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December 5, 2014

Ms. Sheila Holman
Director
North Carolina Division of Air Quality
1641 Mail Service Center
Raleigh, NC 27699-1641

Re: **Petition for Rule-making, on Behalf of Hallie Turner, for Promulgation of a Rule Based on the Best Available Climate Science to Limit North Carolina's Carbon Dioxide Emissions.**

Dear Ms. Holman:

This Petition for Rule-making ("Petition") is being filed on behalf of Hallie McKenzie Turner, age 13. Like the majority of Americans under 30 years old, she strongly supports government action to reduce greenhouse gas (GHG) emissions.¹ Hallie has been involved in climate action since the fourth grade. She has attended rallies and marches in Washington D.C. and has spoken at several events, including the Climate Convergence on Raleigh in 2013 and the NC League of Conservation Voters Green Tie Awards Dinner in 2014. In addition, Hallie loves reading, writing, art, and spending time with her friends. She is a talented violinist and an enthusiastic soccer player. Hallie is determined to leave behind a small carbon footprint. She bikes and walks to school everyday, looks after her family garden, eats a local and pescatarian diet, and voices her climate concerns in her classroom, and at rallies and marches in North Carolina and Washington, D.C. She is very proud of her family's solar panels and is excited to address the North Carolina Environmental Commission ("Commission" hereafter).

Hallie has always loved animals and nature. She worries that if we do not act now to stop climate change, many more species will vanish and many more ecosystems will be degraded. She knows that if we destroy Earth's atmosphere with greenhouse gas overload, there will not be a second chance. Unable to stand by meekly, Hallie is especially passionate about engaging other youth, recognizing that they are the ones who will inherit the Earth created by today's policies and practices unless they take action.

¹ See poll in Washington Post results available online at: http://www.washingtonpost.com/page/2010-2019/WashingtonPost/2014/06/02/National-Politics/Polling/question_14229.xml?uqid=YYAdvup3EeOxDICOzztZWA.

On her behalf, I submit this Petition for Rulemaking and supporting documents pursuant to and in accordance with N.C.G.S. § 150B-20 and 15A N.C.A.C. 02I .0501. North Carolina owes its citizens a mandatory and affirmative duty “to control and limit the pollution of our air and water” and to protect “in every other appropriate way to preserve as a part of the common heritage of this State its forests, wetlands, estuaries, beaches, historical sites, open lands, and places of beauty.”² Petitioner seeks the adoption of a rule that will ensure the integrity of North Carolina’s climate system by adequately protecting our atmosphere, a public trust resource upon which all North Carolina residents rely for their health, safety, sustenance, and security. The State’s forests, wetlands, estuaries, beaches, historical sites, open lands, and places of beauty are threatened by climate change and a stable climate system is necessary to preserve these constitutionally protected resources. The harmful effects of climate change are already being felt in North Carolina and are the direct result of anthropogenic greenhouse gas emissions—primarily carbon dioxide.

The North Carolina General Assembly long ago entrusted the Commission with both the *duty and power* to adopt regulations for air quality and emissions control standards for air contaminant sources pursuant to N.C.G.S. § 143-215.107.³ In outlining the authorizing article for air pollution control, the N.C. Legislature incorporated the purpose and definitions of Article 21, Water and Air Resources.⁴ The purpose and intent authorizing the Commission to control air pollution was “to achieve and *maintain* for the citizens of the State a *total environment of superior quality*.”⁵ As detailed in this Petition for Rulemaking, reducing carbon dioxide emissions is essential to maintaining a total environment of superior quality.

Furthermore, the Legislature adopted these policies under the recognition that the water and *air resources* of the State belong to the *people*, and affirmed the ultimate responsibility of the State to *preserve* and develop these resources in the best interest of all the citizens and that the prudent utilization of these resources is *essential* to the general welfare.⁶ Long ago the North Carolina General Assembly directed the Commission to set pollution standards for air as follows: “Standards of water and air purity shall be designed to protect human health, to prevent injury to plant and animal life, to prevent damage to public and private property, to insure the continued enjoyment of the natural attractions of the State, to encourage the expansion of employment opportunities, to provide a permanent foundation for healthy industrial development and to secure for the people of North Carolina, now and in the future, the beneficial uses of these great natural resources.”

The Petition requests that Commission promulgate a rule that:

- (1) Ensures that Statewide carbon dioxide (“CO₂”) emissions peak in the year 2015;

² N.C. CONST. art. XIV § 5.

³ 15A N.C.A.C. § 02A .0103.

⁴ N.C.G.S. § 143-215.105 *specifically* §§ 143-211 and 143-213.

⁵ N.C.G.A. § 143-211(a) (emphasis added).

⁶ *Id.*

- (2) Adopts and implements a CO₂ emissions reduction plan that, consistent with the best available science, reduces Statewide CO₂ emissions by at least 4% annually until at least 2050;
- (3) Establishes an accounting, verification, and inventory system for Statewide CO₂ emissions;
- (4) Requires the issuance of annual reports providing the public with accurate data on the effectiveness of North Carolina's efforts to reduce CO₂ emissions; and
- (5) Requires the adoption of any policies or regulations necessary to implement the emissions reduction plan referred to in (1) through (4) above.

Petitioner's proposed rule is based on the best available science. The best available science indicates that atmospheric CO₂ concentrations must return to 350 parts per million ("ppm") by century's end.⁷ In order to meet this target, CO₂ emissions must be reduced by an adequate margin each year.⁸ The rate of emission reductions required to return the atmospheric CO₂ concentration to a safe level depends on the year in which emissions peaked.⁹ For example, "if emissions reduction had begun in 2005, reduction at 3.5%/year would have achieved 350 ppm at 2100."¹⁰ A peak in 2012 or 2020 would require annual reductions of 6% and 15%, respectively.¹¹

According to North Carolina's emissions data, CO₂ emissions in the State peaked in 2007.¹² Dr. Pushker A. Kharecha, co-author with Dr. James Hansen on the scientific publication, *Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, which has been attached as Exhibit A, confirmed that with a peak year of 2007, CO₂ emissions must be reduced by 4% per year in order to achieve safe atmospheric CO₂ concentrations by century's end.¹³ Accordingly, this petition is seeking a 4% annual CO₂ emission reduction rate.

The North Carolina Division of Air Quality ("DAQ") is the Division responsible for developing and implementing air quality standards pursuant to 15A N.C.A.C. 02I .0501(a), therefore, this Petition is addressed to Ms. Sheila Holman, the Director of the North Carolina Division of Air Quality. As required by 15A N.C.A.C. 02I .0501(a), a copy of this Petition in electronic form has been sent to the Recording Clerk of the Environmental Management Commission.

Pursuant to the North Carolina Administrative Procedures Act, I submit Hallie's Petition for Rulemaking to the Commission for its consideration. Hallie will be ready to present her Petition

⁷ James Hansen et al., *Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, 8 PLOS ONE 1, 5, 10, 17-18 (2013).

⁸ *Id.*

⁹ *Id.* at 10, 18.

¹⁰ *Id.*

¹¹ *Id.* at 10, 18.

¹² Carbon dioxide emissions data taken from U.S. Energy Information Administration, available at http://www.eia.gov/environment/emissions/state/state_emissions.cfm.

¹³ Dr. Pushker A. Kharecha conferred the best method of calculating the required annual rate of emissions reductions if the peak year was 2007 and that his recommendations are based upon best available science.

to the Air Quality Committee at its January meeting of 2015. Please confirm your receipt of this Petition by contacting me at the address listed at the end of the Petition.

The following sections are organized in order to mirror the information identified as needed for a petition for rule-making pursuant to 15A N.C.A.C. 02I .0501(b) of the Commission's rules. The language of the corresponding numbered subsections of that rule appears in bold and italic script below.

(1) Provide the text of the proposed rule(s) conforming to the Codifier of Rules' requirements for publication of proposed rules in the North Carolina Register.

15A NCAC 2D § CARBON DIOXIDE EMISSIONS REDUCTION TARGETS

(1) The State must limit emissions of carbon dioxide to achieve the following emission reductions for North Carolina:

- (a) Statewide carbon dioxide emissions must peak in 2015;
- (b) Starting in 2016, statewide carbon dioxide emissions must be reduced by at least four percent per year each year until 2050.

(2) By January, 2015, the Environmental Management Commission and the Division of Air Quality shall adopt a carbon dioxide emissions reduction plan to achieve the limits set forth in (1)(a)-(b);

(3) Consistent with this directive, the Commission shall take the following actions:

- (a) Publish annual progress reports on statewide carbon dioxide emissions on the Division of Air Quality website for public review. These reports shall include an accounting and inventory for each and every source of carbon dioxide emissions within the State, without exception. This accounting must be verified by an independent, third-party. Annual reports must be posted to the Division of Air Quality website and be made publicly available no later than December 31 of each year, beginning in the year 2015.
- (b) Track progress toward meeting the emission reductions established in subsection 1(b), including the results from policies currently in effect, those that have been previously adopted by the State, and policies to be adopted in the future, and publicly report on that progress annually.

(4) By December 31st of each year beginning in 2015, the Division of Air Quality must report to the Governor and the appropriate Committees of the Senate and House of Representatives the total emissions of carbon dioxide for the preceding year, and totals in each major source sector. The Division of Air Quality shall ensure that reporting rules adopted under section (3)(a) allow it to develop a comprehensive inventory of emissions of carbon dioxide from all sectors of the state economy.

(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.

The purpose of this Petition and the proposed rule is to initiate a rulemaking process before the Division of Air Quality with the ultimate goal of having the DAQ promulgate a carbon dioxide emission reduction plan based on the best available science. Should the DAQ object to any particular word, phrase, or section of the proposed rule we request that the DAQ suggest an alternative phrasing that would accomplish the overall purpose of the Petition.

(2) Provide the statutory authority for the agency to promulgate the rule(s).

The North Carolina Environmental Management Commission ("Commission") is responsible for adopting rules for the protection and preservation of North Carolina's air quality and, in conjunction with the North Carolina Department of Environment and Natural Resources, oversees the Division of Air Quality. The Commission has the *duty and power* to adopt the rule proposed in this Petition for air quality and emissions control standards for air contaminant sources pursuant to N.C.G.S. § 143-215.107 and other statutes.¹⁴

In outlining the authorizing article for air pollution control, the North Carolina General Assembly incorporated the purpose and definitions of Article 21, Water and Air Resources.¹⁵ According to N.C.G.S. § 143-211(a), it is the –

"public policy of this State to provide for the conservation of its water and air resources. Furthermore, it is the intent of the General Assembly, within the context of this Article and Articles 21A and 21B of this Chapter, to *achieve and to maintain* for the citizens of the State *a total environment of superior quality*. Recognizing that *the water and air resources of the State belong to the people*, the General Assembly affirms the State's ultimate responsibility for the preservation and development of these resources in the *best interest of all its citizens* and declares the prudent utilization of these resources to be essential to the general welfare," (emphasis added).

Long ago, the North Carolina General Assembly enacted a statutory scheme to confer the necessary duties and powers to administer programs of air pollution management, abatement, and control on the Department of Environment and Natural Resources. This Commission is responsible for adopting rules for the protection and preservation of North Carolina's air quality and, in conjunction with the North Carolina Department of Environment and Natural Resources, oversees the Division of Air Quality as it carries out these duties and implements this program of pollution control. Explicit statutory authority for the Environmental Management Commission to promulgate the proposed rule is provided in N.C.G.S. § 143-215.107(a)(1) and N.C.G.S. § 143-215.107(a)(5).

When authorizing the Commission to act, the North Carolina General Assembly required it to adopt air quality standards to protect our environment in the future and not merely correct

¹⁴ 15A N.C.A.C. § 02A .0103 (emphasis added).

¹⁵ N.C.G.S. § 143-215.105, specifically §§ 143-211 and 143-213.

violations found in the past. These standards are to be protective and not merely reactive. Pursuant to N.C.G.S. § 143-211(c),

“[s]tandards of air purity are to be designed to protect human health, to prevent injury to plant and animal life, to prevent damage to public and private property, to encourage the expansion of employment opportunities, to provide a permanent foundation for healthy industrial development and to secure for the people of North Carolina, now and in the future, the beneficial uses of these great natural resources.”

There can be no permanent foundation for healthy industrial development while greenhouse gas concentrations rise out of control. There can be no secure enjoyment of the great natural resources in the future, if we fail to act today to limit greenhouse gas emissions.

The North Carolina General Assembly defined “air pollution” as “the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as is or tends to be injurious to human health or welfare, to animal or plant life or to property or that interferes with the enjoyment of life or property.”¹⁶ Carbon dioxide and other greenhouse gasses clearly meet the definition of air contaminants: “The term “air contaminant” means particulate matter, dust, fumes, gas, mist, smoke, or vapor or any combination thereof.”¹⁷ Ambient air concentrations of carbon dioxide are nearing a global atmospheric concentration of 400 ppm and CO₂ can remain in the atmosphere for thousands of years. As detailed below and in attached supporting documents, this increased concentration of carbon dioxide is injurious to human health, human welfare, animal life, plant life, property and the enjoyment of life and property. Therefore, there is no doubt that carbon dioxide constitutes “air pollution.”

To combat air pollution, the Commission was directed and empowered: (1) to prepare and develop a comprehensive plan for the prevention, abatement, and control of air pollution in the State; (2) to develop and adopt, after proper study, air quality standards to preserve and develop the State’s air resources; and (3) to develop and adopt emission control standards as, in the judgment of the Commission, may be necessary to prohibit, abate, or control air pollution commensurate with established air quality standards.¹⁸

It is abundantly clear that the General Assembly’s purpose in promulgating the Commission’s enabling statutes was to empower the Commission to have the power and authority necessary to protect air resources for both present and future generations. In addition to this clear mandate to protect air resources, additional sources of statutory authority that give the Commission authority to promulgate the proposed rule can be found in other provisions of N.C.G.S. § 143-215.107; N.C.G.S. § 143-215.108 (requiring permits before emitting air contaminants); and N.C.G.S. § 143-215.64 (requiring water and air quality reporting). Of course, the Commission is also required to adhere to the North Carolina Constitution, of which Article

¹⁶ N.C.G.S. § 143-213(5).

¹⁷ N.C.G.S. § 143-213(2).

¹⁸ N.C.G.S. § 143-215.107(a)(1)-(3).

XIV, § 5 is most relevant for the purposes of this Petition, and its fiduciary obligations as a trustee under the Public Trust Doctrine. While the Constitution and Public Trust Doctrine are not sources of statutory authority, they are additional sources of authority for the Commission to promulgate the rule proposed in this Petition.

In sum, the Commission's clear statutory mandate is to promulgate rules and regulations that protect and preserve North Carolina's air. Accordingly, the Commission has been granted the statutory duty and power to promulgate rules and regulations necessary to achieve such goals and has the statutory duty and authority to promulgate the proposed rule in this Petition.

(3) Provide a statement of the reasons for adoption of the proposed rule.

The reason for the proposed rule is to ensure that North Carolina is doing its part to reduce carbon dioxide emissions that contribute to global climate change and ocean acidification. The impacts of climate change are already being felt in North Carolina and throughout the United States. Scientific observations clearly show global warming over the past 50 years is caused by anthropogenic emissions of greenhouse gasses, including CO₂, primarily from burning fossil fuels.¹⁹ In North Carolina, climate change is causing, among other things, more extreme heat, rising sea levels, more intense hurricanes, and changing precipitation patterns with extreme swings between drought and heavy rainfalls.²⁰

The impacts of climate disruption have been extensively studied in North Carolina at the direction of the North Carolina General Assembly. In its final report, the North Carolina Legislative Commission formally endorsed the following list of impacts, which are likely to occur in the Southeastern United States, including North Carolina:

“Projected increases in air and water temperatures will cause heat-related stresses for people, plants, and animals. Effects of increased heat include more heat-related illness; declines in forest growth and agricultural crop production due to the combined effects of heat stress and declining soil moisture; declines in cattle production; increased buckling of pavement and railways; and reduced oxygen levels in streams and lakes, leading to fish kills and declines in aquatic species diversity. Decreased water availability is very likely to affect the region's economy as well as its natural systems. Increasing temperatures and longer periods between rainfall events coupled with increased demand for water will result in decreased water availability. Sea-level rise and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change. Low-lying areas, including some communities,

¹⁹ U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 2 (Jerry M. Melillo, Terese C. Richmond, & Gary W. Yohe eds., 2014), (November 24, 2014, 9:05 AM), <http://nca2014.globalchange.gov/downloads>.

²⁰ SIERRA C. WOODRUFF ET. AL., COASTAL HAZARDS CTR., UNIV. OF N.C. AT CHAPEL HILL., ADAPTING TO CLIMATE CHANGE: A HANDBOOK FOR LOCAL GOVERNMENTS IN NORTH CAROLINA 6 (2013), (November 24, 2014, 10:20 AM) <http://coastalhazardscenter.org/dev/wp-content/uploads/2013/06/adapt.pdf>.

will be inundated more frequently—some permanently—by the advancing sea. Current buildings and infrastructure were not designed to withstand the intensity of the projected storm surge, which would cause catastrophic damage. If sea-level rise increases at an accelerated rate (dependent upon ice sheet response to warming) a large portion of the Southeast coastal zone could be threatened. Ecological thresholds are likely to be crossed throughout the region, causing major disruptions to ecosystems and to the benefits they provide to people. Quality of life will be affected by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties.”²¹

The North Carolina Division of Air Quality subcommittee, is acutely aware of how reliant our health and economy is upon healthy air and how fragile are our air resources. As the DAQ has explained:

“Clean air is essential to public health, the environment, and the economy in North Carolina. We need clean air so people can breathe without triggering asthma and other health problems. We need clean air to preserve our forests, streams and lakes for public recreation and wildlife. We need clean air so citizens can view scenery in our mountains, parks and coastal areas. We need clean air to sustain tourism, forestry, and other aspects of the economy.

Despite the value of clean air, people often don't notice it unless there are problems such as smoke, haze, noxious fumes or bad odors. That's too bad. Consider this: Humans can live for days without water and weeks without food, but only a few minutes without air. That's why we need laws and regulatory programs to protect air quality. In North Carolina, the Division of Air Quality is primarily responsible for protecting and improving air quality.”²²

The United States Global Change Research Program²³ has confirmed that global warming is occurring and adversely impacting the Earth's climate.²⁴ The present rate of global heating is

²¹ FINAL REPORT TO THE GENERAL ASSEMBLY AND THE ENVIRONMENTAL REVIEW COMMISSION OF THE LEGISLATIVE COMMISSION ON CLIMATE CHANGE (MAY 2010) (NOVEMBER 26, 2014 10:31 AM), http://climateadaptationnc.nema6.org/LCGCC_Final_Report_05-20-10.pdf.

²² NORTH CAROLINA DIVISION OF AIR QUALITY, *Clearing the Air*, (November 24, 2014, 1:10 PM), <http://www.daq.state.nc.us/news/brochures/clearair.shtml> (emphasis added).

²³ The U.S. Global Change Research Program (USGCRP) was established by Presidential Initiative in 1989 and mandated by Congress in the Global Change Research Act (GCRA) of 1990 to “assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.” The organization's vision is to produce “[a] nation, globally engaged and guided by science, meeting the challenges of climate and global change.” Their mission is “to build a knowledge base that informs human responses to climate and global change through coordinated and integrated Federal programs of research, education, communication, and decision support.”, (November 24, 2014, 9:40 AM), <http://www.globalchange.gov/about/legal-mandate>.

²⁴ UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM (USGCRP), *Climate Change Impacts in the United States: Third National Climate Assessment 7* (2014) [hereinafter *Climate Change Impacts*], (November 24, 2014, 9:45 AM), <http://nca2014.globalchange.gov/downloads> (“Evidence for climate change abounds, from the top of the atmosphere to the depths of the oceans . . . Evidence of climate change is also visible in the observed and measured changes in location and behavior of species and functioning of ecosystems. Taken together, this evidence tells an

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.²⁵ This abnormal climate change is unequivocally human-induced,²⁶ is occurring now, and will continue to occur unless drastic measures are taken to curtail it.²⁷ Climate change is damaging both natural and human systems, and if unrestrained, will alter the planet's habitability.²⁸

A. Greenhouse Gas Emissions are Causing Climate Change to Endanger the Health and Welfare of Human Beings, Plants, and Animals

According to the United States Environmental Protection Agency ("EPA"), "the case for finding that *greenhouse gases in the atmosphere endanger public health and welfare is compelling and, indeed, overwhelming.*"²⁹ The EPA further stated in April 2009 that "the 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.*"³⁰ North Carolina's Legislative Commission on Climate Change explicitly found that climate change is real, that human activity is in part responsible for climate change and that the Commission should take action to address climate change.³¹

Human beings have significantly altered the chemical composition of the Earth's atmosphere and its climate system.³² Collectively, we have changed the atmosphere and the Earth's climate

unambiguous story: the planet is warming, and over the last half century, this warming has been driven primarily by human activity."

²⁵ *Id.* ("Multiple lines of independent evidence confirm that human activities are the primary cause of the global warming of the past 50 years."); DEUTSCHE BANK CLIMATE CHANGE ADVISORS, *Climate Change: Addressing the Major Skeptic Arguments* 9 (Sept. 2010), (November 24, 2014, 9:45 AM), http://www.climateaccess.org/sites/default/files/Carr_Addressing%20Skeptic%20Arguments.pdf;

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), *IPCC Fifth Assessment Report: Climate Change*

²⁶ USGCRP, *Climate Change Impacts*, *supra* note 25, at 7.

²⁷ *Id.* at 14 ("The cumulative weight of the scientific evidence contained in this report confirms that climate change is affecting the American people now, and that choices we make will affect our future and that of future generations."); IPCC, *AR5 1.2.2*, 124 (2013) ("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.") (key statement from IPCC Fourth Assessment Report).

²⁸ USGCRP, *Climate Change Impacts*, *supra* note 25, at 5 ("While some climate changes will occur slowly and relatively gradually, others could be rapid and dramatic, leading to unexpected breaking points in natural and social systems.").

²⁹ Proposed Endangerment Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 18886, 18904 (Apr. 24, 2009) (to be codified in 40 C.F.R. Chapter 1) (emphasis added).

³⁰ *Id.* (emphasis added).

³¹ FINAL REPORT TO THE GENERAL ASSEMBLY AND THE ENVIRONMENTAL REVIEW COMMISSION OF THE LEGISLATIVE COMMISSION ON CLIMATE CHANGE (MAY 2010) (NOVEMBER 26, 2014 (10:31 AM) http://climateadaptationnc.nemac.org/LCGCC_Final_Report_05-20-10.pdf

³² 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., 2007) ("We

system by engaging in activities that produce or release GHGs into the atmosphere.³³ Carbon dioxide ("CO₂") is the key GHG, and there is abundant evidence that its emissions are largely responsible for the current warming trend.³⁴ Although much of the excess carbon dioxide is absorbed by the oceans, plants, and forests, the increase of CO₂ resulting from historic and present human activities has altered the Earth's ability to maintain the delicate balance of energy it receives from the sun and that which it radiates back out into space.³⁵

In 2013, the CO₂ concentration in our atmosphere exceeded 400 ppm for the first time in recorded history³⁶ (compared to the pre-industrial concentration of 280 ppm).³⁷ The monthly average atmospheric CO₂ concentration for May 2014 was 401.88 ppm and the present annual mean is approximately 397 ppm.³⁸ Current atmospheric CO₂ concentrations are the highest they have been in the last 800,000 years.³⁹

Humans not only continue to add CO₂ into the atmosphere at a rate that outpaces its removal through natural processes,⁴⁰ but the current and projected CO₂ increase is about one hundred times faster than any that has occurred over the past 800,000 years.⁴¹ This increase has to be

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.").

³³ *Id.*

³⁴ See James E. Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?* 2 THE OPEN ATMOSPHERIC SCIENCE JOURNAL 217, 217-231 (2008), (November 24, 2014, 10:30 AM), http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf

³⁵ 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, 15-22 (Joseph F. C. DiMento & Pamela Doughman eds., 2007).

³⁶ NOAA, *Greenhouse Gases Continued Rising in 2013, 34 Percent Increase Since 1990*, (May 2, 2012), (November 24, 2014, 10:30 AM),

<http://research.noaa.gov/News/NewsArchive/LatestNews/TabId/684/ArtMid/1768/ArticleID/10553/Greenhouse-gases-continued-rising-in-2013-34-percent-increase-since-1990.aspx> ("We continue to turn the dial up on this 'electric blanket' of ours without knowing what the resulting temperatures will be.").

³⁷ IPCC, *AR5*, *supra* note 26, at TS.5.7.2, 100; NAT'L SCI. AND TECH. COUNCIL (NSTC), *Scientific Assessment of the Effects of Global Change on the United States 2* (May 2008) [hereinafter *Scientific Assessment*], (November 24, 2014, 10:30 AM), http://downloads.globalchange.gov/ccsp/CCSP_Scientific_Assessment_Full.pdf;

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* (Dec. 9, 2009) [hereinafter *TS Endangerment Findings*], (November 24, 2014, 10:35 AM),

http://www.epa.gov/climatechange/Downloads/endangerment/Endangerment_TSD.pdf.

³⁸ SCRIPPS, *CO₂ Data – Mauna Loa Observatory*, (November 24, 2014, 10:45 AM), <http://co2now.org/Current-CO2/CO2-Now/>.

³⁹ DIETER LÜTHI ET AL., *High-resolution carbon dioxide concentration record 650,000–800,000 years before present* 453 NATURE 379, 379-382 (May 2008), (November 24, 2014, 10:36 AM),

<http://www.nature.com/nature/journal/v453/n7193/full/nature06949.html> (Prior to this 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).

⁴⁰ EPA, *TS Endangerment Findings*, *supra* note 38, 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.").

⁴¹ LÜTHI, *supra* note 40, at 379-382.

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.⁴² The current concentration of CO₂ in the atmosphere, therefore, is the result of both historic and current emissions. What this means is that the impacts associated with the CO₂ emissions of today will be mostly borne by our children and future generations.

Changes in 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).⁴³ Collectively, these changes cannot be explained as the product of natural climate variability alone.⁴⁴ A large human contribution provides the best explanation of observed climate changes.⁴⁵

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.⁴⁶ The Earth will continue to warm in reaction to concentrations of CO₂ from past emissions as well as future emissions.⁴⁷ Warming already in the pipeline is mostly attributable to climate mechanisms that slowly heat the Earth's climate system in response to atmospheric CO₂.⁴⁸

B. Temperature Increases are Consistent and Trending Upwards

One key observable change due to the increased concentration of CO₂ in the atmosphere is the rapid increase in recorded global surface temperatures.⁴⁹ As a result of increased atmospheric

⁴² Hansen, *Target Atmospheric CO₂: Where Should Humanity Aim?*, *supra* note 35, at 220; *see also* EPA, *TS Endangerment Findings*, *supra* note 38, 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."); Abatzoglou, *supra* note 36, at 29 ("Since CO₂ has a lifetime of over one hundred years, these emissions have been collecting for many years in the atmosphere.").

⁴³ USGCRP, *Climate Change Impacts*, *supra* note 25, at 23.

⁴⁴ *Id.* at 24.

⁴⁵ Susan Solomon et al., *Irreversible climate change due to carbon dioxide emissions*, 106 PNAS 1704, 1704-09 (Feb. 10, 2009), (November 24, 2014, 10:45 AM), <http://www.pnas.org/content/106/6/1704.full.pdf+html>; IPCC, *AR5*, *supra* note 26, at 15.

⁴⁶ USGCRP, *Climate Change Impacts*, *supra* note 25, at 7.

⁴⁷ EPA, *TS Endangerment Findings*, *supra* note 38, at 26.

⁴⁸ FRED PEARCE, *WITH SPEED AND VIOLENCE: WHY SCIENTISTS FEAR TIPPING POINTS IN CLIMATE CHANGE 101-04* (2007), (November 24, 2014, 10:45 AM), <http://www.gci.org.uk/Documents/vsav.pdf>; IPCC, *AR5*, *supra* note 26, at 1.2.2, 128-29.

⁴⁹ NSTC, *Scientific Assessment*, *supra* note 38, at 51; IPCC, *AR5*, *supra* note 26, at 1.3.1, 131; USGCRP, *Climate Change Impacts*, *supra* note 25, at 22; EPA, *TS Endangerment Findings*, *supra* note 38, 26-30; Nat'l Aeronautics and Space Admin. (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 June 10, 2014).

GHGs from human activities, based on fundamental scientific principles, the Earth has been warming as scientists have predicted.⁵⁰ The increased concentrations of GHGs in our atmosphere have raised global surface temperature by 0.85°C (1.4°F) from 1880 to 2012.⁵¹ In the last century, the Earth has warmed at a rate “roughly ten times faster than the average rate of ice-age-recovery warming.”⁵²

Because of year-to-year variations in these thermometer readings, as with daily readings, scientists compare temperature differences over a decade to determine patterns.⁵³ Employing this decadal scale, the surface of the planet has warmed at a rate of roughly 0.12°C per decade since 1951.⁵⁴ 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.⁵⁵ Global surface temperatures have been rising dramatically since 1951, and 2010 tied for the hottest year on record, while “[t]he year 2013 tied with 2009 and 2006 for the seventh warmest year since 1880.”⁵⁶ April 2014 tied with April 2010 as the warmest April globally since 1880.⁵⁷

The dramatic increase of the average global surface temperature is alarming. It has become quite clear that the past several decades present an anomaly, as global surface temperatures from 2000-2009 are registering higher than at any point in the past 1,300 years.⁵⁸ The Intergovernmental Panel on Climate Change (“IPCC”) has observed that “[w]arming of the climate system is unequivocal.”⁵⁹ The United States Environmental Protection Agency (“EPA”) has recognized the scientific consensus that has developed on the fact of global warming and its cause: the Earth is heating up due to human activities.⁶⁰

⁵⁰ IPCC, *AR5*, *supra* note 26, at TS.2.2.1, 37; USGCRP, *Climate Change Impacts*, *supra* note 8, at 22; EPA, *TS Endangerment Findings*, *supra* note 38, at 48.

⁵¹ IPCC, *AR5*, *supra* note 26, at B.1, 5; NASA, *Climate Change: Key Indicators*, http://climate.nasa.gov/key_indicators#globalTemp (last visited June 12, 2014).

⁵² NASA, NASA Earth Observatory, *How is Today's Warming Different from the Past?*, (November 24, 2014, 10:50 AM), <http://earthobservatory.nasa.gov/Features/GlobalWarming/page3.php>

⁵³ IPCC, *AR5*, *supra* note 26, at TS.2.2.1, 37.

⁵⁴ *Id.* at B.1, 5.

⁵⁵ The Nat'l Academies Press (Board on Atmospheric Sciences and Climate), *Surface Temperature Reconstructions for the Last 2,000 Years* 3 (2006), (November 24, 2014, 10:50 AM),

http://www.nap.edu/catalog.php?record_id=11676.

⁵⁶ NASA, *Global Climate Change – Global Surface Temperature*, (November 24, 2014, 10:51 AM), http://climate.nasa.gov/key_indicators#globalTemp; NASA, *Global Climate Change: Vital Signs of the Planet*, (November 24, 2014, 10:50 AM), <http://climate.nasa.gov/> (“January 2000 to December 2009 was the warmest decade on record.”).

⁵⁷ NOAA, *Global Analysis-April 2014*, available at <http://www.ncdc.noaa.gov/sotc/global/> (last visited June 12, 2014).

⁵⁸ USGCRP, *Climate Change Impacts*, *supra* note 25, at 23.

⁵⁹ IPCC, *AR5*, *supra* note 26, at B, 4.

⁶⁰ EPA, *TS Endangerment Findings*, *supra* note 38, 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).

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 surfaces,⁶¹ but also to the warming of oceans,⁶² increased atmospheric moisture levels,⁶³ rises in the global sea level,⁶⁴ and changes in rainfall⁶⁵ and atmospheric air circulation patterns that affect water and heat distribution.⁶⁶

As expected (and consistent with the temperature increases in land surfaces), ocean temperatures have also increased.⁶⁷ 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.⁶⁸ The average temperature of the global ocean has increased significantly despite its amazing ability to absorb enormous amounts of heat before exhibiting any indication thereof.⁶⁹ 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.⁷⁰

In North Carolina, average temperatures are expected to rise by 4-5°F in the winter and 6-7°F in the other seasons by 2100 as a result of CO₂ and other GHG emissions, producing more intense and frequent heat waves.⁷¹ The expected results include reduced recreation and tourism, increased demand for electricity for cooling, reduced agricultural production, and an increase in heat-related injury and death.⁷²

C. Sea Level is Rising

As expected, global sea levels have risen as a result of increasing CO₂ emissions.⁷³ Sea levels have been rising at an average rate of 3.2 millimeters per year (0.13 inches) based on

⁶¹ IPCC, *AR5*, *supra* note 26, at TS.2.2.1, 37.

⁶² *Id.* at TS.2.2.3, 38.

⁶³ USGCRP, *Climate Change Impacts*, *supra* note 25, at 33; B.D. Santer et al., *Identification of Human-Induced Changes in Atmospheric Moisture Content*, 104 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 15248, 15248-53 (Sept. 25, 2007), (November 24, 2014, 10:52 AM), <http://www.pnas.org/content/104/39/15248.full.pdf+html>

⁶⁴ IPCC, *AR5*, *supra* note 26, at TS.2.6, 46.

⁶⁵ USGCRP, *Climate Change Impacts*, *supra* note 25, at 26, 32-33, 36.

⁶⁶ IPCC, *AR5*, *supra* note 26, at TS.2.4, 39.

⁶⁷ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), *IPCC Fifth Assessment Report: Climate Change 2013-Working Group II 6.1.1.1, 7* (2013) [hereinafter *AR5*], (November 24, 2014, 10:55 AM), <http://www.ipcc.ch/report/ar5/wg2/>; EPA, *TS Endangerment Findings*, *supra* note 38 at ES-2.

⁶⁸ USGCRP, *Climate Change Impacts*, *supra* note 25, at 560.

⁶⁹ United Nations Environment Programme (UNEP), *Climate Change Science Compendium 2009 26* (2009), (November 24, 2014, 10:55 AM), <http://www.unep.org/compendium2009/>.

⁷⁰ S. Levitus et al., *Global Ocean Heat Content 1955-2008 in Light of Recently Revealed Instrumentation Problems* 36 J. GEOPHYSICAL RES. LETTERS L07608 (Apr. 2009), (November 24, 2014, 10:55 AM), <ftp://ftp.nodc.noaa.gov/pub/data.nodc/vwoa/PUBLICATIONS/grlheat08.pdf>.

⁷¹ *Id.*

⁷² *Id.* at 34.

⁷³ USGCRP, *Climate Change Impacts*, *supra* note 25, at 44; EPA, *TS Endangerment Findings*, *supra* note 38, at ES-3; IPCC, *AR5*, *supra* note 26, at B.4, 11

measurements from 1993 to 2010.⁷⁴ 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

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 immediate 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.⁸²

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 this century between 0.5 and 2 meters (1½ to 6½ feet), continuing to rise for several centuries after that, depending on future CO₂ levels and the behavior of polar ice sheets.⁸³ "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."⁸⁴ Low-lying lands are especially vulnerable to sea level rise. Between 1996 and 2011, 20 square miles of land were inundated by rising sea levels along the Atlantic coast.⁸⁵ Scientists have predicted that wetlands in the Mid-Atlantic region of the United States cannot withstand a 7-millimeter per year rise in

⁷⁴ IPCC, *AR5*, *supra* note 26, at B.4, 11.

⁷⁵ NASA, *Climate Change: How Do We Know? - Sea Level Rise*, (November 24, 2014, 10:57 AM) <http://climate.nasa.gov/evidence/#no4> (citing J.A. Church & N.J. White, *A 20th Century Acceleration in Global Sea Level Rise* 33 *Geophysical Research Letters* (2006)).

⁷⁶ EPA, *TS Endangerment Findings*, *supra* note 38, at ES-7; USGCRP, *Climate Change Impacts*, *supra* note 25, at 45.

⁷⁷ USGCRP, *Climate Change Impacts*, *supra* note 25, at 45; EPA, *TS Endangerment Findings*, *supra* note 38, at 75.

⁷⁸ EPA, *TS Endangerment Findings*, *supra* note 38, at 86, 118.

⁷⁹ IPCC, *AR5*, *supra* note 26, at E.6, 26.

⁸⁰ EPA, *TS Endangerment Findings*, *supra* note 38, at 121.

⁸¹ *Id.* at 128; USGCRP, *Climate Change Impacts*, *supra* note 25, at 589 (Annual damage resulting from sea level rise "in the Gulf region alone could be \$2.7 to \$4.6 billion by 2030, and \$8.3 to \$13.2 billion by 2050.").

⁸² EPA, *TS Endangerment Findings*, *supra* note 38, at 159.

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, 168 (2011), (November 24, 2014, 11:00 AM), <http://rsta.royalsocietypublishing.org/content/369/1934/161.full.pdf+html>.

⁸⁴ U.S. CLIMATE CHANGE SCIENCE PROGRAM (USCCSP), COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 2 (Jan. 2009) [hereinafter *Coastal Sensitivity to Sea-Level Rise*], (November 24, 2014, 11:05 AM), <http://downloads.globalchange.gov/sap/sap4-1/sap4-1-final-report-all.pdf>.

⁸⁵ EPA, *Climate Impacts in the Southeast*, (November 24, 2014, 11:05 AM), <http://www.epa.gov/climatechange/impacts-adaptation/southeast.html#impactscoast>, (citing USGCRP, *Global Climate Change Impacts in the United States: Second National Climate Assessment* (2009)).

sea levels.⁸⁶ As wetlands are inundated, further impacts from sea level rise will multiply, as “protection of coastal lands and people against storm surge will be compromised.”⁸⁷

Glacial and ice cap melting is one of the major causes of global sea level change. When glaciers and ice caps melt, this adds water to the ocean.⁸⁸ Another cause is that as ocean water warms, it expands and takes up more space.⁸⁹ Therefore, “sea level rise is expected to continue well beyond this century as a result of both past and future GHG emissions from human activities.”⁹⁰

The rate of sea-level rise (“SLR”) on North Carolina’s coast has already reached 18 inches per century, but is projected to accelerate due to climate change, resulting in SLR of 39-55 inches, approximately three to four feet, by 2100.⁹¹ The North Carolina Coastal Resources Commission recommended adopting a projected SLR of 39 inches by 2100 for policy development and planning purposes.⁹² This alarming SLR will result in damage to coastal property and infrastructure, a decline in coastal tourism, damage to coastal agriculture and fisheries, increased flooding, saltwater intrusion into water supplies, and the outright loss of beaches.⁹³

D. Ocean Acidification

The negative effects of increased CO₂ emissions are not limited to changes in our climate systems. Rather, CO₂ emissions are also having a severe impact on our oceans. As it stands, the oceans absorb around 30 percent of global CO₂ emissions.⁹⁴ This absorption has greatly mitigated the effects CO₂ otherwise would have had on our climate.⁹⁵ However, the cost of this mitigation has been a pernicious change in our ocean’s chemistry.⁹⁶

Ocean acidification is defined as “a reduction in the pH of seawater for an extended period of time due primarily to the uptake of carbon dioxide from the atmosphere by the ocean.”⁹⁷ Over

⁸⁶ USCCSP, *Coastal Sensitivity to Sea-Level Rise*, *supra* note 85, at 4.

⁸⁷ USGCRP, *Climate Change Impacts*, *supra* note 25, at 402.

⁸⁸ USGCRP, *Climate Change Impacts*, *supra* note 25, at 44.

⁸⁹ *Id.*

⁹⁰ *Id.* at 45.

⁹¹ STANLEY R. RIGGS ET AL., *THE BATTLE FOR NORTH CAROLINA’S COAST: EVOLUTIONARY HISTORY, PRESENT CRISIS, & VISION FOR THE FUTURE 3* (2011).

⁹² SCI. PANEL ON COASTAL HAZARDS, N.C. COASTAL RES. COMM’N, *NORTH CAROLINA SEA-LEVEL RISE ASSESSMENT REPORT 12* (2010), (November 24, 2014, 11:10 AM), http://portal.ncdenr.org/c/document_library/get_file?uuid=724b16de-ef9f-4487-bddf-e1cb20e79ca0&groupId=38319.

⁹³ Woodruff et. al., *supra* note 21 at 54.

⁹⁴ Ellycia Harrould-Kolieb & Jacqueline Savitz, *Acid Test: Can We Save Our Oceans From CO₂?*, *Oceana* 2 (2d ed. 2009) [hereinafter *Acid Test*], available at http://www.salemspound.org/PDF/Acidification_Report-09.pdf (last visited June 14, 2014).

⁹⁵ *Id.*

⁹⁶ *Id.*

⁹⁷ Washington State Blue Ribbon Panel on Ocean Acidification, *Ocean Acidification: From Knowledge to Action, Washington State’s Strategic Response* xi (H. Adelman & L. Whitely Binder eds., 2012) [hereinafter *Strategic*].

the last 250 years, humans have increased atmospheric CO₂ concentrations by 40 percent.⁹⁸ The oceans, in turn, have absorbed about a quarter of this CO₂.⁹⁹ As CO₂ has been absorbed and dissolved in the seawater it has had an acidifying effect.¹⁰⁰ As a result, “[o]ver the last 250 years, the average upper-ocean pH has decreased by about 0.1 units, from about 8.2 to 8.1.”¹⁰¹ This drop in pH corresponds with a 30 percent increase in surface ocean acidity.¹⁰²

Ocean acidity has been rising at a geologically unprecedented rate. Currently, acidity is rising at least 100 times faster than at any other period during the last 100,000 years.¹⁰³ There have been periods during which atmospheric CO₂ concentration and oceanic pH have been higher than today’s levels. However, the rate at which these levels were reached was much slower than the rate at which atmospheric CO₂ and oceanic pH are changing today.¹⁰⁴ For example, around 55 million years ago, during the Paleocene-Eocene Thermal Maximum (“PETM”), atmospheric CO₂ concentrations increased to around 1800 ppm and the pH of the oceans declined by around 0.45 units over roughly 5000 years.¹⁰⁵ This rise in pH resulted in an extinction event, during which “about half of benthic foraminifera (tiny shelled protists) species went extinct over a 1000-year period.”¹⁰⁶ Today, the rate at which acidity is rising is nearly ten times faster than during the period leading up the PETM extinction event.¹⁰⁷ The danger here is that the rate of acidification may outpace the natural capacity of the ocean to buffer the excess CO₂ levels.¹⁰⁸ Scientists have projected that if anthropogenic CO₂ emissions continue at present trends, oceanic pH may drop another 0.5 units by 2100.¹⁰⁹ This represents a threefold decrease from pre-industrial times. Such a drop would also bring oceanic pH outside the natural range of CO₂.

Response], available at <https://fortress.va.gov/ecy/publications/publications/1201015.pdf> (last visited June 14, 2014).

⁹⁸ *Id.* at 9.

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ *Id.*

¹⁰² *Id.*

¹⁰³ Harrould-Kolieb, *Acid Test*, *supra* note 95, at 7.

¹⁰⁴ Washington Shellfish Institute Blue Ribbon Panel on Ocean Acidification, *Scientific Summary of Ocean Acidification*, *supra* note 98, at 9.

¹⁰⁵ *Id.*; P. Jardine, *Patterns in Palaeontology: The Paleocene-Eocene Thermal Maximum*, Paleontology Online (Jan. 10, 2011), available at <http://www.paleontologyonline.com/articles/2011/the-paleocene-eocene-thermal-maximum/> (last visited June 12, 2014) (“This warming has been linked to a similarly rapid increase in the concentration of greenhouse gases in Earth’s atmosphere, which acted to trap heat and drive up global temperatures by more than 5 °C in just a few thousand years. The fossil record gives us the means of understanding how life was affected by the PETM, and so provides an excellent opportunity to study the relationships between evolution, extinction, migration and climate change.”).

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

¹⁰⁹ The Royal Society, *Ocean Acidification Due to Increasing Atmospheric Carbon Dioxide* vi (2005), available at http://coralreef.noaa.gov/aboutcrp/strategy/reprioritization/wgroups/resources/climate/resources/oa_royalsociety.pdf (last visited June 14, 2014).

The results of ocean acidification create similar impacts in shellfish and other crustaceans as osteoporosis creates in humans.¹¹⁰ Many important marine organisms, including shellfish and corals, require sufficient concentrations of carbonate and bicarbonate in order to build structures, such as shells, out of calcium carbonate (CaCO₃).¹¹¹ As acidity increases, shells become thinner, growth slows down and death rates rise.¹¹² Calcium carbonate will dissolve in seawater unless the water is saturated with carbonate ions.¹¹³ Calcium carbonate also becomes more soluble as temperature decreases and pressure increases.¹¹⁴ As a result, as depth increases, causing temperature to decrease and pressure to increase, calcium carbonate becomes more soluble.¹¹⁵ These variables (carbonate ion concentrations, temperature, and pressure) interact to create a natural barrier, known as a saturation horizon, below which calcium carbonate will dissolve, and above which calcium carbonate is capable of forming.¹¹⁶ As more anthropogenic CO₂ has dissolved, the carbonate ion concentration has decreased causing the saturation horizon for calcium carbonate to rise.¹¹⁷ To survive, calcium carbonate-dependent species must live above the saturation horizon.¹¹⁸ As the saturation horizon rises, it poses a greater threat to calcium carbonate-dependent marine species by reducing their habitat.¹¹⁹ Without immediate science-based action to curb carbon dioxide emissions, the oceans undergo mass extinctions of marine animals, significantly altering the marine food web dynamics, and impacting the lives and sustenance of coastal citizens, including those in North Carolina.

Duke University researchers have found evidence of dramatic pH changes occurring to North Carolina's coastal waters over a short time frame, which are compounded by the long-term increasing acidification of the oceans. Water samples taken at the marine lab on Piver's Island over the course of a year showed variability in the acidity of the waters that exceeded the expected change in ocean acidity predicted in the world's oceans for the next 100-years.¹²⁰

¹¹⁰ NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, transcript, *Ocean Acidification's Impact on Oysters and Other Shellfish*, available at <http://www.pmel.noaa.gov/co2/story/Ocean+Acidification%27s+impact+on+oysters+and+other+shellfish> (December 4, 2014, 11:20 AM)

¹¹¹ Royal Society, *Ocean Acidification Due to Increasing Atmospheric Carbon Dioxide* vi (2005), at 10.

¹¹² NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, transcript, *Ocean Acidification's Impact*, *supra*, note 111, *see also*, The Economist, *Ocean Acidification*, THE ECONOMIST, January 18, 2014, <http://www.economist.com/news/science-and-technology/21594238-acid-seas-mean-smaller-more-vulnerable-oysters-shrinking-problem> (December 4, 2014, 11:35 AM)

¹¹³ Royal Society, *Ocean Acidification Due to Increasing Atmospheric Carbon Dioxide* vi (2005), at 10.

¹¹⁴ *Id.*

¹¹⁵ *Id.*

¹¹⁶ *Id.*

¹¹⁷ *Id.*

¹¹⁸ *Id.* at 11.

¹¹⁹ *Id.*

¹²⁰ Zackary I. Johnson, *Dramatic Variability of the Carbonate System at a Temperate Coastal Ocean Site (Beaufort, North Carolina, USA) Is Regulated by Physical and Biogeochemical Processes on Multiple Timescales*, December 17, 2013, DOI: 10.1371/journal.pone.0085117; *see also* North Carolina Coastal Federation, WORKING TOGETHER FOR A HEALTHY COAST: Casting New Light on Ocean Acidity, February 2, 2014 <http://www.nccoast.org/m/article.aspx?k=8665aea9-11e7-4cd1-b125-1a5449cc4a04> (December 4, 2014, 10:50 AM)

In many U.S. East Coast estuaries ocean acidification is quickly threatening shellfish like Eastern oysters, hard clams, soft-shelled clams, mussels, and bay clams.¹²¹ In 2010, the value of shellfish landings in Mid-Atlantic and Southeastern coastal states totaled \$497 million.¹²² The 2012 value of North Carolina shellfish aquaculture from commercial landings alone was nearly \$42 million.¹²³

E. Precipitation Patterns are Being Disrupted

As predicted, precipitation patterns have changed due to increases in atmospheric moisture levels and changes in atmospheric air circulation patterns, another indicator that the Earth is warming.¹²⁴ Moisture levels increase when temperature increases because warmer air generally holds more moisture.¹²⁵ In more arid regions, however, higher temperatures lead to greater evaporation.¹²⁶ These changes in the Earth's hydrological cycle increase the potential for, and severity of, severe storms, flooding, and droughts.¹²⁷ Storm-prone areas are already experiencing a greater chance of severe storms, and this will continue.¹²⁸ Even in arid regions, increased precipitation is likely to cause flash flooding, and will be followed by drought.¹²⁹ Droughts in parts of the midwestern, southeastern, and southwestern United States have increased in frequency and severity within the last fifty years, coinciding with rising temperatures.¹³⁰ Most of the recent heat waves can be attributed to human-caused climate disruption.¹³¹ Climate change is already causing, and will continue to result in, more frequent, extreme, and costly weather events (such as hurricanes).¹³² 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.¹³³

As the 2010 Russian summer heat wave graphically demonstrated, heat can destroy crops, trigger wildfires, exacerbate air pollution, and cause increased illness and deaths.¹³⁴ Similar impacts are occurring across the United States. Precipitation and stream temperatures are

¹²¹ NATURAL RESOURCES DEFENSE COUNCIL, <http://www.nrdc.org/oceans/acidification/files/ocean-acidification-eastcoast.pdf> (December 4, 2014, 10:55 AM).

¹²² *Id.*

¹²³ NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, "Annual Commercial Landings by Group," http://www.st.nmfs.noaa.gov/st1/commercial/landings/ge_runc.html (December 4, 2014, 11:05 AM).

¹²⁴ USGCRP, *Climate Change Impacts*, *supra* note 25, at 1, 27, 32, 36.

¹²⁵ EPA, *TS Endangerment Findings*, *supra* note 38, at 111.

¹²⁶ *Id.*

¹²⁷ *Id.*

¹²⁸ *Id.* at 120-21; USGCRP, *Climate Change Impacts*, *supra* note 25, at 43.

¹²⁹ EPA, *TS Endangerment Findings*, *supra* note 38, at 115.

¹³⁰ *Id.* at 143, 145, 148.

¹³¹ USGCRP, *Climate Change Impacts*, *supra* note 25, at 38 ("The summer 2011 heat wave and drought in Texas was primarily driven by precipitation deficits, but the human contribution to climate change approximately doubles the probability that the heat was record-breaking.").

¹³² USGCRP, *Climate Change Impacts*, *supra* note 25, at 38.

¹³³ NSTC, *Scientific Assessment*, *supra* note 38, at 7.

¹³⁴ See NOAA Earth System Research Lab, *The Russian Heat Wave 2010* (Sept. 2010), (November 24, 2014, 11:11 AM), <http://www.esrl.noaa.gov/psd/csi/moscow2010/>.

increasing in most of the continental United States. The growth of many crops and weeds is being stimulated with adverse impacts outweighing any short-term benefits. Up to 30 percent of the millions of species on our planet could go extinct following just a few tenths of a degree warming above present.¹³⁵ Coastal storms and associated storm surges, paired with increased sea level rise, have the power to erode shorelines, move barrier islands, and disrupt human habitation.¹³⁶ The number of Category 4 and 5 hurricanes in the Atlantic basin has increased substantially since the early 1980s compared to the historical record that dates back to the mid-1880s.¹³⁷ Although no one storm can be directly linked to climate change, the increase in number of storms and their intensity is consistent with the increase in GHG emissions. Experts state that this trend of increasing hurricane intensity is expected to continue, causing increased damage to critical infrastructure, losses to businesses, storm-related injury and death, human displacement, and degradation of coastal resources.¹³⁸

Normally, coastal storm risks would be passed on to insurance companies. However, over 40 percent of the insurance policies written in North Carolina's coastal area are "Beach Plan" policies.¹³⁹ The "Beach Plan" was intended as an insurance plan of last resort where homeowners and other insureds could turn when they could not purchase satisfactory private insurance.¹⁴⁰ Because this insurance is not purchased on the open market, it is not underwritten by private insurers and the costs and risks are carried by the citizens of North Carolina. In fact, insurance companies operating in North Carolina have recently asked for up to 25-35 percent rate increases citing the increasing practice of consent-to-rate plans and "Beach Plan" reliance as evidence that they cannot effectively cover North Carolina's hurricane risk exposure even under the status quo.¹⁴¹

F. Crop, Livestock, and Forest Losses are Attributable to Greenhouse Gas Emissions

The disruption in the hydrological cycle due to climate change alters water supplies and water quality and will impact agriculture in the United States.¹⁴² Increased heat and associated issues such as pests, crop diseases, and weather extremes, will all impact crop and livestock production and quality.¹⁴³ 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

¹³⁵ IPCC, *ARS*, *supra* note 26, at 4.3.2.5, 30.

¹³⁶ RIGGS et al., *supra* note 92, at 24.

¹³⁷ U.S. Global Change Research Program, *supra* note 24, at 398.

¹³⁸ WOODRUFF et al., *supra* note 21 at 42.

¹³⁹ North Carolina Department of Insurance, 2014 Homeowners Insurance Rate Hearing Transcripts, 10-20 Morning Hearing Transcripts at 30. (November 24, 2014, 11:15 AM), http://www.ncdoi.com/PC/PC_Hearing_Transcripts.aspx.

¹⁴⁰ North Carolina Department of Insurance, (November 24, 2014, 11:15 AM), http://www.ncdoi.com/hurriclaims/typesofcoverage_beachfairplan.aspx.

¹⁴¹ 2014 Homeowners Insurance Rate Hearing Transcripts, *supra* note 140, at 31.

¹⁴² USGCRP, *Climate Change Impacts*, *supra* note 25, at 161; See United States Department of State (USDS), 2014 *Climate Action Report (Draft/Not Final)* 6,4 (Sept. 26, 2013) [hereinafter *Climate Action Report*], available at <http://www.state.gov/e/oes/climate/ccreport2014/index.htm>.

¹⁴³ USDS, *Climate Action Report*, *supra* note 143.

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.¹⁴⁴ 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.¹⁴⁵

Agriculture is extremely susceptible to climate changes and higher temperatures generally reduce yields of desirable crops while promoting pest and weed proliferation.¹⁴⁶ Global climate change is predicted to decrease crop yields, increase crop prices, decrease worldwide calorie availability, and by 2050 increase child malnutrition by 20 percent.¹⁴⁷

In 2007 North Carolina suffered its worst drought in more than 100 years.¹⁴⁸ The frequency and intensity of droughts in North Carolina is expected to increase in the future due to climate change.¹⁴⁹ This may cause decreased agricultural production, decreased production of electricity, water-use restrictions, and reduced water quality.¹⁵⁰ Furthermore, drier conditions due to drought may increase the frequency and intensity of wildfires.¹⁵¹

G. Climate Change is Causing Adverse Human Health Impacts

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.¹⁵² The World Health Organization has stated that “[l]ong-term climate change threatens to exacerbate today’s problems while undermining tomorrow’s health systems, infrastructure, social protection systems, and supplies of food, water, and other ecosystem products and services that are vital for human health.”¹⁵³ 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

¹⁴⁴ 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* 15 (June 2008) [hereinafter *Weather and Climate Extremes*], (November 24, 2014, 11:15 AM), http://www.agci.org/dB/PDFs/Publications/07S1_USCCSP.pdf.

¹⁴⁵ *Id.*

¹⁴⁶ USCCSP & USDA, *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity*, in SYNTHESIS AND ASSESSMENT PRODUCT 4.3 59 (May 2008), (“Many weeds respond more positively to increasing CO₂ than most cash crops, . . . 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.”).

¹⁴⁷ *Id.*

¹⁴⁸ *Id.* at 6.

¹⁴⁹ *Id.* at 20.

¹⁵⁰ *Id.*

¹⁵¹ *Id.* at 23.

¹⁵² See THE CENTER FOR HEALTH AND THE GLOBAL ENVIRONMENT, HARVARD MEDICAL SCHOOL, CLIMATE CHANGE FUTURES: HEALTH, ECOLOGICAL, AND ECONOMIC DIMENSIONS (Nov. 2005), (November 24, 2014, 11:18 AM), http://coralreef.noaa.gov/aboutcrp/strategy/reprioritization/vgroups/resources/climate/resources/cc_futures.pdf; USGCRP, *Climate Change Impacts*, *supra* note 25, at 221-28.

¹⁵³ WORLD HEALTH ORGANIZATION, ATLAS OF HEALTH AND CLIMATE 4 (Oct. 2012), (November 24, 2014, 11:20 AM), <http://www.who.int/globalchange/publications/atlas/report/en/>.

infectious disease and even “halt or reverse the progress that the global public health community is now making against many of these diseases.”¹⁵⁴

H. Climate Change Increases Threats to National Security and Disrupts Global Politics

The changing climate also raises national security concerns, as “climate change will add to tensions even in stable regions of the world.”¹⁵⁵ The U.S. Department of Defense has acknowledged the severity of climate change and its connections to national security.¹⁵⁶ The Quadrennial Defense Review classified climate change as a “threat multiplier.”¹⁵⁷ Specifically, “Pentagon leaders have identified three main ways that climate change will affect security: accelerating instability in parts of the world wracked by drought, famine, and climate-related migrations; threatening U.S. military bases in arid Western states or on vulnerable coastlines; and increasing the need for U.S. forces to respond to major humanitarian disasters.”¹⁵⁸ The United States may experience an additional need to accept immigrant and refugee populations as droughts increase and food production declines in other countries.¹⁵⁹ Increased extreme weather events (such as hurricanes) will also present an increased strain on foreign aid and call for military forces.¹⁶⁰ For instance, by 2025, 40 percent 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, of millions of people.¹⁶¹

I. The Public Trust Doctrine Requires North Carolina to Protect its Air Resources

The Public Trust Doctrine holds government responsible, as a perpetual trustee, for the protection of essential natural resources—such as air, water, and the sea—for the benefit of present and future generations. Governments, including the State of North Carolina, have a fiduciary obligation to protect these essential natural resources, the trust *res*, for the benefit of all people, including generations yet unborn. The public trust doctrine is an inalienable attribute of sovereignty that no government can disclaim.¹⁶² The Public Trust Doctrine traces its roots back to 530 A.D. to the legal reforms of the Roman Emperor Justinian:

¹⁵⁴ WORLD HEALTH ORGANIZATION, PROTECTING HEALTH FROM CLIMATE CHANGE: CONNECTING SCIENCE, POLICY, AND PEOPLE 02 (2009), (November 24, 2014, 11:20 AM), <http://www.who.int/globalchange/publications/reports/9789241598880/en/index.html>.

¹⁵⁵ THE CNA CORP., MILITARY ADVISORY BD., NATIONAL SECURITY AND THE THREAT OF CLIMATE CHANGE 7 (Apr. 1, 2007), (November 24, 2014, 11:21 AM), <http://www.cna.org/research/2007/national-security-threat-climatechange>.

¹⁵⁶ Keith Johnson, *A Clear and Present Danger*, Foreign Policy 3 (May 6, 2014), (November 24, 2014, 11:22 AM), http://www.foreignpolicy.com/articles/2014/05/06/a_clear_and_present_danger (“Environmental issues, energy issues—they are all connected, and they are all integrated into our national security.”).

¹⁵⁷ *Id.* at 3.

¹⁵⁸ *Id.*

¹⁵⁹ CNA Corporation, *supra* note 156, at 7.

¹⁶⁰ *Id.*

¹⁶¹ *Id.* at 16.

¹⁶² *Illinois Cent. R.R. Co. v. Illinois*, 146 U.S. 387, 455 (1892).

By the law of nature, these things are common to mankind—the air, running water, the sea, and consequently the shores of the sea. No one, therefore, is forbidden to approach the seashore, provided that he respects habitations, monuments, and buildings which are not, like the sea, subject only to the law of nations.¹⁶³

While early cases recognized marine resources, tidal waters and the submerged lands beneath them, and navigable waters as public trust resources, the scope of the doctrine as evolved over the years. Most relevant for the purposes of this Petition, the atmosphere has been recognized in various Constitutional provisions and cases as a public trust resource.¹⁶⁴

In North Carolina, public trust rights are defined in N.C.G.S. § 1-45.1 and referenced elsewhere in the North Carolina General Statutes and judicial opinions.¹⁶⁵ Public trust rights mean “those rights held in trust by the State for the use and benefit of the people of the State in common. They are established by common law as interpreted by the courts of this State. They include, *but are not limited to*, the right to navigate, swim, hunt, fish, and enjoy all recreational activities in the watercourses of the State and the right to freely use and enjoy the State’s ocean and estuarine beaches and public access to the beaches.”¹⁶⁶

In North Carolina, the Public Trust Doctrine has already been used to protect the rights of the public in navigable waters and in the land adjoining them. In *Capune v. Robbins*, for example, the North Carolina Supreme Court, citing a New York opinion written by Justice Cardozo, acknowledged the right of adjoining riparian owners to build piers, but only to the point that it did not unnecessarily obstruct the public’s right.¹⁶⁷ In *State ex rel. Rohrer v. Credle*, the defendant argued he had acquired rights to an oyster bed under navigable waters through prescription. The North Carolina Supreme Court, in the context of title under navigable waters, stated that the lands were held in trust by the State for the benefit of the public. Furthermore, the Court stated that under the Public Trust Doctrine, property subject to the public trust could only be regulated or disposed of if it could be done without substantial impairment of the public’s interest.¹⁶⁸

The atmosphere, a most critical natural resource essential to human existence, is an asset that belongs to all people and the State of North Carolina holds it in trust for all citizens of North Carolina. Under North Carolina’s public trust law, the atmosphere is held in trust by the State for the benefit of its citizens similar to navigable waters and the land adjacent. Thus, the State has an obligation to ensure that emitters of GHGs do not intrude on the public’s rights by acting in a

¹⁶³ Justinian, *Institutes*, 1.2.1, 2.1.1 (T. Sandars trans. 1st Am. Ed n. 1876).

¹⁶⁴ See, e.g., *Robinson Twp. v. Commonwealth*, 83 A.3d 901, 955 (Pa. 2013) (plurality opinion); HI CONST. art XI, § 1.

¹⁶⁵ N.C.G.S. §§ 113-131, N.C.G.S. § 113A-134.2; see also, *Friends of Hatteras Island Nat’l Historic Maritime Forest Land Trust for Pres., Inc. v. Coastal Res. Comm’n*, 117 N.C.App. 556, 574 (1995).

¹⁶⁶ N.C.G.S. § 1-45.1 (emphasis added).

¹⁶⁷ *Capune v. Robbins*, 160 S.E.2d 881 (NC Sup.Ct. 1968).

¹⁶⁸ *State ex rel. Rohrer v. Credle*, 369 S.E.2d 825 (NC S.Ct. 1988), citing *Illinois Cent. R.R. Co. v. Illinois*, 146 U.S. 387 (1892).

manner that substantially impairs the atmosphere and the environment. The State is not allowed to cede its responsibility to protect the atmosphere and cannot allow property subject to the public trust, such as the atmosphere, to be substantially impaired by excessive GHG emissions.

In addition, continued failure to protect the atmosphere from the adverse impacts of climate disruption will impair the public's rights of use in waters. Streams and rivers will dry up, flood, or both. Seashores will disappear in front of seawalls and groynes designed to protect structures but sacrificing beaches. Failure to act is an abdication of responsibility. This Commission cannot continue to ignore this pressing problem without violating its public trust duties to North Carolina's youth, such as Hallie.

J. North Carolina's Emissions are Significant Globally

The most direct way to significantly reduce the severity of climate change is to reduce greenhouse gas emissions, such as CO₂.¹⁶⁹ Of course North Carolina cannot solve climate change on its own and other states, the federal government, and other countries must also do their part to reduce their CO₂ emissions. However, it is important to note that North Carolina's carbon dioxide emissions are significant globally. If North Carolina were a country, it would be the 39th largest CO₂ emitter in the world, out of 216 countries and territories (based on 2012 emissions data).¹⁷⁰ Thus, while North Carolina cannot solve climate change on its own, a solution to climate change must include emission reductions from North Carolina.

Please see the film *Thin Ice: The Inside Story of Climate Science*, a copy of which is attached hereto and incorporated herein as Exhibit D. The film is also available to be streamed online at <http://thiniceclimate.org/>.

Given the harmful impacts of climate change discussed above and North Carolina's contribution to global carbon dioxide emissions, the Division of Air Quality should adopt the rule proposed in this Petition to reduce North Carolina's share of global CO₂ emissions.

(4) Provide a statement of the effect on existing rules or orders.

A. Effect on N.C.G.S. § 62-133.8

The Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") requires electric utilities in the State to increase the renewable energy in their portfolios to 12.5 percent by 2021.¹⁷¹ If carbon dioxide emissions are reduced pursuant to the rule proposed in this Petition by shifting electricity generation from carbon-intensive coal-fired plants to renewable sources such

¹⁶⁹ U.S. Global Change Research Program, *supra* note 24, at 815.

¹⁷⁰ This figure was calculated after comparing North Carolina's 2012 CO₂ emissions with the CO₂ emissions from each country. The emissions data for other countries is available from U.S. Energy Information Administration, available at <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8>.

¹⁷¹ See N.C.G.S. § 62-133.8.

as wind and solar, (and reducing emissions from other sources set forth in Table 2 herein) compliance with the proposed rule will be consistent with and support compliance with REPS.

B. Effect on N.C.G.S. § 143-215.107D

The amount of nitrogen oxide and sulfur dioxide that certain coal-fired power plants may emit is limited by N.C.G.S. § 143-215.107D. If carbon emissions are reduced pursuant to the rule proposed in this Petition by shifting electricity generation away from carbon-intensive coal-fired plants, emissions of nitrogen oxide and sulfur dioxide from those plants will also be reduced. The proposed rule will thus encourage compliance with § 143-215.107D.

C. Effect on N.C.G.S. § 150B-19.3

N.C.G.S. § 150B-19.3 prohibits North Carolina agencies from adopting certain environmental rules that are more stringent than their federal counterparts. The rule proposed in this Petition does not presently conflict with § 150B-19.3 because there are no federal rules in force that limit carbon dioxide emissions. Even if the EPA promulgated a carbon dioxide emission reduction goal through the Clean Power Plan, the proposed rule in this Petition would not conflict with that rule because the rule proposed in this Petition does not seek to only limit emissions from power plants but rather seeks emission reductions from all sources. Thus, there would still not be a federal counterpart that the rule proposed in this Petition would conflict with.

Furthermore, it is important to note that any federal regulations on carbon dioxide emissions would only be a floor and that under federal law, states would be allowed to enact more stringent regulations. If N.C.G.S. § 150B-19.3 impeded North Carolina's authority to reduce greenhouse gas emissions in such a way that led to violation of North Carolina's constitutional mandate "to control and limit the pollution of our air and water" and to protect "in every other appropriate way to preserve as a part of the common heritage of this State its forests, wetlands, estuaries, beaches, historical sites, open lands, and places of beauty"¹⁷² than such an application of N.C.G.S. § 150B-19.3 would be unconstitutional; a statute cannot displace a constitutional obligation.

D. Effect on N.C.G.S. § 143-215.107

N.C.G.S. § 143-215.107 empowers the Environmental Management Commission to develop air quality standards. The proposed rule does not conflict with the statute but rather would help the Commission fulfill its statutory obligations.

E. Effect on EPA's proposed Clean Power Plan

The EPA recently proposed a rule known as the Clean Power Plan that would require North Carolina to reduce its CO₂ emissions from existing, fossil-fuel fired Electric Utility Generating

¹⁷² N.C. CONST. art. XIV § 5.

Units.¹⁷³ Adopting the rule proposed in this Petition would encourage compliance with the Clean Power Plan if North Carolina chooses to accomplish the proposed CO₂ reductions by limiting CO₂ emissions caused by electric power generated by burning fossil fuels. The EPA has pointed out that “[State] Programs already in place . . . would apply toward the state’s 2030 CO₂ emission goal. Thus, states with existing programs will be better positioned to achieve the goals.”¹⁷⁴

(5) Provide copies of any documents and data supporting the proposed rule(s).

Supporting documents/evidence are attached as:

Exhibit A – Assessing “Dangerous Climate Change”: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature, by Dr. Pushker A. Kharecha, co-author with Dr. James Hansen

Exhibit B – Measuring the Impacts of Climate Change on North Carolina Coastal Resources, by Okmyung Bin, Chris Dumas, Ben Poulter, & John Whitehead, (2007).

Exhibit C – Measuring the Impacts of Sea-Level Rise on Coastal Real Estate in North Carolina by Okmyung Bin (2008).

Exhibit D – THIN ICE: THE INSIDE STORY OF CLIMATE SCIENCE; 2013; A David Sington/Simon Lamb Film (The University of Oxford and Victoria); (The film is enclosed and can be streamed at the link at <http://thiniceclimate.org/>.)

(6) Provide a statement of the effect of the proposed rule on existing practices in the area involved, including cost factors for persons affected by the proposed rule(s).

A. The Costs of Action are Largely at the Discretion of the Committee but Some Guidance can be Provided.

Although the proposed rule provides the Committee with broad discretion how the goals will be achieved, some preliminary information on the costs of the proposed rule can be provided. There are strengths and weakness to the different approaches. Under EPA’s authority through the Clean Air Act of 1970, this summer the EPA proposed the Clean Power Plan. This proposal is targeted at lowering the GHG emissions at fossil fuel-fired power generators. Under the plan, the EPA will create a target CO₂ emission goal and leave implementation to the states to determine how best to comply.¹⁷⁵ The EPA provides some recommendations such as: renewable energy standards; efficiency improvements; switching power generators to natural gas; carbon storage technology; and market-based trading programs.¹⁷⁶ Others have suggested compliance could be met more efficiently under a carbon tax.¹⁷⁷ Furthermore, whatever steps are taken earlier will

¹⁷³ See 79 Fed. Reg. at 34830.

¹⁷⁴ *Id.* at 34839.

¹⁷⁵ EPA, Clean Power Plan Proposed Rule, (November 24, 2014, 11:41 AM), <http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule>.

¹⁷⁶ EPA, Fact Sheet: Clean Power Plan, The Role of the States, (November 24, 2014, 11:42 AM), <http://www2.epa.gov/sites/production/files/2014-05/documents/20140602fs-states-role.pdf>.

¹⁷⁷ Michael Wara et. al., *How the EPA Should Modify Its Proposed 111(d) Regulations to Allow States to Comply By Taxing Pollution*, THE BROOKINGS INSTITUTION, October 28, 2014, (November 24, 2014, 11:45 AM),

apply towards compliance at the time the proposal becomes law. Now is the time to get out ahead of forthcoming regulation and take ownership of the problem.

i. Market Based Approaches

Both the International Monetary Fund and the Organisation for Economic Co-operation and Development (“OECD”) have recommended carbon emission taxes and trading systems as the most effective and least expensive methods to regulate CO₂ emissions.¹⁷⁸ This revenue can be reinvested into the State either to further green technology or other legislative goals. To date, California has generated over 850 million dollars through the state’s auction-based, emissions trading program and has plans to earmark the money for infrastructure reinvestment and affordable housing among others.¹⁷⁹

At the economic level, carbon taxation and cap and trade systems functionally operate the same. Both systems encourage greater efficiency in allocating resource and investment in green technology to avoid paying an emission-based fee.¹⁸⁰ Under a trading policy, the maximum amount of CO₂ emissions is set and the trade price is determined by the market; the environmental impact is known but the economic impact is unknown. Under a taxing policy, the environmental impact must be guessed at but the price per emission is set by the tax rate. The price for this economic certainty is an unknown environmental impact—difficult to reconcile with our proposed rule. However, a carbon tax is cheaper to administer, provides greater pricing predictability for planning purposes, is less volatile, and works better with additional GHG-reducing policies.¹⁸¹

Creating governmental market-based approaches to mitigating CO₂ is in line with current business practices. Many companies are already taking into account possible carbon taxes and cap and trade programs in internal planning. ConocoPhillips calculates cost of carbon emissions in determining potential revenue at a price between 8 and 46 dollars a ton.¹⁸² Shell applies a carbon price of 40 dollars per ton to some current operations in an effort to determine its high polluting facilities and to quantify its risks.¹⁸³ Disney actually taxes the cost of its investments in

<http://www.brookings.edu/research/papers/2014/10/28-epa-should-allow-states-to-comply-taxing-pollution-wara-morris> (last visited November 11, 2014).

¹⁷⁸ OECD, *Carbon Taxes and Emissions Trading are Cheapest Ways of Reducing CO₂*, *OECD Says*, (November 24, 2014, 11:47 AM), <http://www.oecd.org/environment/carbon-taxes-and-emissions-trading-are-cheapest-ways-of-reducing-co2.htm>; IMF, *Climate, the Environment, and the IMF*, (November 24, 2014, 11:48 AM), <http://www.imf.org/external/np/exr/facts/enviro.htm>. (Though, the IMF encourages that any cap-and-trade program be designed to mimic a tax program.)

¹⁷⁹ California’s 2014-15 planned expenditures on Environmental Protection are available at <http://www.ebudget.ca.gov/2014-15/pdf/BudgetSummary/EnvironmentalProtection.pdf> pp. 104-09

¹⁸⁰ Lawrence H. Goulder & Andrew R. Schein, *Carbon Taxes vs. Cap and Trade: A Critical Review*, *CLIMATE CHANGE ECONOMICS*, Vol. 4, No. 3 (2013).

¹⁸¹ *Id.*

¹⁸² *The Economist*, *Carbon Copy*, *THE ECONOMIST*, December 14, 2013, (November 24, 2014, 11:51 AM), <http://www.economist.com/news/business/21591601-some-firms-are-preparing-carbon-price-would-make-big-difference-carbon-copy> (last visited November 11, 2014).

¹⁸³ *Id.*

carbon offsets against its subsidiaries in proportion to their carbon pollution.¹⁸⁴ Businesses are already braced for change; it is time for the State, as trustee of the public's air, to seize ownership of the problem.

ii. *Government Subsidies*

A multi-national survey conducted by the OECD to determine the effective prices of carbon emissions found that capital subsidies and feed-in tariffs are currently the least efficient method of abating carbon emissions. Feed-in tariffs are policies that encourage the development of renewable energy by allowing targeted energy sources to charge more for the energy they produce. In the electricity generation sector, on average, carbon abatement costs more than one hundred and fifty dollars per ton of CO₂ abated using capital subsidies and feed-in tariffs and, in some cases, cost as much as eight hundred dollars per ton.¹⁸⁵

Another study, when postulating a relatively high social cost of carbon globally, noted that many sources of renewable energy were actually cheaper than energy generated by fuel-fired plants due to the damage CO₂ causes to the environment.¹⁸⁶ This social cost reflects the fact that those most impacted are developing countries in regions that will be disparately affected by climate changes. This indicates that, if desired, feed-in tariffs could be used to ameliorate some of the social costs of carbon emissions.

iii. *Natural Gas*

While the rule proposed in this Petition does not mandate a particular method for achieving the four percent annual reduction in CO₂ emissions, one possible method is phasing out coal-fired electric generation capacity in favor of less carbon-intensive methods. REPS already requires electric utilities to maintain 12.5 percent of their portfolios with renewable sources by 2021.¹⁸⁷ Assuming electric utilities satisfy that requirement with zero-emissions methods such as wind, solar, or hydroelectric generation, replacing the remaining coal portfolio with natural gas would help satisfy the four percent annual reduction of Statewide CO₂ emissions required by the rule proposed here. Approximately three percent of the reductions could come through REPS compliance and replacing coal with natural gas. The remaining one percent could come from transitioning from fossil fuels as an electricity source to renewable energy (see § 6.A.v below for more on this additional one percent). After REPS requirements are satisfied, the cost of replacing the electricity generated by coal-fired plants with natural gas-fired plants is approximately \$2.67 billion. See § 7.F *infra* for calculations.

iv. *Carbon Dioxide Capture and Sequestration*

¹⁸⁴ *Id.*

¹⁸⁵ OECD, *Effective Carbon Prices* 52 fig. 3-7.

¹⁸⁶ Skeptical Science, *The Economic Impacts of Carbon Pricing*, (November 24, 2014, 11:53 AM),

<http://www.skepticalscience.com/co2-limits-economy-advanced.htm>.

¹⁸⁷ N.C.G.S. § 62-133.8(b).

Carbon dioxide capture and sequestration ("CCS") has been suggested as a potential method to prevent CO₂ from entering the atmosphere. The premise is that CO₂ emissions can be prevented from entering the atmosphere by capturing the gas at the point of entry, transporting it and injecting it into underground formations of non-porous rock. An international study has suggested that the relative cost of abating CO₂ emissions with CCS could cost approximately 25 to 37 dollars per ton of emissions abated by 2030.¹⁸⁸

A 2007 study on the feasibility of carbon capture and sequestration concluded that it was "not economically or technically feasible within North Carolina" because the state lacks the capacity to store much more than three years of worth of captured CO₂. The study points out that CCS "may be viable if the captured CO₂ is piped out of North Carolina and stored elsewhere."¹⁸⁹ This would require prohibitive investment necessitating new pipelines to be created to transport the emissions.

There are possible alternatives. The Southeast Regional Carbon Sequestration Partnership maintains a field site at a coal seam in Russell County Virginia where CO₂ emissions might be transported.¹⁹⁰ Furthermore, a more recent preliminary study than the 2007 study suggests that there may be possible CCS sites in Dare, Hyde, and Tyrrell counties near Nucor Corporation and Weyerhaeuser NR Co. plants.

Although Carbon Capture and Sequestration has been suggested as a potential method of abating CO₂ emissions, at least in North Carolina, it is not the most efficient alternative due to lack of storage capacity in the state.

v. *Renewable Energy, Energy Efficiency Measures, and Energy Conservation Measures*

Other measures that would help North Carolina achieve the proposed rule would be to develop renewable energy projects, including wind and solar, and promote energy efficiency and energy conservation measures. The costs associated with these projects vary. However, according to one expert's analysis, the cost of eliminating CO₂ emissions from fossil fuels used to generate electricity is between \$10-40 per metric ton of CO₂ emissions.¹⁹¹ Assuming that three percent of emissions reduction would come from meeting the REPS requirement and transitioning from coal to natural gas (as described in § 6.A.iii above), an additional one percent of emission reductions could come from replacing fossil fuels with renewable energy sources for electricity generation. As explained more in § 7.G below, it would cost approximately \$1.34

¹⁸⁸ Per-Anders Enkvist et. al., *A Cost Curve for Greenhouse Gas Reduction*, THE MCKINSEY QUARTERLY 2007: 1, 43. (Euros converted to dollar values).

¹⁸⁹ Eric Williams, Nora Greenglass, and Rebecca Ryals, "Carbon Capture, Pipeline and Storage: A Viable Option for North Carolina Utilities?" Working paper prepared by the Nicholas Institute for Environmental Policy Solutions and The Center on Global Change, Duke University at 3, (November 24, 2014, 11:26 AM), <https://nicholas.duke.edu/cgc/news/carboncapture.pdf>.

¹⁹⁰ The Southeast Regional Carbon Sequestration Partnership operates a Coal Seam Project in North Carolina, more information available at <http://www.secarbon.org/> (November 24, 2014).

¹⁹¹ Arjun Makhijani, *Carbon-Free, Nuclear-Free: A Roadmap for U.S. Energy Policy*, 23-24 (IEER Press and RDR Books, 2007).

billion in total (i.e., not annually), between 2016 and 2025, to reduce CO₂ emissions by an additional one percent by using renewable energy sources for electricity generation.

While reducing carbon dioxide emissions does require a short-term increase in spending, in the long-term these costs would be largely or fully offset by reduced energy costs and other benefits. For example, new jobs would be created in the renewable energy sector that could boost North Carolina's economy. In short, any short-term costs would be outweighed by long-term economic benefits.

When considering the costs of reducing emissions, it is also important to consider damages avoided by reduced emissions. The federal government has developed the social cost of carbon ("SCC") analysis to estimate the climate benefits of rulemaking that seek to reduce CO₂ emissions.¹⁹² The SCC represents the value of damages avoided by a reduction in CO₂ emissions. The EPA and IPCC both note that the SCC does not include all damages and is likely to underestimate the damages. Nevertheless, it can be a helpful tool when considering the benefits of a proposed rule. For 2015, the "central value" (or average) SCC is \$37 per metric ton of CO₂.¹⁹³ This means that the benefit of emission reductions (\$37 a ton) outweighs the average estimated cost of emission reductions (\$25 per metric ton)¹⁹⁴ and thus it makes sound economic sense to reduce CO₂ emissions and replace fossil fuels with renewable energy sources.

vi. *Summary*

Depending on how the Commission chooses to implement the rule proposed in this Petition the costs will vary. However, the preceding sections provide important guidance on different ways in which the Commission could achieve the emissions reductions sought in the proposed rule and analysis on the economic impacts. The Petitioner feels strongly that North Carolina should be transitioning away from all fossil fuels as a source of electricity generation and transportation and should be aggressively pursuing renewable energy sources. Pursuing renewable energy sources makes economic sense and is best for the health of the atmospheric resource.

B. The Costs of Inaction are Substantial and Impact a Surprising Swath of Economic Sectors Including Real Estate, Recreation, Infrastructure, Agriculture and Human Lives.

While the cost of reducing CO₂ emissions from fossil fuels may seem high, the costs of inaction far exceed the costs related to reducing CO₂ emissions.¹⁹⁵ The effects of unmitigated

¹⁹² EPA, *The Social Cost of Carbon*, (last accessed Dec. 4, 2014, 3:00 PM), available at <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>.

¹⁹³ *Id.* (The central value is determined by calculating the average value of the 5% average (\$12), 3% average (\$39), and 2.5% average (\$61)).

¹⁹⁴ This \$25 figure was arrived at by taking the average of the \$10-40 estimate noted in the first paragraph of this sub-section.

¹⁹⁵ CTR. FOR INTEGRATIVE ENVTL. RESEARCH, UNIV. OF MD., *ECONOMIC IMPACTS OF CLIMATE CHANGE ON NORTH CAROLINA* 4 (2008).

climate change are expected to impose serious costs on the value of coastal real estate, beach recreation, agriculture, infrastructure, and human health. The costs of restricting CO₂ emissions are small in comparison. When possible, all dollar amounts below have been normalized to 2014 dollars.¹⁹⁶

- i. *Adopting the proposed rule will help prevent lost property value in North Carolina's coastal communities.*

Compared to the recommended projection of 39 inches of sea level rise by 2100,¹⁹⁷ a projection of 26 cm (about 10 inches) of SLR by 2080 is extremely conservative. Even given that conservative projection, SLR caused by unmitigated climate change will still have a devastating impact on coastal property value. A study of four representative North Carolina coastal counties (Dare, Carteret, Bertie, and New Hanover) estimates the results of unmitigated SLR below.¹⁹⁸ All figures represent the present value of property that will be lost given SLR of 26 cm by 2080. Property is considered "lost" when the projected SLR would inundate a property based on its present elevation above sea level.¹⁹⁹

In New Hanover County, over \$191 million in residential and \$99.49 million in non-residential property will be lost.²⁰⁰ In Dare County, \$1.55 billion in residential and \$904.25 million in non-residential property would be lost.²⁰¹ In Carteret County, \$152.39 million in residential and \$80.6 million in non-residential property would be lost.²⁰² In Bertie County, \$12.59 million in residential and \$5.04 million in non-residential property will be lost.²⁰³

In sum, **\$2.5 billion** of property value is projected to be lost given the conservative assumption of 26 cm of SLR, far less than the recommended 39 inch SLR projection. Furthermore, that figure represents property lost in just four of North Carolina's twenty coastal counties, so it dramatically understates total potential losses. It bears reiterating that this loss is driven solely by real property damages. These numbers do not reflect the losses cost by business migration and closings or by displaced human populations. By adopting the proposed rule to limit CO₂ emissions, DAQ can help mitigate climate change-induced SLR mitigating the costs it will impose on coastal property owners.

¹⁹⁶ Accomplished using the Bureau of Labor Statistics CPI Calculator available at <http://data.bls.gov/cgi-bin/cpicalc.pl>. (hereinafter "CPI Inflation Calculator"). Original dollar amounts are variously in 2004 and 2006 dollars, and can be found in source citations.

¹⁹⁷ Sci. Panel on Coastal Hazards, *supra* note 93 at 12.

¹⁹⁸ OKMYUNG BIN, CTR. FOR NATURAL HAZARDS RESEARCH, E. CAROLINA UNIV., MEASURING THE IMPACTS OF SEA-LEVEL RISE ON COASTAL REAL ESTATE IN NORTH CAROLINA (2008), (November 24, 2014, 11:30 AM), <http://www.ecu.edu/cs-cas/hazards/upload/bin.pdf>.

¹⁹⁹ *Id.* at 2.

²⁰⁰ *Id.* at 16.

²⁰¹ *Id.* at 19.

²⁰² *Id.* at 22.

²⁰³ *Id.* at 24.

- ii. *Adopting the proposed rule will help prevent reduced recreation on North Carolina's beaches.*

Recreational beach trips, including shore fishing trips, will be impacted by climate change-induced SLR.²⁰⁴ In assessing the impact of SLR on beach recreation, both (1) welfare costs to beachgoers in the form of fewer beach trips and lower quality beach trips and (2) reduced trip expenditures on regional economic activity are considered. All figures presented here are based on the conservative assumption that there will be no population or income growth in the affected areas.

By 2080, the total welfare cost to beachgoers is projected to be \$255 million.²⁰⁵ The loss in trip expenditures is projected to be \$113.35 million for day trips and \$2.46 billion for overnight trips.²⁰⁶ For recreational shore fishing, the welfare costs are projected to be \$1.24 billion.²⁰⁷

In sum, just due to SLR related losses, failure to mitigate climate change will negatively impact the recreational activities of beachgoers and shore fishers, resulting in costs totaling approximately over \$4 billion by 2080. Adopting the proposed rule to limit CO₂ emissions will help mitigate those costs by preventing the SLR that will cause them.

- iii. *Adopting the proposed rule will help mitigate infrastructure costs for the State of North Carolina.*

State Highway 12, which runs along the Outer Banks, has, by itself, cost the North Carolina Department of Transportation approximately \$100 million in repairs since 1983 due to frequent storm and flood damage.²⁰⁸ To cope with continuing SLR and increasing storm intensity, proposals to permanently adapt at-risk portions of Highway 12 are projected to cost, at a minimum, \$602 million.²⁰⁹ In addition to coastal roads, beaches are threatened by SLR. The cost of nourishing an additional two feet of beach eroded by SLR for North Carolina's 138 miles of shoreline will be \$11.01 million annually. Given this rate, the present value of beach nourishment required to adapt to sea level rise from 2015 to 2080 is \$715.65 million.

In sum, protecting key parts of Highway 12 and continuing to nourish beaches will cost the State at least \$1.318 billion by 2080. There will undoubtedly be millions, if not billions, of additional costs related to other infrastructure in North Carolina that is threatened by climate impacts such as sea level rise and extreme weather events. Adopting the proposed rule to limit

²⁰⁴ OKMYUNG BIN, CHRIS DUMAS, BEN POULTER, & JOHN WHITEHEAD, MEASURING THE IMPACTS OF CLIMATE CHANGE ON NORTH CAROLINA COASTAL RESOURCES 37-38 (2007), (November 24, 2014, 11:34 AM), <http://econ.appstate.edu/climate/>.

²⁰⁵ *Id.* at 48.

²⁰⁶ *Id.* at 49.

²⁰⁷ *Id.* at 57.

²⁰⁸ RIGGS et al., *supra* note 92 at 73.

²⁰⁹ *Id.* at 76.

CO₂ emissions will help mitigate those costs by preventing the SLR and increased storm intensity that will cause them.

- iv. *Adopting the proposed rule will help prevent business interruptions and damage to the agriculture and forestry industries.*

North Carolina can expect even more significant damage from hurricanes than it has experienced in the past if nothing is done to mitigate climate change.²¹⁰ Considering only Bertie, Carteret, Dare, and New Hanover counties, more intense Category 3 hurricanes caused by climate change are projected to cause approximately \$1.81 billion in additional business interruption by 2080.²¹¹ Higher intensity storms also produce greater damage to agriculture.²¹² If climate change strengthens what would have been a Category 1 storm into a Category 2, an additional \$188.91 million in damages to agriculture and livestock is projected.²¹³ Further, if climate change strengthens a Category 2 storm into a Category 3, damage to the forestry sector is estimated to *double*, and based on historical data that could cause an additional \$629.7 million in damage.²¹⁴

In sum, more intense hurricanes due to climate change are projected to cost an additional **\$2.629 billion**. Adopting the proposed rule to limit CO₂ emissions will help mitigate those costs by reducing the likelihood of more intense hurricanes.

- v. *Adopting the proposed rule will help prevent an increase in heat-related deaths.*

Increased temperatures caused by climate change could increase heat-related deaths in North Carolina from 20 deaths to 35 deaths every summer.²¹⁵ Given the EPA values a statistical life at \$8.73 million (\$7.4 million in 2006 dollars),²¹⁶ the economic impact of the additional loss of life is valued at \$130.99 million every year, or **\$8.51 billion** by 2080. Adopting the proposed rule will help prevent the expected loss of life and the associated economic impacts.

Table 1: Summary of costs associated with adopting proposed rule

COSTS THE RULE HELPS PREVENT

Sector	Impact	Cost Prevented (billions of 2014 dollars)
Coastal Real Estate	Inundation due to SLR	\$2.5

²¹⁰ WOODRUFF et. al., *supra* note 21 at 39.

²¹¹ BIN et. al., *supra* note 204 at 76.

²¹² *Id.* at 78.

²¹³ *Id.* at 84.

²¹⁴ *Id.* at 81.

²¹⁵ Ctr. for Integrative Env'tl. Research, *supra* note 195 at 12.

²¹⁶ *Frequently Asked Questions on Mortality Risk Valuation*, National Center for Environmental Economics, <http://yosemite.epa.gov/ee/epa/eed.nsf/pages/MortalityRiskValuation.html#whatisvsl> (last visited 07/14/2014).

Recreation and Tourism	Inundation due to SLR	\$4.06
Infrastructure	Inundation due to SLR; damage from increased storm intensity	\$1.318
General business / agriculture / forestry	Damage from increased storm intensity	\$2.629
Human health	Heat injury from increased average temperature	\$8.51
<i>Total Costs Prevented: \$19.017 billion</i>		

COSTS INCURRED²¹⁷

Sector	Impact	Cost Incurred
Electric power utilities	Replacement of coal-fired power generation with natural gas generation	\$2.67
Renewable energy	Replacing fossil-fuel electricity generation with renewable energy sources	\$1.34

Total Costs Incurred: \$4.01

(7) Provide a statement explaining the computation of the cost factors.

A. Calculation of impact on coastal real estate

The economic impact of climate change-induced SLR discussed in section 6.A *supra* relies on a paper produced by Okmyung Bin, Associate Professor of Economics at East Carolina University, entitled *Measuring the Impacts of Sea-Level Rise on Coastal Real Estate in North Carolina*.²¹⁸ A summary of the methods used in that paper are included here, but for a complete discussion see the full paper attached as Exhibit C.

The four counties studied represent a cross-section of the North Carolina coastline in geographic distribution and economic development.²¹⁹ Real estate data for the study, including assessed values and other structural characteristics, were obtained from each county's tax office.²²⁰ Inundation maps used to identify property that would be lost under different SLR scenarios were obtained using high-resolution topographic LIDAR (Light Detection and

²¹⁷ The exact costs incurred will depend on how the Commission chooses to implement the proposer rule. This chart represents the costs incurred under one scenario of emission reductions.

²¹⁸ BIN, *supra* note 198.

²¹⁹ *Id.* at 2.

²²⁰ *Id.*

Ranging) data.²²¹ The net loss associated with inundation is measured as follows. First, hedonic price models are estimated to predict the contribution of each attribute to the value of the property; second, the value of risks and amenities of the lost properties are purged from the total value of the lost properties; third, the predicted value of each lost property is inflated to 2080.²²² Lastly, all figures from the paper were here converted from 2004 to 2014 dollars.²²³

B. Calculation of impact on coastal recreation-

The economic impact of climate change-induced SLR discussed in section 6.B *supra* relies on a paper produced by Okmyung Bin, Associate Professor of Economics at East Carolina University, *et al.*, entitled *Measuring the Impacts of Climate Change on North Carolina Coastal Resources*.²²⁴ A summary of the methods used in that paper are included here, but for a complete discussion see the full paper attached as Exhibit B.

All of coastal North Carolina is included in the recreational fishing analysis, but recreational beach-going and swimming is limited to Brunswick, New Hanover, Pender, Onslow, and Carteret counties.²²⁵ Impacts to the beach tourism industry are analyzed at the county level as a result of SLR, and economic effects are estimated using a recreation demand methodology on data gathered by the U.S. Army Corps of Engineers.²²⁶ Information from a geospatial analysis is used to identify beach recreation sites that may become unavailable due to SLR.²²⁷ Then, a nested logit random utility model is used to simulate site closure at these locations and the resulting reallocation for beach recreation trips.²²⁸ These estimates are combined with trip expenditures data to estimate the economic effects on North Carolina coastal counties.²²⁹ The projected economic impact of changes in recreational fishing is based on data gathered by the National Marine Fisheries Service.²³⁰ Information from a geospatial analysis is used to identify fishing sites that may become unavailable due to SLR.²³¹ Then, a nested logit site selection model is used to simulate site closure at those locations and the resulting reallocation of shore-based fishing trips.²³² Lastly, all figures from the paper are here converted from 2004 to 2014 dollars.²³³

C. Calculation of impact on infrastructure

²²¹ *Id.*

²²² *Id.* at 7.

²²³ *CPI Inflation Calculator*.

²²⁴ BIN *et. al.*, *supra* note 204.

²²⁵ *Id.* at 2-3.

²²⁶ *Id.* at 3.

²²⁷ *Id.*

²²⁸ *Id.*

²²⁹ *Id.*

²³⁰ *Id.*

²³¹ *Id.*

²³² *Id.*

²³³ *CPI Inflation Calculator*.

The cost projection to adapt portions of Highway 12 to SLR used in section 6.C *supra* is based on several alternative scenarios centered on Pea Island. Pea Island is a simple barrier island that has been subject to inlet formation and overwash for hundreds of years.²³⁴ Both inlet formation and overwash threaten Highway 12 at several "hot-spots."²³⁵ One proposal to address the hot-spots is to build a new bridge parallel to the present bridge, maintain the Pea Island road on its present right-of-way, and rebuild new segments of road as needed.²³⁶ Minimum estimates for that proposal range from \$602 million to \$1.58 billion.²³⁷ Another alternative is to build a back-barrier, bridge-causeway across the Oregon Inlet flood-tide delta and into the deeper water of the Pamlico Sound. This 17-mile-long structure would return to the barrier island in the village of Rodanthe.²³⁸ Minimum cost estimates for the back-barrier corridor range from \$1.3 billion to \$1.8 billion.²³⁹ Because \$602 million is the least expensive alternative, we adopt it as a conservative estimate of costs for adapting Highway 12 to SLR. This figure was not converted to 2014 dollars because the source for the estimate did not indicate the dollar year.

The estimated annual cost of nourishing all 138 miles of North Carolina shoreline is \$831 million every 10 years before accounting for SLR.²⁴⁰ So assuming the annual cost of beach nourishment in North Carolina is one-tenth that figure, or \$83.1 million, the present value of annual beach nourishment from 2015 to 2080 (65 years) is about \$5.4 billion. According to personnel at the U.S. Army Corps of Engineers, one cubic yard per running foot of beach is needed to replace each foot of eroding beach—so a one mile stretch of beach would require 10,560 cubic yards of sand per mile to replace an average annual two feet of erosion per mile assumed in the Bin *et al.*, study.²⁴¹ The average cost of sand is \$6 per cubic yard.²⁴² So, given 138 miles of beach, the annual cost to replace two additional feet of eroded beach due to climate-change induced SLR is \$8.74 million.²⁴³ Therefore, climate change-induced SLR will result in an additional cost of \$568.1 million for nourishing North Carolina's beaches after for 65 years (2015-2080). This figure is here converted from 2004 dollars to 2014 dollars,²⁴⁴ resulting in the final estimate of \$715.45 million. The total estimated cost of adapting North Carolina infrastructure to climate change is the sum of the projected beach nourishment costs (\$715.45 million) and the projected costs of adapting Highway 12 (\$602 million), or \$1.317 billion.

D. Calculation of impact to coastal businesses, agriculture, livestock, and forestry

The projected economic impact of increased hurricane intensity caused by climate change discussed in section 6.D *supra* relies on a paper produced by Okmyung Bin, Associate Professor

²³⁴ RIGGS *et al.*, *supra* note 101 at 76.

²³⁵ *Id.*

²³⁶ *Id.*

²³⁷ *Id.*

²³⁸ *Id.*

²³⁹ *Id.*

²⁴⁰ BIN *et al.*, *supra* note 204.

²⁴¹ *Id.* at 89

²⁴² *Id.*

²⁴³ *Id.*

²⁴⁴ CPI Inflation Calculator.

of Economics at East Carolina University, *et. al.*, entitled *Measuring the Impacts of Climate Change on North Carolina Coastal Resources*.²⁴⁵ A summary of the methods used in that paper are included here, but for a complete discussion see the full paper attached as Exhibit B.

This analysis is based on projected changes in the severity of tropical storms and hurricanes due to climate change, and focuses on impacts to agriculture, forestry, and general "business interruption."²⁴⁶ Business interruption impacts are temporary reductions in business activity or output caused by hurricane strikes, and are produced by power loss, inaccessibility due to damaged infrastructure, and supply chain interruption.²⁴⁷ Estimates of business interruption are based on the Wilmington region and use an existing study that estimated business interruption impacts by industry sector for hurricane strikes in Wilmington in the 1990s.²⁴⁸ The impacts are adjusted for inflation, and for counties other than New Hanover, impacts are adjusted according to differences in industry mix using the IMPLAN economic impact software database.²⁴⁹ Incremental storm damages to agriculture and forestry from more intense storms caused by climate change are assessed by comparing historical storm damages across storm categories, i.e., the difference in dollar value between damage to agriculture after a Category 2 versus a Category 3 hurricane.²⁵⁰ Lastly, all figures from the paper are here converted from 2004 to 2014 dollars.²⁵¹

E. Calculation of impact of heat-related injury

Heat-related deaths per summer are expected to increase by 15 due to climate change.²⁵² The EPA values a statistical life at \$7.4 million.²⁵³ So for each summer affected by climate change, the statistical value of additional lives lost is $15 * \$7.4 \text{ million} = \$111 \text{ million per summer}$. To project costs by 2080, that figure is multiplied by 65 summers (summers of 2015 through 2080). $\$111 \text{ million} * 65 \text{ summers} = \7.215 billion . Lastly, this figure is here converted from 2006 to 2014 dollars,²⁵⁴ resulting in an estimated loss of \$8.51 billion.

F. Calculation of impact on electric utilities

Calculating the cost the rule proposed in this Petition will impose on electric utilities is difficult because the rule does not require the State to dictate whether, or how, electric utilities will reduce CO₂ emissions. It requires only that statewide emissions be reduced by at least 4 percent annually. The following scenario, however, is illustrative of how electric utilities could

²⁴⁵ BIN *et. al.*, *supra* note 204.

²⁴⁶ *Id.* at 3.

²⁴⁷ *Id.* at 4.

²⁴⁸ *Id.*

²⁴⁹ *Id.*

²⁵⁰ *Id.*

²⁵¹ *CPI Inflation Calculator*.

²⁵² Ctr. for Integrative Env'tl. Research, *supra* note 195 at 12.

²⁵³ National Center for Environmental Economics, *Frequently Asked Questions on Mortality Risk Valuation*, (November 24, 2014, 11:58 AM),

<http://yosemite.epa.gov/ee/epa/eed.nsf/pages/MortalityRiskValuation.html#whatisvsl>.

²⁵⁴ *CPI Inflation Calculator*.

help meet the requirement by reducing their CO₂ emissions and what the associated costs would be.

It is possible for electric utilities alone to cause a statewide reduction of carbon dioxide emissions from fossil fuel combustion by 3 percent annually by shifting their electric power generation from coal-fired power plants to natural gas combined-cycle plants ("NGCC"). In 2012, the electric power industry in North Carolina generated 116,681,763 megawatt hours (Mwh) of electric power.²⁵⁵ Of that total, utility-owned coal-fired power plants generated 50,932,180 Mwh,²⁵⁶ resulting in 49,260,000 metric tons of CO₂ emissions.²⁵⁷ That translates to a ratio of .97 metric tons of CO₂ emitted per Mwh produced with coal. Natural gas-fired power plants in North Carolina generated 19,302,008 Mwh in 2012,²⁵⁸ resulting in 8,271,000 metric tons of CO₂ emissions.²⁵⁹ That translates to a ratio of .43 metric tons of CO₂ emitted per Mwh produced with natural gas. In 2012, North Carolina also generated 3,867,429 Mwh with zero-emission renewable resources (3,727,938 Mwh from hydroelectric and 139,491 Mwh from solar).

Pursuant to N.C.G.S. § 62-133.8(b), electric utilities are already required to have renewable energy and energy efficiency compose 12.5 percent of their energy portfolios by 2021.²⁶⁰ Therefore, utilities must generate an additional 10,717,791 Mwh from renewables by 2021 to meet that requirement.²⁶¹ Assuming that electric utilities meet the REPS requirements by replacing coal capacity with zero-emission renewable capacity like wind and solar, that still leaves 40,214,389 Mwh of coal-generated electricity available for replacement with natural gas.²⁶² The levelized cost of electricity for new NGCC capacity is \$66.3/Mwh.²⁶³ Therefore, the cost of NGCC capacity required to replace the remaining coal-generated electricity assuming no growth in overall generation is approximately **\$2.67 billion**.²⁶⁴

The following tables detail a possible scenario where (1) coal generation is replaced with NGCC and renewable generation, (2) REPS is satisfied by increasing renewable generation to

²⁵⁵ U.S. Energy Information Administration, *State Electricity Profiles*, (November 24, 2014, 11:59 AM), <http://www.eia.gov/electricity/state/NorthCarolina/>.

²⁵⁶ *Id.*

²⁵⁷ *Id.*

²⁵⁸ *Id.*

²⁵⁹ United States Environmental Protection Agency, *State Energy CO₂ Emissions*, (November 24, 2014, 11:59 AM), http://www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2012.pdf.

²⁶⁰ N.C.G.S. § 62-133.8(b).

²⁶¹ Calculation: 116,681,763 Mwh (total generated in 2012) * 12.5% (renewables required by REPS) = 14,585,220 Mwh; 14,585,220 Mwh (required capacity) – 3,867,429 Mwh (current capacity from hydro and solar) = 10,717,791 mwh.

²⁶² Calculation: 50,932,180 Mwh (total coal generated) – 10,717,791 Mwh (renewables for REPS) = 40,214,389 Mwh.

²⁶³ U.S. Energy Information Administration, *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014*, (November 24, 2014, 12:00 PM), http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

²⁶⁴ Calculation: 40,214,389 Mwh (available for capture from coal) * \$66.3 (cost of NGCC capacity per Mwh) = \$2,666,213,991.

12.5 percent by 2021, (3) additional renewable energy projects are used to reduce reliance on electricity from fossil fuel sources, and (4) the rule proposed in this Petition is satisfied by reducing Statewide CO₂ emissions by at least 4 percent annually. Importantly, this scenario assumes that no additional steps will be taken to encourage energy efficiency or conservation and that there will be no reductions from the transportation sector. As highlighted below, energy generation makes up less than a quarter of easily attained emissions abatement. Table 2 was taken from the EPA's calculated impacts of its Clean Power Plan proposal based, in part, on the most recent year for which CO₂ emissions are available, 2012. This 3% provides a "stepping stone" towards quick, affirmative action to reduce GHG emissions.

To be clear, the petitioner is not advocating replacing coal generation with natural gas given that natural gas is still a fossil fuel with significant GHG emissions, including carbon dioxide and methane. Replacing coal generation with renewable energy sources will ultimately be necessary to avoid the worst impacts of climate change. Table 3 demonstrates the costs of further reducing North Carolina CO₂ emissions by 1% by traditional energy generation with modern renewable sources. The figures in Table 3 were calculated by subtracting the 3% emissions that will come from NGCC transitioning from our rule's 4% proposed reduction. The total figure was determined by multiplying the remaining 1% by \$25 per metric ton.²⁶⁵

These costs will not be incurred overnight and have been presented over a thirty year horizon recognizing that on-going capital improvements will be prorated over the years. In fact, spread over the residents of North Carolina over the thirty year horizon period, each individual would only pay approximately \$4.55 more per year to account for this.²⁶⁶ Furthermore, these numbers cannot reflect technologies being developed to streamline renewable energy generation and make it more efficient; nor can these numbers reflect the positive economic impact that new, green-energy job creation will have. Lastly, because the timeline details have been left to the discretion of the Commission, these numbers have not been adjusted for present value or inflation.

²⁶⁵ This cost estimate comes from Arjun Makhijani, CARBON-FREE AND NUCLEAR-FREE (2007). In this study, based on a joint study by the Institute of Energy and Environmental Research and the Nuclear Policy Research Institute, the author calculated the cost of eliminating CO₂ emissions with renewable sources to be between \$10-40 per metric ton. For planning purposes, this window has been averaged to provide a more definite total.

²⁶⁶ Population data taken from the United States Census Bureau, *available at*, <http://quickfacts.census.gov/qfd/states/37000.html> (December 4, 2014, 2:00 pm), (\$4.55 = Total Estimated Cost ÷ 9,848,060 N.C. Population ÷ 30 yr Timeline)

Table 2: Projected Costs of 3% Reduction in CO2 Emissions Statewide

Year	Coal†	Natural Gas†	Renewable Energy†	Coal CO2 Emissions‡	Natural Gas CO2 Emissions‡	Annual Reduction of CO2 Emissions‡	Remaining Statewide CO2 Emissions‡	%	Cost of NG Replacement (2014 dollars)
2012	50,932,180	19,302,008	3,867,429	49,260,000	8,271,000		120,600,000		
2016	45,441,003	22,863,983	5,796,631	44,077,773	9,831,513	3,621,715	116,982,000	3	236,158,915
2017	40,743,023	25,932,761	7,725,834	39,229,732	11,151,087	3,528,466	113,472,540	3	203,459,988
2018	35,833,482	28,398,743	9,869,392	34,758,477	12,211,460	3,410,882	110,068,384	3	163,494,633
2019	31,557,582	30,816,729	12,227,306	30,610,854	13,036,194	3,322,889	106,766,313	3	127,162,493
2020	27,639,277	31,577,120	14,885,220	26,810,098	13,578,162	3,258,788	103,563,324	3	83,563,924
2021	21,637,322	39,879,075	14,585,220	20,988,202	16,288,002	3,112,056	100,456,424	3	417,619,619
2022	15,992,962	43,523,435	14,585,220	15,513,173	18,715,077	3,047,954	97,442,731	3	374,221,050
2023	10,348,602	49,167,795	14,585,220	10,038,144	21,142,152	3,047,954	94,519,449	3	374,221,050
2024	5,087,840	54,428,557	14,585,220	4,935,204	23,404,280	2,840,812	91,683,866	3	348,788,551
2025	0	59,516,397	14,585,220	0	25,592,051	2,747,433	88,933,350	3	337,221,767
									\$2,666,213,990

Table 3: Effect of Additional 1% Reduction on Remaining CO2 Emissions by Transitioning to Renewable Energy

Year	Remaining Statewide CO2 Emissions‡	4% reductions‡	Difference of Additional 1% Emissions‡	Cost of Renewables Replacement (2014 dollars)
2012	120,600,000			
2016	116,982,000	115,776,000	1,206,000	30,150,000
2017	113,472,540	111,144,960	2,327,580	58,189,500
2018	110,068,384	106,699,162	3,369,222	84,230,550
2019	106,766,313	102,431,195	4,335,118	108,377,950
2020	103,563,324	98,333,947	5,229,377	130,734,425
2021	100,456,424	94,400,589	6,055,835	151,395,875
2022	97,442,731	90,624,566	6,818,165	170,454,125
2023	94,519,449	86,999,583	7,519,866	187,996,650
2024	91,683,866	83,519,600	8,164,266	204,106,650
2025	88,933,350	80,178,816	8,754,534	218,863,350
				\$ 1,344,499,075

† In Megawatt Hours
 ‡ In Metric Tons

G. Calculation on the costs of transitioning from fossil fuels as a source of electricity to renewable energy sources

Assuming that the scenario described in section 7.F is adhered to, North Carolina would need to reduce emissions by an additional one percent to comply with the proposed rule. One possible way that could be achieved is by replacing some of the fossil fuel electricity generation with renewable energy sources. According to one national expert, it costs between \$10-40 to eliminate one metric ton of CO₂ from the electricity sector by transitioning from fossil fuel sources of electricity to renewable energy sources.²⁶⁷ In order to calculate how much an additional one percent of emission reductions would cost, the cumulative metric tons of an additional one percent of North Carolina's CO₂ emissions was calculated—this equaled 53,779,963 metric tons of CO₂ between 2016 and 2025. This number was then multiplied by \$25, the average of \$10-40. That gives an estimated cost of replacing an additional one percent of emissions with renewable energy sources of \$1.34 billion in total between 2016 and 2025 (see Table 3).

(8) Provide a description, including the names and addresses, if known, of those most likely to be affected by the proposed rule.

We anticipate the rule proposed in this Petition will have indirect positive effects on all residents of North Carolina because it will help mitigate the impacts of climate change that, if left unmitigated, will affect everyone. More specifically, residents of coastal counties will be vulnerable to climate-change induced SLR if carbon dioxide emissions are not reduced. We also anticipate the rule having direct effects on electric power and related industries. In general, we expect the rule will result in a reduction of emissions from coal-fired power plants because energy and electricity will be generated by lower emitting sources such as renewable power and natural gas plants.

Facilities that emit 25,000 or more GHG per year are required to report their emissions to the Environmental Protection Agency.²⁶⁸ By August 18, 2014, 107 facilities located in North Carolina reported their 2013 CO₂ emissions to the EPA. The parent companies of these facilities are listed in Table 4, below. Duke Energy owns 17 of the 107 highest emitters of CO₂ and has already begun to take charge of its emissions. In 2010, Duke Energy voluntarily established carbon reduction goals attempting to reduce or offset CO₂ emissions by 17 percent of their 2005 levels by 2020.²⁶⁹ In fact, for the last two years its internal goal has already been met. However, Duke Energy's emissions alone make up over 84 percent of the total reported emissions to the EPA. Duke Energy's initial efforts demonstrate that environmental conservation and good business practices are not mutually exclusive and provide opportunities of common interest. However, there is much more to be done.

²⁶⁷ Arjun Makhijani, CARBON-FREE, NUCLEAR-FREE: A ROADMAP FOR U.S. ENERGY POLICY, 23-24 (IEER Press and RDR Books, 2007).

²⁶⁸ The table is available from the EPA at www.ghgdata.epa.gov/ghgp/main.do. (November 24, 2014).

²⁶⁹ Duke-Energy.com/pdfs/2013DukeSustainabilityReport.pdf at 15 (last visited November 6, 2014).

Power generation makes up only 22 percent of the total “low-hanging” CO₂ emissions that can be abated over the next decades.²⁷⁰ Nearly a quarter of these emission reductions could be attained in the building and transportation sector.²⁷¹ This abatement could be achieved through lowering the consumer demand for electricity through such simple means as improving the insulation of new buildings.²⁷² Lowering CO₂ emissions and other GHG emissions is not a simplistic matter of ensnaring “the usual suspects” in further and more complicated regulations but instead an exercise in innovative problem solving.

The Table 4 below sets forth a list of parties that are known emitters of carbon dioxide. While we do not know the names, addresses, or descriptions of all the specific parties likely to be directly affected, the table below describes them with as much specificity as is known:

TABLE 4: Parties likely to be most affected by the proposed rule

<u>Name</u>	<u>Address</u>	<u>Description</u>
Allegheny Technologies Inc.	1000 Six PFG Place Pittsburgh, PA 15222	A specialty materials & components supplier with a factory operating in Monroe, NC.
Blue Ridge Paper Products Inc.	41 Main Street Canton, NC 28716-4331	A specialty paper and paperboard packaging facility in Canton, NC.
Bridgestone Americas Tire Operations, LLC	535 Marriot Drive Nashville, TN 37214-5092	A tire producing factory located in Wilson, NC.
Buncombe County New Landfill	81 Panther Branch Road Alexander, NC 28701	A landfill operated by Buncombe County.
Campbell Soup Co.	1 Campbell Place Camden, NJ 08103-1701	A food manufacturing facility for Campbell Soup in Maxton, NC.
Cardinal Glass Industries	775 Prairie Center Dr. #200 Eden Prairie, MN 55344	A glassware manufacturer with a facility located in Mooresville, NC.
Cargill Inc.	15407 McGinty Rd W, MS26 Wayzata, MN 55391	An agricultural company with specific facilities located in Charlotte, Fayetteville, and Raleigh, NC.
Carolina Stalite Co.	205 Klumac Rd Salisbury, NC 28144	A slate lightweight aggregate manufacturer with a facility located in Gold Hill, NC.
Catawba County	100 A SW Blvd Newton, NC 28658	Blackburn landfill operated by Catawba County.

²⁷⁰ “A Cost Curve for Greenhouse Gas Reduction,” *The McKinsey Quarterly* 2007:1, 41.

²⁷¹ *Id.*

²⁷² *Id.* at 42.

Charlotte Pipe and Foundry Co.	2109 Randolph Road Charlotte, NC 28207	A manufacturer of pipe and fittings for plumbing and industrial systems located in Charlotte, NC.
City of Fayetteville	955 Old Wilmington Rd Fayetteville, NC 28301	A public waste facility operated by the City of Fayetteville, NC.
City of Lexington	28 West Center St. Lexington, NC 27292	A public waste facility operated by the City of Lexington, NC.
City of Winston-Salem	101 N. Main Street Winston-Salem, NC 27101	Hanes Mill road landfill operated by the City of Winston-Salem.
Clearwater Paper Corp.	601 W. Riverside Ave, Suite 1100 Spokane, WA 99201-0644	A tissue products manufacturer with a facility located in Shelby, NC.
CMS Energy Corp.	1730 Rhode Island Ave. NW, Suite 1007 Washington, D.C. 20036	A combination electric and natural gas utility operating Craven County Wood Energy in New Bern, NC.
CPI USA North Carolina LLC	700 Commerce Drive, Suite 160 Oak Brook, IL 60523-8733	A power company with facilities in Roxboro and Southport, NC serving the local region.
Cree, Inc.	460 Silicon Drive Durham, NC 27703-8475	Manufactures light bulbs and light fixtures among others.
Cumberland County Solid Waste Management	698 Ann Street Fayetteville, NC 28301	A landfill operated by Cumberland County.
DAK Americas LLC	5925 Carnegie Blvd Ste 500 Charlotte, NC 28209	PET resin manufacturer and polyester staple fibers producer located in Charlotte, NC. Wholly owned by Alfa S.A.B. de C.V. of Monterrey, Mexico.
Dominion North Carolina Power	P.O. Box 26543 Richmond, VA 23290	Investor-owned utility serving NC residents that owns coal-fired plants.
Dorner Paper Co. LLC	100 Kingsley Park Drive Fort Mill, SC 29715-6476	An investor-owned paper manufacturer with a paper mill operating in Plymouth, NC.
DSM Pharmaceuticals Product	P.O. Box 650 6401 JH Heerlen (NL)	Producer of food ingredients and nutritional additives with a facility operating in Greenville, NC.
Duke Energy Carolinas	550 South Tryon Street Charlotte, NC 28202	Investor-owned utility serving NC residents that owns coal-fired plants.
Duke University	114 S. Buchanan Blvd., Box 90144	A private research university located in Durham, North Carolina.
Edgemore Genco LLC	327 Hillsborough Street Raleigh, NC 27603-1725	A fossil fuel electric power generator located in Battleboro, NC owned by Calypso Holdings, LLC.

DU PONT DE NEMOURS & CO	1007 Market St Wilmington, DE, 19898	Du Pont operates two reporting facilities in NC. One in Fayetteville that produces a variety of building materials and one in Kinston involved in industrial bioscience.
ElectricCities	1427 Meadow Wood Blvd Raleigh, NC 27604	North Carolina Eastern Municipal Power Agency
ELEMENTIS Worldwide	469 Old Trenton RD East Windsor, NJ, 08512	An investor-owned chemical manufacturing company based out of the United Kingdom.
Evonik Goldschmidt Corporation	914 East Randolph Road Hopewell, VA 23860	A multinational, investor-owned chemical manufacturing company.
Frito-Lay, Inc.	7701 Legacy Drive Plano, TX 75024-4099	A food manufacturing company with a facility located in Greensboro, NC.
Gas Natural Inc	1 First Avenue South Great Falls, MT 59401	A natural gas distributor with a facility located in Elkin, NC.
Gerdau Ameristeel US Inc.	4221 W. Boy Scout Blvd, Suite 600 Tampa, FL 33607-5760	A steel manufacturer with a facility located in Charlotte, NC.
GlaxoSmithKline International	5 Crescent Drive Philadelphia, PA 19112-1001	A specialty medical products manufacturer with a facility in Research Triangle Park.
Automotive Components North America	28333 Telegraph Road Southfield, MI 48034-1953	An automotive part manufacturer with a facility located in Albemarle, NC.
International Paper Co.	6400 Poplar Avenue Memphis, TN 38197-0100	A paper and packaging manufacturer in Riegelwood, NC.
Kapstone Paper & Packaging Corp.	1101 Skokie Blvd, Suite 300 Northbrook, IL 60062-4124	A corrugated paper products manufacturer with a paper-mill located in Roanoke Rapids, NC.
Koch Industries, Inc.	P.O. Box 2256 Wichita, KS 67201-2256	Its subsidiary, Invista, is a chemical fibers, and plastics manufacturer with a facility located in Wilmington, NC.
MILLERCOORS LLC	250 S. Wacker Dr., Suite 800 Chicago, IL 60606-5888	An alcoholic beverage manufacturer with a facility in Eden, NC.
New Hanover County	3002 U.S. Highway 421 North Wilmington, NC 28401	A county-owned public waste facility operated by New Hanover County.
New NGC Inc.	2001 Rexford Rd Charlotte, NC 28211-3498	A gypsum wallboard manufacturing facility in Mount Holly, NC.
NGK North America	1105 North Market St, #1300 Wilmington, DE 19801	An automotive parts manufacturer with a facility in Mooresville, NC.

North Carolina Electric Membership Corporation	3400 Sumner Blvd, Raleigh, NC 27616	An energy distribution cooperative operating in North Carolina.
North Carolina State University	Campus Box 7001, A Holladay Hall Raleigh, NC 27695-7001	A public university located in Raleigh, NC.
Nucor Corporation	1915 Rexford Road Charlotte, NC 28211-3465	A steel manufacturing facility located in Cofield, NC.
Owens-Illinois, Inc.	One Michael Owens Way Perrysburg, OH 43551-2999	A glass bottle manufacturer for beers, wines, and other bottled products located in Lexington, NC.
PCS Phosphate Company Incorporated	1101 Skokie Boulevard, Suite 400 Northbrook, IL 60062-4123	A fertilizer, industrial and animal feed producer located in Aurora, NC.
Perdue Farms Inc.	31149 Old Ocean City Rd. Salisbury, MD 21804-1806	A poultry processing plant in Lewiston, NC.
Performance Fibers Operations Inc.	13620 Reese Blvd., Suite 400 Huntersville, NC 28078-6415	An industrial polyester fabric and fiber manufacturer located in Salisbury, NC.
Piedmont Natural Gas Co.	4720 Piedmont Row Dr. Charlotte, NC 28210-4269	A natural gas distributions company located in Charlotte servicing North Carolina, South Carolina, and Tennessee out of the same location.
Pilkington North America, Inc.	811 Madison Ave Toledo, OH 43604-5684	A glass manufacturer for building and automotive purposes with a facility located in Laurinburg, NC.
PPG Industries Inc.	327 Hillsborough St. Raleigh, NC 27603	A fiberglass manufacturer located in Lexington and Shelby, NC.
PQ Corp.	300 Lindenwood Dr. Valleybrooke Corporate Center Malvern, PA 19355-1740	A chemical manufacturer with a facility in Apex, NC.
R-F Micro Devices	7628 Thorndike Rd. Greensboro, NC 27409	Manufacturer of integrated RF circuits and semiconductor components.
ReEnergy Holdings, LLC	30 Century Hill Dr., Suite 101 Latham, NY 12110	Owners of a retrofitted coal-fired electrical generation plant It now runs on biomass as its primary fuel. Located in Kenansville, NC.
Reynolds American Inc.	401 North Main Street Winston-Salem, NC 27101-3804	A tobacco manufacturer with a facility located in Winston-Salem.
Saint-Gobain Containers Inc	750 E. Swedesford Road Valley Forge, PA 19482	A glass bottle producing factory with facilities located in Henderson and Wilson, NC.

SCANA Corp	220 Operation Way Cayce, SC 29033-3701	A natural gas company with a facility located in Gastonia, NC
Smith Beecham Corporation	980 Great West Road Brentford, Middlesex TW8 9GS	A GSK, Inc. company.
Smithfield Packing Company, Inc.	200 Commerce Street Smithfield, VA 23430	A meat packing facility located in Fair Heel, NC
Southern Company	30 Ivan Allen Jr. Blvd, Atlanta, GA 30308	A power company with generating facilities located in Grover and Salisbury, NC.
Stapet, Inc.	801 Pineview Rd Asheboro, NC 27203	A PET resin manufacturing facility located in Asheboro, NC. It has been acquired by Indorama Ventures an international PET producer that is headquartered out of Thailand.
Sun Capital	300 N Greene St., Ste 1750 Greensboro, NC 27401	Owns Performance Fibers, Inc. an industrial polyester fabric and fibers manufacturer with a facility in New Hill, NC.
The Goodyear Tire & Rubber Company	200 Innovation Way Akron, OH 44316-0001	A rubber manufacturing company with a facility located in Fayetteville, NC
Tyson Foods, Inc.	2200 W. Don Tyson Parkway Springdale, AR 72762	A food manufacturer with facilities in Harmony and Wilkesboro, NC.
Valley Proteins, Inc.	1309 Industrial Dr Fayetteville, NC 28301-6323	An animal byproduct recycling and restaurant grease rendering company with facilities in Gastonia, Rose Hill, Wadesboro, and Fayetteville, NC.
Westmoreland Coal Company	9540 South Maroon Circle Suite 200 Englewood, CO 80112	Owns the Roanoke Valley Energy Facility a power plant located in Weldon, NC.
Weyerhaeuser NR Co.	33663 Weyerhaeuser Way South Federal Way, WA 98001-9620	A paper and packaging company with a facility located in Vanceboro, NC
Williams Partners, LP	One Williams Center 5000 Tulsa, OK 74172-0172	A natural gas company with facilities located in Mooresville, Lexington, and Reidsville, NC.
Coal production/transportation industries	Unknown	Reducing demand for coal in NC will result in less coal being shipped in from out-of state.
Natural gas production/	Unknown	Reduced demand for natural gas in NC will result in less being shipped in from

transportation
industries

out of state.

Renewable energy
industries

Unknown

Increased demand for solar and wind energy will encourage increased importation and manufacture of necessary components, and increased demand for installation contractors.

(9) Provide the name(s) and address(es) of the petitioner(s).

Hallie Turner
1108 Tonsler Dr.
Raleigh, NC 27604

Gayle Goldsmith Tuch
P.O. Box 1006
3540 Clemmons Road, Suite 107
Clemmons, NC 27102

Conclusion

North Carolina's atmosphere is a precious resource, essential to the survival and well being of all North Carolina's residents and the environment and natural resources they rely on. North Carolina has an affirmative duty to protect the environment, and although we call for action with regards to carbon dioxide in particular, this does not abrogate North Carolina's obligation generally.

The Public Trust Doctrine requires that, as co-tenant trustee the State of North Carolina and its agencies, the North Carolina Environmental Management Commission and the North Carolina Department of Environment and Natural Resources, hold vital natural resources in trust for both present and future generations of its citizens. In recognition of this responsibility, the Commission was entrusted with both the *duty and power* to adopt regulations for air quality and emissions control standards for air contaminant sources pursuant to N.C.G.S. § 143-215.107. North Carolina's atmosphere is a shared natural resource vital to the health, welfare, and survival of its citizens. Because only the State has the technology and power to protect it, the atmosphere has been entrusted the State's care for its preservation and protection as a common property interest. As such, the State of North Carolina has a fiduciary, perpetual, affirmative duty to preserve and protect the atmosphere for the present citizens and future generations of the State as beneficiaries of this trust asset.

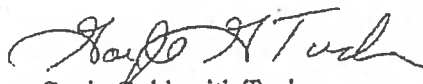
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This duty is articulated in the Public Trust Doctrine but also in the Commission's enabling statutes and the North Carolina Constitution. For example, the State's affirmative duty to preserve the atmosphere under the public trust doctrine is demanded by the State's public policy "to provide for the conservation of its water and air resources [and] to achieve and to maintain for the citizens of the State a total environment of superior quality. Recognizing that the water and air resources of the State belong to the people, the General Assembly affirms the State's ultimate responsibility for the preservation . . . of these resources in the best interest of all its citizens[.]"²⁷³

And so, for the reasons above, it is with utmost respect that this Petition is hereby submitted on behalf of Hallie Turner, the citizens of the State of North Carolina, and present and future generations of minor children. The petitioner respectfully requests that the North Carolina Environmental Management Commission and the Division of Air Quality promulgate a rule that requires the agency to take the necessary steps in order to protect the integrity of Earth's climate by adequately protecting our atmosphere, a public trust resource upon which all North Carolina residents rely for their health, safety, sustenance, and security.

The Petitioner respectfully request an opportunity for a public hearing on the rule proposed in the Petition and a written decision on whether or not to proceed with the rulemaking process. We appreciate your consideration of this Petition. If you have any questions or need additional information, please contact me.

Very truly yours,



Gayle Goldsmith Tuch

Enclosures

cc: Lois Thomas-Spence, EMC Clerk
Kelly Turner, mother of Hallie Turner
Hallie Turner

²⁷³ N.C.G.S. § 143-211(a) (emphasis added).