warming are correlated with the earlier break-up of ice on lakes and rivers, which increases the influx of early spring waters into surface flows.²¹³
70. Groundwater recharge could be adversely affected by declines in groundwater

²⁰⁹ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²¹⁰ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²¹¹ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²¹² See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²¹³ See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007).

supply during the late summer and early fall. Precipitation events during these months are expected to be intense, but with greater length of time between events.²¹⁴

71. Some of the most extreme flood events on record in the United States occurred in Pennsylvania. Increases in winter and spring runoff are expected to increase the incidence of flooding. Flood events may also increase the amount of pollution, erosion, and nutrient inputs moving from urban, agricultural, and industrial lands, into wetland ecosystems.²¹⁵
72. Warmer ambient temperatures will warm surface and groundwater supplies, potentially compromising the quality of these resources.²¹⁶
73. The increased frequency and intensity of flooding, drought, wildfires and invasion of non-native plant species are all anticipated to cause, and accelerate, a rapid transformation of Pennsylvania's current landscape and its ecosystems.²¹⁷
74. A significant increase in summer drying is expected to change tree species composition in forested regions of the State and lead to an overall decrease in forested land. With warmer conditions, it is also expected that forested lands will shift northward, and grasslands and pasture will replace many forested areas. A 15-20% overall loss of forestlands is projected.²¹⁸

²¹⁴ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²¹⁵ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²¹⁶ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011).

²¹⁷ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²¹⁸ See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning*

75. A change in climate has the ability to increase the occurrence of wildfires by increasing drought conditions, increasing insect pest and disease pressure with a longer growing season, and also cause tree-community shifts to accommodate more fire-prone species. Increased wildfire events will increase the rate at which invasive plant species will be able to encroach on forested lands.²¹⁹
76. Initial increases in forest growth may be observed in response to elevated levels of atmospheric CO₂, but within a short amount of time forests will begin to be adversely affected by high amounts of ground-level ozone. Ground-level ozone is damaging to trees and plants.²²⁰
77. With forest habitat losses, it is expected that the area's Bald Eagles will also face decline, as they migrate north with shifting climate patterns and resources. This event is predicted to coincide with a 25% overall decline in the biodiversity of bird species.²²¹
78. The Pocono Mountains and the Two Mile Run wetlands in Pennsylvania are home to many rare and valuable species of trees and wildlife, as well as several acres of public wilderness. The flora and fauna could have difficulty adapting to climate change, and with only a few corridors allowing for migration, it is possible that there could be a significant reduction in biodiversity, causing local extinctions.²²²
79. With lengthened growing seasons and warmer temperatures, the growth, reproductive capability, and geographical range of forest insect pests, such as the Hemlock Woolly Adelgid, will all be increased.²²³

Report: Risks and Practical Recommendations (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²¹⁹ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²²⁰ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²²¹ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²²² See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²²³ See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Pennsylvania

80. The Erie National Wildlife Refuge provides aquatic resources vital to the preservation of approximately 70 species of fish and 25 species of freshwater mussels, many of which are already endangered. Further pressure to this ecosystem from climate change puts the aquatic wildlife at increased risk for extirpation.²²⁴
81. Brook trout and other coldwater fish are expected to decline in population due to warmer water temperatures in the rivers and lakes of Pennsylvania.²²⁵
82. Invasive plant and wildlife species better adapted to hotter and drier conditions (like those predicted by climate change models) have a higher chance of successfully overtaking native species (which are expected to experience decreases in geographic range due to stress from climate change). These stresses include seasonal drying of wetland habitat, increase in the frequency and severity of extreme weather events, and changes in atmospheric chemical composition.²²⁶
83. Heat waves are predicted to become much more common, which will pose increased risks to human health. An increase in average temperatures is expected to increase the number of heat-related illnesses and deaths, especially in cities. One study has predicted that the number of heat related deaths could increase by as much as 90% by the year 2050, increasing from 130 per year to over 240.²²⁷
84. Increase in flooding is of high concern, as the increase in the frequency and magnitude of flooding events will increase the incidence of related morbidity and mortality.²²⁸

Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²²⁴ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997).

²²⁵ See Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²²⁶ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011).

²²⁷ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²²⁸ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); The Center

85. Increased emissions combined with higher temperatures will cause an increase in levels of ground-level ozone. Ozone is a toxic component of smog with the potential to cause serious long-term and permanent damage to lung tissues with repeat exposure. A 4-degree increase in average temperature near Pittsburg could increase concentration of ground-level ozone by 8%.²²⁹
86. Increases in temperature and humidity levels (thought to increase mold) can aggravate symptoms of respiratory allergies and asthma by stimulating plant pollen production. This problem will be further exacerbated by high availability of atmospheric CO₂, which is also predicted to stimulate plant growth early in the season.²³⁰
87. Due to “Island Heat” effects in urban areas, the effects of climate change will be much more extreme in cities, which may be as much as 7-10 degrees warmer than surrounding suburban areas.²³¹
88. With milder, shorter winters and longer growing seasons, insects and other disease vectors are expected to increase. Risk of increase in West Nile Virus, malaria, and dengue transmission are all of special concern.²³²

for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²²⁹ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²³⁰ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²³¹ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²³² See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997);

89. Many waterborne diseases (such as cholera) thrive in warm water conditions, and will present an increased risk to public health as temperatures and flood frequency both increase. There is also increased risk of sewage and septic system overflows during times of flooding.²³³
90. Warmer temperatures and increased seasonal precipitation could increase low-lying vegetation. This may lead to an increase in the population of ticks (and their rodent hosts) possibly carrying Lyme's and other tick-borne diseases.²³⁴
91. Changes to forest tree species include shifts from the current maple-dominated community composition to a community dominated by species better adapted to warmer climates, such as pines and oak. The additional risk from more frequent and severe forest fires will increase as the region experiences a hotter and drier climate. An overall loss of forested lands between 15-25% is projected by the end of the current century.²³⁵
92. Climate changes and a shift in plant and animal communities will lead to a loss of wildlife and habitat. This reality threatens the \$181 million annual industry that is received by the state in the form of hunting, fishing, and wildlife-viewing tourism.²³⁶

Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²³³ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²³⁴ See Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²³⁵ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

²³⁶ See The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

93. Agricultural crop yields are heavily reliant on temperature, moisture and day-to-day weather. They are also especially vulnerable to climate change. Major, regional shifts are expected to occur and it will be difficult to maintain current production rates, and quality, of food commodities. It is predicted that crop production will shift northward, which will make adaptation for farmers difficult.²³⁷
94. Initial increases in forest and crop growth may be observed in response to elevated levels of atmospheric CO₂, but within a short amount of time plants will begin to be adversely affected by high amounts of ground-level ozone. Ground-level ozone is damaging to trees and plants.²³⁸
95. Milder winters increase the likelihood that weeds (such as kudzu), pests, and pathogens, previously unable to survive New England's lower temperatures will be able to successfully invade. This will lead to increased costs for pest control and is likely to result in other costly damages.²³⁹
96. Overall crop yield for hay and corn is expected to decrease by as much as 39% by the year 2100, leading to large changes in the number of acres farmed and the subsequent production rates.²⁴⁰
97. As winters become milder, the number of freezing days available for certain crops (such as Concord grapes) will be more infrequent, with an estimated projection of harvests only every other year by 2050, and only 3 out of every 5 years by the end of the century. Apple orchards will also decline in yield with decreased winter freezing.²⁴¹
98. Livestock production is expected to decline as the cost of feed and ventilation for indoor animals increases, and as decreased crop production is expected to limit forage resources. Increased temperatures may also cause direct stress to animals, causing decreases in growth and a projected 20% or more decrease in milk

²³⁷ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000).

²³⁸ See *id.*

²³⁹ See Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007).

²⁴⁰ See EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²⁴¹ See Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008).

production.²⁴²

99. Increasing precipitation received during downpours is expected to increase flooding, increase damages to infrastructure, and cause human health problems. This is especially so in cities, where heavy rains can overwhelm drainage systems and water treatment facilities, increasing the likelihood of waterborne diseases and therefore increasing associated health care costs.²⁴³
100. Increased flooding poses a serious risk to transportation agencies. More frequent and severe storm events coupled with flooding and structural failures resulting from high-heat conditions are expected to cause damage to roadways, bridges, railways, and other utility systems.²⁴⁴
101. Decreased water levels could cause several economic issues for all of the states bordering the Great Lakes. Low water levels lead to a decrease in depth of navigation channels and will cause damage to vessels and increase repair expenses, as well as require the rebuilding of docks and harbors. These transformations are expected to require between \$85 and \$142 million dollars annually.²⁴⁵
102. If the Commonwealth of Pennsylvania had begun reducing carbon emissions in 2005, it would have done its part by protecting a stable livable atmosphere by 2100 with only a 3% annual reduction in emissions. Because we have waited, reaching a

²⁴² See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Union of Concerned Scientists, *Climate Change in Pennsylvania: Impacts and Solutions in the Keystone State* (2008); Center for Health and the Global Environment, Harvard Medical School, *Climate Change and Health in Pennsylvania* (2011).

²⁴³ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Northeast Climate Impacts Synthesis Team, *Confronting Climate Change in the United States: Northeast Science, Impacts and Solutions* (2007); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); EPA, Office of Policy, Planning, and Evaluation, *Climate Change and Pennsylvania*, Pub. No. 230-F-97-00811 (1997); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²⁴⁴ See USGCRP, *Global Climate Change Impacts on the United States: Regional Climate Impacts on the Northeast* (Washington D.C., 2000); Pennsylvania Department of Environmental Protection, *Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations* (2011); The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

²⁴⁵ See The Center for Integrative Environmental Research, University of Maryland, *Economic Impacts of Climate Change on Pennsylvania* (2008).

safe atmosphere by the end of the century will require a 6% annual reduction in emissions beginning in 2013. If we delay until 2020 to reduce our greenhouse gas emissions we would have to reduce emissions by 15% every year until the end of this century to ensure a livable atmosphere for our generation and the next.²⁴⁶

C. THE PUBLIC TRUST DOCTRINE DEMANDS THAT THE STATE OF PENNSYLVANIA ACT TO PRESERVE THE ATMOSPHERE AND PROVIDE A LIVABLE FUTURE FOR PRESENT AND FUTURE GENERATIONS OF PENNSYLVANIANS.

103. The citizens of Pennsylvania, including Petitioners, have a right to a healthy atmosphere and stable climate.

104. Article I, section 27 of the Pennsylvania Constitution provides as follows:

“Sec. 27. Natural Resources and the Public Estate

The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.”

105. This amendment (Sec. 27), which was adopted in 1971, encompasses two basic principles. First, Pennsylvanians have a right to a healthy environment, and second, the sovereign government of Pennsylvania has a trusteeship responsibility to protect that environment on behalf of future generations.²⁴⁷

106. The statute that creates the Department of Conservation and Natural Resources, as well as the statutes that the Department is charged with administering, implement this amendment.²⁴⁸

107. A court in the State of Texas recently held that pursuant to the Texas Constitution, all natural resources, including the air and atmosphere, are trust assets and must be protected by the state.²⁴⁹ Similarly, a New Mexico court has recently denied a

²⁴⁶ James E. Hansen et al., *Scientific Case for Avoiding Dangerous Climate Change to Protect Young People and Nature* (Jul. 9th, 2012) <http://pubs.giss.nasa.gov/abs/ha08510t.html>. (“these scenarios assume a massive 100 GtC reforestation program”).

²⁴⁷ See John C. Dernbach, *Taking the Pennsylvania Constitution Seriously When it Protects the Environment: Part I—An Interpretive Framework for Article I, Section 27*, 103 DICK. L. REV. 693, 700 (1999).

²⁴⁸ <http://www.dcnr.state.pa.us/legal/constitution.htm>

²⁴⁹ See *Angela Bonser-Lain v. Texas Commission on Environmental Quality*, Cause No. D-1-GN-11-002194 (on review of denial of petition for rulemaking) http://ourchildrenstrust.org/sites/default/files/Texas-letter-ruling_0.pdf

motion to dismiss a suit against the governor and the state for violating its public trust duties to protect the atmosphere. That case will be proceeding on the merits to determine if the state has complied with its trust duties to protect the atmosphere when repealing regulations that address greenhouse gas emissions.²⁵⁰

108. There is no greater duty of parents than to provide for the protection and safety of their children. Likewise, there is no greater duty of our government than to ensure the protection and safety of its citizens, both born and yet to be born. As described above, the Earth's atmosphere is what has allowed humans to exist and flourish on this planet. But human activity has allowed the atmospheric equilibrium to become imbalanced, and now human life on Earth is in grave danger.
109. The atmosphere, essential to human existence, is an asset that belongs to all people. The public trust doctrine requires that as a trustee, the State of Pennsylvania and the Governor, through the Environmental Quality Board, its Department of Environmental Protection, its Department of Conservation, its Natural Resources, and its Department of Transportation, hold vital natural resources in *trust*, for both present and future generations of its citizens. These resources are so vital to the well-being of all people, including the citizens of Pennsylvania, that they must be protected by this distinctive, long-standing judicial principle. The atmosphere, including the air, is one of the most crucial assets of our public trust.
110. The public trust doctrine holds government responsible, as perpetual trustee, for the protection and preservation of the atmosphere for the benefit of both present and future generations. Today the citizens of Pennsylvania are confronted with an atmospheric emergency. No case ever decided by the courts of Pennsylvania under the state Constitution, section 27, have been faced with a threat of such enormity to public resources. Thus, it is incumbent upon the Department to uphold its public trust obligation to the people of Pennsylvania and initiate rulemaking in accordance with this petition.
111. If the Department, as trustees of the atmosphere (an essential and fundamental resource that belongs to all citizens of Pennsylvania), does not take immediate and extraordinary action to protect, preserve, and bring the Earth's atmosphere back into balance, then children in Pennsylvania and countless future generations of children will suffer continually greater injuries and damaging consequences. If we, as a society, want to protect and keep the world safe for our children, including here in the great State of Pennsylvania, then the Department must immediately accept its fiduciary responsibility as mandated by its trustee obligation and adopt the rule proposed herein.
112. The public trust imposes a legal obligation on the Department to affirmatively

²⁵⁰<http://ourchildrenstrust.org/sites/default/files/Order%20Denying%20Motion%20to%20Dismiss.pdf>

preserve and protect the citizen's trust assets from damage or loss, and not to use the asset in a manner that causes injury to the trust beneficiaries, be they present or future. The sovereign trustee has an affirmative, fiduciary duty to prevent waste, to use reasonable skill and care to preserve the trust property, and to maintain trust assets. The duty to protect the trust asset means that the Department must ensure the continued availability and existence of healthy trust resources for present and future beneficiaries. This duty mandates the development and utilization of the trust resource in a manner consistent with its conservation and in furtherance of the self-sufficiency of the State.

113. Pennsylvania's fiduciary duty in this instance is defined by scientists' concrete prescriptions for carbon reductions. Scientists have clearly expressed the minimum carbon dioxide reductions that are needed, and requisite timelines for their implementation. Pennsylvania may not disclaim this fiduciary obligation, and is subject to an ongoing mandatory duty to preserve and protect this atmospheric trust asset.
114. The children in the State of Pennsylvania are already experiencing serious environmental, economic, physical, emotional and aesthetic injuries as a result of the State government's actions and inactions. If Pennsylvania fails to regulate and continues to contribute to this atmospheric crisis, then these injuries will only intensify and expand. A failure to immediately take bold action to protect and preserve Earth's safe climate-zone will cause irreparable harm to the citizens of Pennsylvania and others. Immediate state action is imperative.
115. Once certain tipping points of energy imbalance and planetary heating have been exceeded, we will not be able to prevent the ensuing harm. A failure to act soon may cause the collapse of the Earth's natural systems resulting in a planet that is largely unfit for human life. The responsibility to protect and preserve the atmosphere for the citizens of Pennsylvania is the duty of the Department. This mandate requires the Department to protect and preserve that which belongs to all of its citizens and not to allow uses of those assets in a way that causes injury and damage to its citizen beneficiaries.
116. If sovereign governments, including the Department, do not immediately react to this crisis and act swiftly to reduce carbon dioxide emissions being released into the atmosphere, the environment in which humans and other life on Earth has thrived, will no longer exist. If Pennsylvania does not act immediately to reduce carbon dioxide emissions into the atmosphere, the youth of Pennsylvania and future generations of the State's children will face a planet that may be largely uninhabitable.
117. Pennsylvania must protect and preserve the planet for its children and future generations. The United States, and the State of Pennsylvania, must lead the way and reduce its carbon dioxide emissions. The United States, including Pennsylvania, not only has a large responsibility for currently harming the

atmosphere, but it has the capacity and the technology to reduce emissions, as well as the will and obligation to protect its citizens. The rest of the world is looking to the United States to lead this effort. Without Pennsylvania's action the catastrophic collapse of natural systems is inevitable.

118. The shared atmosphere is a natural resource vital to human health, welfare, and survival. Atmospheric health is essential to all survival. Our atmosphere is a fundamental natural resource entrusted to the care of our governments, and the State of Pennsylvania, in trust, for its preservation and protection as a common property interest. As a co-tenant trustee of this shared asset, the Department has a fiduciary, and perpetual, affirmative duty to preserve and protect the atmosphere for the present citizens and future generations of Pennsylvania, as beneficiaries of this trust asset.

D. Persons, Businesses or Entities Affected

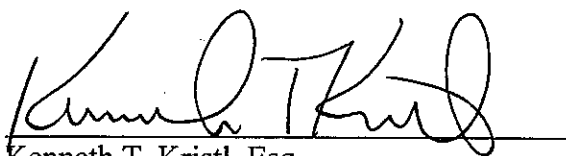
119. Pursuant to Pa. Code 23.1(a)(4), Petitioner believes that virtually every citizen and business in the Commonwealth would be affected by the proposed regulation. They can be classified into those whose conduct could be subject to the regulations and those that will benefit from the results produced by the regulatory regime. *Persons Affected Because Their Conduct Could Be Subject To The Regulations:* Because the goal of the regulation is to reduce fossil fuel carbon dioxide emissions, any person or entity that emits CO₂ could potentially be subject to regulatory actions designed to reduce those emissions. However, Petitioner believes that the most effective way to achieve the reductions necessary for safe atmospheric concentrations of CO₂ is to focus the regulatory reduction efforts on large sources of CO₂ including the energy sector, transportation, efficiency and conservation. Thus, the most likely affected sources would be electricity generating plants and large and medium industrial consumers of fossil fuels. However, depending upon the final form of the regulations, small users of fossil fuels, such as residential and transportation users, might find that the regulations will impact their actions. *Persons Affected Because They Will Benefit From The Regulations:* Every citizen and business in the Commonwealth stands to benefit from the proposed regulatory regime. As CO₂ concentrations decrease to safe levels, all such citizens and businesses will enjoy a world with fewer damaging and dangerous effects of climate disruption. Citizens of the Commonwealth will suffer fewer adverse health effects, and less property damage from storms, flooding, and other natural disasters caused by climate change. Farmers in the Commonwealth will suffer less property damage from storms, flooding, drought, and other natural disasters. Businesses will suffer fewer losses and lost profits caused by climate change. And many jobs will be created in order to support the transition away from fossil fuel consumption to a clean energy economy.

And so, for the reasons above, it is with utmost respect that petitioner Ashley Funk hereby submits this petition on behalf of herself, the citizens of the State of

Pennsylvania, and present and future generations of minor children in Pennsylvania. The petitioner respectfully requests that the EQB (in order to fulfill the Commonwealth's fiduciary duties) promulgate a rule that requires the Department to take the necessary steps (outlined herein) to protect the integrity of Earth's climate by adequately protecting our atmosphere, a public trust resource upon which all Pennsylvanians rely for their health, safety, sustenance, and security.

Petitioner also respectfully requests a public hearing on this rulemaking petition, and the opportunity to meet with and present their petition to Department staff and the Board. Should the petition be denied, Petitioners request a written decision explaining how the Department is complying with its Constitutional, public trust obligation to protect the atmospheric resource and what level of protection it believes is necessary to protect the people of the State of Pennsylvania.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Kenneth T. Kristl", written over a horizontal line.

Kenneth T. Kristl, Esq.

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APPENDIX I – SUGGESTED REGULATORY LANGUAGE

1. **Regulatory Goal.** In accordance with 35 P.S. § 4004(18), the Department shall prepare and develop a comprehensive plan for the control and abatement of carbon dioxide emissions that will specifically achieve the following:

(a) Carbon dioxide emissions from fossil fuels in the Commonwealth of Pennsylvania will peak no later than 2013 as determined by the Baseline CO₂ Emission Rate; and

(b) Starting in 2013, annual fossil fuel carbon dioxide emissions in the Commonwealth will be reduced by at least 6% per year as determined by the previous year's Annual CO₂ Emission Rate through the year 2050.

2. **Baseline Emission Rate.** In connection with its work required by 71 P.S. § 1361.4 (the Pennsylvania Climate Change Act, Act 70), the Department shall determine the amount of carbon dioxide emitted in 2012 from all fossil fuel burning sources in the Commonwealth. This amount shall be the Baseline CO₂ Emission Rate for purposes of this regulation.

3. **Determination of Annual CO₂ Emission Rate.** The Department shall undertake such actions as are necessary to determine the amount of carbon dioxide emitted each year from all fossil fuel burning sources in the Commonwealth. This amount shall be the Annual CO₂ Emission Rate for that given year.

4. **Reductions in Annual CO₂ Emission Rate.** The Department shall undertake such actions as are necessary to achieve at least a 6% reduction in the Annual CO₂ Emission Rate from the Baseline CO₂ Emission Rate by the end of 2013, and then at least a 6% reduction in the Annual CO₂ Emission Rate each year compared to the Annual CO₂ Emission Rate of the previous year, through the year 2050.

(a) The Department shall have such powers as necessary to achieve the annual 6% reduction in Annual CO₂ Emission Rate, including the powers to create permit provisions, conditions, enforceable agreements with emission sources, as well as the power to enforce, through administrative or judicial means, any reductions imposed on or agreed to by a source of carbon dioxide emissions.

(b) The Department shall certify the rate of reduction of the Annual CO₂ Emission Rate each year and make the information used in determining the reduction in that Rate publicly available. The information made available to the public shall include the data compiled by individual source, source categories, and the methodology used by the Department to compile both any components of as well as the total reduction in the Annual CO₂ Emission Rate.

(c) If the Department determines that the rate of reduction for a particular year does not meet the required 6% reduction, the Department shall announce and undertake such further actions, including the imposition of greater reductions in emissions of carbon dioxide, so that the total reductions in carbon dioxide emissions will return to the rate

imposed by this regulation within 12 months.

5. To the extent that any rule in this section conflicts with any other rule in effect, the more stringent rule, favoring full disclosure of emissions and protection of the atmosphere, governs.