

10-1-2005

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Recommended Citation

David W. Childs, *The Unresolved Debates That Scorched Kyoto: An Analytical Framework*, 13 U. Miami Int'l & Comp. L. Rev. 233 (2005)

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THE UNRESOLVED DEBATES THAT SCORCHED KYOTO: AN ANALYTICAL FRAMEWORK

*David W. Childs**

I.	Introduction.....	233
II.	Proposition One: Global Warming is Due to Increase of Greenhouse Gas Emissions.....	235
A.	The Proponents of Anthropogenic Global Warming.....	237
B.	The Skeptics of Anthropogenic Global Warming.....	241
III.	Proposition Two: The Kyoto Protocol is a Scientifically Legitimate Response to the Threat of Anthropogenic Climate Change.....	246
A.	The Kyoto Protocol is a Scientifically Legitimate Response.....	249
B.	The Kyoto Protocol is Not a Scientifically Legitimate Response.....	251
IV.	Proposition Three: The Kyoto Protocol is more Economically Palatable than Inaction.....	253
A.	The Economic Impact is Too Severe.....	253
B.	The Economic Impact is Not Too Severe.....	256
V.	Concluding Remarks.....	259

I. Introduction

The abysmal failure of the Kyoto Protocol is best illustrated by the single sentence that comprises the second paragraph of the Protocol's third article: "[e]ach party included in Annex I shall, by 2005, have made demonstrable progress in achieving its commitments under this

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Protocol.”¹ Presently, on the brink of January 1, 2005, the issue is not whether the world’s industrialized nations are making “demonstrable progress” in reducing greenhouse gas emissions; rather, the issue is whether the European Union (EU) can successfully convince Russia to ratify the treaty to give it full force and effect.² Without Russian ratification, Kyoto will become a dead letter document, and EU support for implementing any of its provisions appears likely to falter.³

Proponents of the Protocol may argue that a Russian ratification would at least partially salvage the agreement. However, any attempt to characterize the current situation as an opportunity for success is little

¹ Conference to the Parties to the Framework Convention on Climate Change: Kyoto Protocol to the U.N. Framework Convention on Climate Change, Dec. 10, 1997, art. 3, 37 I.L.M. 22, 33 [hereinafter *Kyoto Protocol*].

² See Reuters, *EU Firm on Climate Change, to Push Russia on Kyoto*, N.Z. Herald, available at <http://www.nzherald.co.nz/latestnewsstory.cfm?storyID=3552609&thesection=business&thesubsection=latest> (last visited Nov. 16, 2004). A Russian ratification is necessary for an effective agreement because the United States withdrew from negotiations. *Id.* The Kyoto Protocol requires fifty-five ratifications by countries accounting for 55% of the total Annex I carbon dioxide emissions as of 1990. *Kyoto Protocol*, *supra* note 1, at art. 25, para. 1. The number of ratifications minus Russian acceptance falls short of the 55% goal by 10.8%. United Nations Framework Convention on Climate Change, *Kyoto Protocol Thermometer*, at http://unfccc.int/essential_background/kyoto_protocol/status_of_ratification/items/3134txt.php (last modified Nov. 2, 2004) [hereinafter *Kyoto Protocol Thermometer*].

³ Germany and Italy both indicated that Europe cannot afford greenhouse gas reductions without greater universal participation. Lisa Jucca, *Germany Raises Doubt over EU’s Kyoto Policy*, Reuters, at <http://www.alertnet.org/thenews/newsdesk/L26197834.htm> (on file with University of Miami International & Comparative Law Review); *Europe’s Cold Sweat over Kyoto*, Christian Science Monitor (Mar. 30, 2004), at <http://www.csmonitor.com/2004/0330/p08s03-comv.html>. Germany, however, ultimately agreed to a “slight reduction.” DW-World, *Germany Makes EU Deadline for CO2 Plans*, at http://www.dw-world.de/english/0,3367,1433_A_1157680_1_A,00.html (last visited Nov. 16, 2004). The number of European nations consenting to reductions independent of Kyoto currently stands at five. Reuters, *Five EU States Submit National CO2 Emission Plans*, available at <http://www.planetark.com/dailynewsstory.cfm/newsid/24572/%20t> (April 2, 2004).

more than a farce. Even if Russia joins the Protocol, three of the world's largest greenhouse gas emitters – India, China, and the United States – as well as every nation on the African continent, would not have to take part in a problem that inherently demands a global response. Over half of the greenhouse gases currently drifting into the upper reaches of the atmosphere originate in nations that will be completely unregulated by the Kyoto Protocol.⁴ Meanwhile, many of the nations willing to be bound to Kyoto's strict emission standards will likely be unable to meet their reduction requirements.⁵ If the requirements can be met, the reduction levels are only binding for four years, between 2008 and 2012.⁶ Thus, the Kyoto Protocol's current effectiveness in slowing global warming is far less than a drop in the bucket. It is a drop in the ocean.

The goal of this paper is not to lament the current state of the Kyoto Protocol or to celebrate it. Instead, this paper will demonstrate that the failure of the Kyoto Protocol is due to its necessary acceptance of three highly contentious propositions. One must first accept that the science underlying the Protocol is compelling. Then one must determine that the Protocol is a scientifically legitimate response to the global warming threat. Finally, one must conclude that the Protocol is more economically palatable than inaction. This paper will delineate the ongoing disputes over each of these issues and thereby illustrate why 2005 will not see the "demonstrable progress" in greenhouse gas reductions called for by the Kyoto Protocol.

II. Proposition One: Global Warming is Due to the Increase of Greenhouse Gas Emissions

The first step in understanding the debate over global warming is parsing what is scientifically accepted from what is contested. Most scientists accept the existence of a "greenhouse effect."⁷ The debatable

⁴ Greg Kahn, *Between Empire and Community: The United States and Multilateralism 2001-2003: A Mid-Term Assessment: Environment: The Fate of the Kyoto Protocol Under the Bush Administration*, 21 BERKELEY J. INT'L L. 548, 561 (2003).

⁵ *Id.* at 556.

⁶ Kyoto Protocol, *supra* note 1, at art. 3, para. 1. While Kyoto flounders, Finland is trying to garner support for expanding and extending its duration beyond 2012. NewsRoom Finland, *Finland Rallies Countries to Get Behind Kyoto*, at <http://virtual.finland.fi/stt/showarticle.asp?intNWSAID=4021&group=Politics> (March 26, 2004).

⁷ See *supra* text 4-13.

issue is whether humans are heightening this effect and, if so, to what extent and with what consequences.

The greenhouse effect, originally hypothesized nearly 200 years ago,⁸ is a necessary and natural occurrence. It is caused by greenhouse gases, such as carbon dioxide, which compose approximately 0.1% of the earth's atmosphere.⁹ These gases trap infrared radiation from the sun and maintain the earth's surface temperature around 34° C above the temperature that would exist were there no atmospheric greenhouse gases.¹⁰ The presence of this greenhouse effect is largely undisputed as are the indications of recent increases in carbon concentrations in the earth's atmosphere.¹¹ Ice core samples in Greenland and Antarctica indicate that there is more carbon dioxide in the air now than at any point in the past 420,000 years.¹² These samples also indicate that carbon dioxide concentrations have increased 30% since the dawn of the industrial revolution,¹³ and methane concentrations are 150% above pre-industrial levels.¹⁴ These historic levels are due in large part to the burning of fossil fuels, which release 6 billion metric tons of carbon yearly.¹⁵ Hence, humans are releasing gases whose atmospheric concentrations are known to have a warming effect on the earth.

⁸ WILLIAM R. COTTON & ROGER A. PIELKE, *HUMAN IMPACTS ON WEATHER AND CLIMATE* 161 (Cambridge University Press 1995) [hereinafter *HUMAN IMPACTS*]. Swedish Professor, Svante Arrhenius, greatly improved upon the theory and published a paper that posited a causal connection between increased carbon dioxide concentrations and temperature increases in 1896. THOMAS G. MOORE, *CLIMATE OF FEAR: WHY WE SHOULDN'T WORRY ABOUT GLOBAL WARMING* 9 (1998) [hereinafter *CLIMATE OF FEAR*].

⁹ U.N. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS* 87 (2001). [hereinafter *IPCC CLIMATE CHANGE*].

¹⁰ DAVID G. VICTOR, *THE COLLAPSE OF THE KYOTO PROTOCOL AND THE STRUGGLE TO SLOW GLOBAL WARMING* 119 (2001) [hereinafter *COLLAPSE OF KYOTO*].

¹¹ Sherwood W. Wise, Jr., *The Antarctic Ice Sheet: Rise and Demise?*, 15 *FLA. ST. U. J. LAND USE & ENVTL. L. & FLA. ST. J. TRANSNAT'L L. & POL'Y* 383, 385 (2000).

¹² *Id.*

¹³ WARWICK J. MCKIBBIN & PETER J. WILCOXEN, *CLIMATE CHANGE POLICY AFTER KYOTO: BLUEPRINT FOR A REALISTIC APPROACH* 1 (2002) [hereinafter *CLIMATE CHANGE POLICY AFTER KYOTO*].

¹⁴ *Id.* at 10.

¹⁵ *Id.* at 1.

Additionally, there is a virtual consensus among scientists that the earth's average surface temperature is 0.4 to 0.8 ° C warmer than it was in 1860.¹⁶ One could easily assume a direct relationship between this increase in temperature and the increase in greenhouse gas emissions. However, the earth's climate system is far too complex to assume a simple cause and effect relationship.¹⁷ Consequently, the proponents and skeptics of anthropogenic climate change theorize the relationship between these two observations quite differently.

A. The Proponents of Anthropogenic Global Warming

The basic premise of the proponents' argument is that human activity has upset the energy balance of the natural greenhouse effect, particularly by "the combustion of fossil fuels and deforestation."¹⁸ The combustion of fossil fuels by cars, power plants, and other sources adds carbon dioxide, methane, and other greenhouse gases to the atmosphere.¹⁹ Meanwhile, deforestation weakens the planet's ability to absorb carbon dioxide before it enters the upper reaches of the atmosphere.²⁰ Chemicals such as carbon monoxide and nitrogen oxides, while not greenhouse gases, react with other gases in the atmosphere to create the greenhouse gas known as tropospheric ozone.²¹

Given these factors, proponents conclude that "the observed change in global mean, annually averaged temperature over the last century is unlikely to be due entirely to natural fluctuations of the climate system," and it is the "forcing of greenhouse gases and sulphate aerosols" that is responsible for this "climate response."²² The Kyoto

¹⁶ The IPCC and the National Academy of Sciences endorse this level of warming. *Id.* at 27. A change in 1° C is equivalent to a 1.8° F change. Thus, the average increase in temperature is around 1° F.

¹⁷ A myriad of other variables factor into the equation. As one climatologist stated, "the complexity of climate makes it impossible to know with any degree of confidence" that the observed temperature changes are anthropogenic. *Id.* at 1.

¹⁸ IPCC CLIMATE CHANGE, *supra* note 9, at 92.

¹⁹ *Id.* at 92-93.

²⁰ *Id.* at 193.

²¹ *Id.* at 92.

²² *Id.* at 97 (quoting the IPCC Second Assessment Report).

Protocol is based on this premise.²³ The perpetual addition of carbon dioxide and other greenhouse gases creates an accumulation of layers in the atmosphere that is similar to a person wearing increasingly more layers of clothing on a sunny day. Kyoto aims to keep additional layers from being added.²⁴

The International Panel on Climate Change (IPCC) deemed the appropriate response to be the stabilization of carbon concentrations through the Kyoto Protocol. The IPCC is a vast body of international climatologists and meteorologists charged by the United Nations Environment Program and the World Meteorological Organization in 1988 with the task of assessing the “available scientific and socio-economic information on climate change.”²⁵ The IPCC assembled enough scientific data on climate to conclude in its 1996 “Second Assessment Report” (SAR) that “[t]he balance of evidence suggests a discernable human influence on global climate.”²⁶ Since that report, new research has caused some flux in the underlying data and theory,²⁷ but the principle conclusion remains the same.

The main challenge facing the IPCC was establishing a causal connection between the increased concentrations of greenhouse gases and the observed warming trends. Proving this correlation requires splicing the anthropogenic influences on climate change from their natural variability.²⁸ The IPCC report readily acknowledges that there are “uncertainties in a number of factors, including the magnitude and patterns of internal climate variability, external forcing and climate system response.”²⁹ However, they still maintain that the overwhelming weight of evidence indicates that there is likely a human influence on the climate’s warming trend, and the accumulation of subsequent data has

²³ J. Kevin Healy & Jeffrey M. Tapick, *Climate Change: It's Not Just a Policy Issue for Corporate Counsel – it's a Legal Problem*, 29 COLUM. J. ENVTL. L. 89, 94 (2004) [hereinafter *Climate Change: A Legal Problem*]

²⁴ See Kyoto Protocol, *supra* note 1.

²⁵ IPCC CLIMATE CHANGE, *supra* note 9, at vii.

²⁶ *Id.* at 10.

²⁷ The most notable changes resulted from additional research concerning aerosols. See *id.* at 291-335.

²⁸ IPCC CLIMATE CHANGE, *supra* note 9, at 697. Some scientists suggest that this task may never be fully accomplished. HUMAN IMPACTS, *supra* note 8, at 200.

²⁹ IPCC CLIMATE CHANGE, *supra* note 9, at 697.

only strengthened their conclusions.³⁰ Their current level of certainty is “unlikely (bordering on very unlikely)”³¹ that the warming of the past 30-50 years is due to “internal climate variability.”³²

The IPCC points to several sources to support the causal connection between the anthropogenic greenhouse gas emissions and the apparent global temperature increases since 1950.³³ First, they dismiss solar and volcanic forcing (i.e. an active sun and volcanic eruptions heating the troposphere) as the warming culprits in the most recent decades.³⁴ Studies indicate a downward trend in both activities since the middle parts of the twentieth century.³⁵ Accordingly, it would be implausible that a decrease in forcing would result in the observed increases in temperature.³⁶ Without an obvious natural source on which to pin causation, the IPCC turns to the issue of whether the recent global warming trends are unusual for our planet.³⁷ The IPCC concludes that there is substantial evidence that rapid temperature change without human causation has previously occurred during an interglacial period, although the scale of these events was not global.³⁸

Without a significant natural origin on which to pin causation and a rate of temperature change of possibly historic proportions, the IPCC focused on greenhouse gases. The National Academy of Sciences

³⁰ *Id.* Among the “remaining uncertainties” are the effects of aerosols, volcanic forcing, and solar signals. *Id.* at 698.

³¹ “Unlikely” is a term of art indicating that there is a 10-33% chance, and “very unlikely” indicates that there is a 1-10% chance. *Id.* at 2.

³² *Id.* at 698.

³³ This time frame is important because skeptics of global warming generally believe that the warmest year of the twentieth century occurred before 1950, and changes since that time have been negligible. *See supra* text 8 and note 55.

³⁴ IPCC CLIMATE CHANGE, *supra* note 9, at 709, 380-85. A decrease in volcanic activity actually could result in an increase in temperature because of the large amount of sulphate aerosols produced by volcanic eruptions. *See* R.C.L. WILSON ET AL., THE GREAT ICE AGE: CLIMATE CHANGE AND LIFE 142 (2000) [hereinafter CLIMATE CHANGE AND LIFE].

³⁵ IPCC CLIMATE CHANGE, *supra* note 9, at 709, 380-85.

³⁶ *Id.*

³⁷ *Id.* at 130-36.

³⁸ *Id.* at 142. One of these events, the “Medieval Warm Period” is specifically dismissed by the IPCC as having “limited utility” in explaining the global phenomenon, although global warming skeptics often cite it as evidence that current warming trends are not anthropogenic. *Id.* at 135. *See supra* 9, for the skeptics’ discussion.

estimates greenhouse gases to be at their highest level in 400,000 years.³⁹ The amount of carbon dioxide in the atmosphere has increased exponentially from 280 parts per million (ppm) in 1800, to 397 ppm in 1999,⁴⁰ because humans are increasingly forcing more gases into the atmosphere than can be naturally absorbed by “carbon sinks” such as forests and the ocean.⁴¹ This increase in concentration causes the naturally occurring greenhouse effect to retain larger amounts of heat, and hence, global temperatures are rising.⁴² More recent IPCC studies indicate that some of the warming has been and will be offset by the release of sulphate aerosols, biomass burning, and mineral dust into the atmosphere.⁴³ However, the IPCC rates their “level of scientific understanding” of these cooling factors to range from “low” to “very low.”⁴⁴

The IPCC constructed a series of global climate models from their collected data on each of these climate factors and different possible economic growth patterns.⁴⁵ These models predicted possible temperature increases of 1.4 to 5.8 degrees Celsius between 1990 and 2100.⁴⁶ Scientists estimate that such an increase could usher in sea level rise between 0.09 and 0.88 meters, extreme seasonal variations in climate, crop failures, and other negative global impacts.⁴⁷ Developing countries would likely experience the most difficulty in coping with the

³⁹ *Climate Change: A Legal Problem*, *supra* note 23, at 90.

⁴⁰ IPCC CLIMATE CHANGE, *supra* note 9, at 187.

⁴¹ *Id.* at 193.

⁴² *Id.* at 55-56.

⁴³ *Id.* at 9. These compounds are believed to have a cooling effect. *Id.*

⁴⁴ *Id.* at 37. The Technical Summary in *Climate Change 2001: The Scientific Basis*, fails to define the terms “low” and “very low.” See *Id.* at 21-83. However, “low” was equated to a “5-33%” confidence level, and “very low” was equated to a “5% or less” confidence level in an earlier publication. See U.N. Intergovernmental Panel on Climate Change, *Climate Change 2001: Impacts, Adaptation, and Vulnerability* 24 available at http://www.grida.no/climate/ipcc_tar/wg2/pdf/wg2TARtechsum.pdf (February 2001) [hereinafter *IPCC: Impacts, Adaptation, and Vulnerability*].

⁴⁵ IPCC CLIMATE CHANGE, *supra* note 9, at 473-512.

⁴⁶ *Id.* at 13.

⁴⁷ *Id.* at 15-16. The extent of damage caused by these factors are discussed *supra* text 25-26.

impact of these changes.⁴⁸ The IPCC further estimates that these effects will remain centuries after atmospheric greenhouse gas concentrations are stabilized.⁴⁹ Therefore, the threat requires immediate action, and although more research is needed,⁵⁰ proponents of the anthropogenic global warming theory argue that the stakes are too great to wait for more conclusive evidence before taking action.⁵¹

B. The Skeptics of Anthropogenic Global Warming

Despite the espoused consensus on anthropogenic influence on climate change, a significant number of scientists remain unconvinced by the IPCC report. In fact, 17,000 scientists signed a statement in 1998 that attested to their skepticism of the science underlying the Kyoto Protocol.⁵² Some speculate that even more scientists would challenge the theory, but many are reluctant because they believe “only good can come from attempts to reduce greenhouse gas emissions.”⁵³ The skeptics generally argue three points in refuting the conclusions of the IPCC: (1) it is currently impossible to distinguish natural warming from anthropogenic warming, (2) the computer models promulgated by the IPCC are severely flawed, and (3) even if there is a minimal increase in average surface temperature, humans would not suffer.

⁴⁸ Matthew Vespa, *Climate Change 2001: Kyoto at Bonn and Marrakech*, 29 *ECOLOGY L.Q.* 395, 397 (2002) [hereinafter *Kyoto at Bonn and Marrakech*].

⁴⁹ IPCC CLIMATE CHANGE, *supra* note 9, at 17.

⁵⁰ *Id.*

⁵¹ One scholar compares our current situation to the Titanic cruising towards an iceberg. Symposium, *An Assessment of the Kyoto Protocol Transcript from Panel Discussion April 15, 1999*, 11 *GEO. INT'L ENVTL. L. REV.* 767, 778 (1999) [hereinafter *Kyoto Panel Discussion*]; see also *COLLAPSE OF KYOTO*, *supra* note 10, at 121 (arguing that the consequences could be equally catastrophic for developed nations as it will be for their developing counterparts); cf. Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 *U. PA. L. REV.* 1003, 1027-28, 1044-54 (2003) (arguing that changing behavior because of a mere possible outcome often makes little economic sense). The purported costs and severity of the global warming damages are discussed *supra* text 19-26.

⁵² *Kyoto Panel Discussion*, *supra* note 51, at 772. This “Oregon Petition” is not the only one of its kind. See Lakshman Guruswamy, *Climate Change: The Next Dimension*, 15 *FLA. ST. U. J. LAND USE & ENVTL. L. & FLA. ST. J. TRANSNAT'L L. & POL'Y* 341, 352 n.58 (2000) [hereinafter *Climate Change: The Next Dimension*].

⁵³ *HUMAN IMPACTS*, *supra* note 8, at 160.

Scientific data demonstrates a considerable amount of fluctuation in weather temperatures over the past 1,000 years. Though the twentieth century was the warmest century of the past 600 years, it was not the warmest century when compared to 1000 AD.⁵⁴ Skeptics point to the "Little Climate Optimum," which lasted from 800 AD to around 1200 or 1300 AD,⁵⁵ as evidence that current temperatures are not unseasonably warm when reviewing the broad historical record.⁵⁶ This period was warm enough for the Vikings to settle and grow crops on the currently frozen wastelands of Greenland.⁵⁷ The Climate Optimum was followed by a 600-year "Little Ice Age," which ended with a steep warming trend that began in 1850, recessed between 1940 and 1975, and now may be resuming.⁵⁸ In light of this climate change occurring before and during the large-scale human addition of greenhouse gases to the atmosphere, it is erroneous to assume that the recent warming trend is the result of human activity without additional scientific evidence.⁵⁹

Skeptics purport that the myriad of natural factors glossed over by the IPCC exhibit the fallacy of assuming that the observed climate change is necessarily anthropogenic. Of these factors, the most egregious lack of understanding is with respect to clouds, solar variability, and life cycle of greenhouse gases.⁶⁰ The IPCC does not adequately address or understand the relationship between temperature

⁵⁴ *Kyoto Panel Discussion*, *supra* note 51, at 771-72. This information is discernable from tree rings and ice core samples. *Id.* at 771-73.

⁵⁵ *CLIMATE OF FEAR*, *supra* note 8, at 46.

⁵⁶ *Kyoto Panel Discussion*, *supra* note 51, at 772.

⁵⁷ *Id.* The IPCC discounts this period as a regional, not a global, phenomenon. IPCC *CLIMATE CHANGE*, *supra* note 9, at 142. The skeptics, however, argue that the phenomenon was global, though not simultaneous, and cite evidence of expanded agricultural activities that took place during this period in South and Central America. *CLIMATE OF FEAR*, *supra* note 8, at 59-61. Japan and China purportedly experienced their own "Climate Optimum," but theirs began around 800 AD and ended around 1000 AD. *Id.* at 48, 57-58.

⁵⁸ S. FRED SINGER, *HOT TALK, COLD SCIENCE: GLOBAL WARMING'S UNFINISHED DEBATE* 33 (1997) [hereinafter *HOT TALK*].

⁵⁹ One scholar considers any statement of certainty that global warming is the result of human activity as an "extremely anthropogenic" statement. *HUMAN IMPACTS*, *supra* note 8, at 202.

⁶⁰ Other factors include water vapor, vegetative feedback, and ocean feedback. *See id.* at 169-175.

and cloud cover.⁶¹ Meteorological studies indicate that the increased low-level cloud cover due to the evaporation of ocean waters from the initial warming temperatures could significantly offset any warming trends.⁶² In addition, the IPCC admits that the current “level of scientific understanding” of the sun’s “total solar irradiance” is “very low.”⁶³ This lack of understanding could seriously undermine IPCC predictions, because the past 100 years witnessed a strikingly strong correlation between the sunspot cycle and average global surface temperature.⁶⁴ The greater the solar activity, the warmer temperatures have been.⁶⁵ Another factor the IPCC does not adequately consider is the life cycle of greenhouse gases in the atmosphere.⁶⁶ While it is known that 40% of the carbon dioxide forced into the atmosphere stays there, too little is known about the length of its atmospheric life and the fate of the 60% that does not remain aloft.⁶⁷ The IPCC simply does not know enough about clouds, solar variability, or carbon’s atmospheric life cycle to construct accurate global climate models.⁶⁸

Skeptics also express misgivings about the significant discrepancy between satellite and surface temperature data.⁶⁹ Readings from surface temperature stations indicate rising temperatures while satellite readings indicate stagnant temperatures.⁷⁰ The IPCC discounts this discrepancy as unimportant because the two systems measure separate layers of the atmosphere.⁷¹ However, their position will become untenable if the temperature divide widens over time because an air volume cannot maintain a stagnant temperature while resting upon a

⁶¹ HOT TALK, *supra* note 58, at 51 (quoting the IPCC science panel’s statement that “[c]loud behavior is the ‘single biggest uncertainty’ and that “[r]esearchers cannot be certain whether (clouds) speed warming or slow it”).

⁶² *Id.* at 50; HUMAN IMPACTS, *supra* note 8, at 180.

⁶³ IPCC CLIMATE CHANGE, *supra* note 9, at 382.

⁶⁴ HOT TALK, *supra* note 58, at 7, 55.

⁶⁵ *Id.*

⁶⁶ *Id.* at 61.

⁶⁷ *Id.*

⁶⁸ See HUMAN IMPACTS, *supra* note 8, at 128-131.

⁶⁹ HOT TALK, *supra* note 58, at 12.

⁷⁰ *Id.*

⁷¹ IPCC CLIMATE CHANGE, *supra* note 9, at 120. Satellites measure the stratosphere, which is the region directly above the troposphere, which is measured by surface instruments. *Id.*

warming air volume.⁷² The skeptics attribute the difference to the “urban heat island effect” – an effect acknowledged by the IPCC but purportedly underestimated.⁷³ This phenomenon explains that data provided by temperature recording stations near populated areas are skewed to be significantly higher.⁷⁴ As all New Yorkers know, downtown New York City is noticeably warmer than the suburbs of Long Island, which are in turn warmer than the farmland in the Catskills. Other temperature measurement irregularities exacerbate the problematic urban heat island effect. These include the lack of uniformity in temperature gathering methods and the dearth of ocean surface temperature measurement (recalling that only one third of the earth is land).⁷⁵ Skeptics thus conclude that the IPCC’s determination that the earth warmed during the latter half of the century is speculation. If one correctly adjusts surface temperature measurements to properly take into account the “urban heat island” effect, the years around 1940 – not the mid-1990’s – become the warmest of the century for both the US and Europe.⁷⁶

Scientists skeptical of the IPCC’s conclusions surmise that the anthropogenic warming threat is a mere paper tiger. They assert that IPCC predictions on global warming over the next century are irreparably flawed because the global climate models fail to adequately take a series of crucial factors into account. These climate models are crude instruments that merely speculate what may happen, and scientists may still be decades away from sufficiently understanding weather systems and global climate change to attribute it to anthropogenic

⁷² HOT TALK, *supra* note 58, at 12, 45-48. However, this gap in temperature may be exactly what is happening, as evidenced by the increases in precipitation observed in the United States over the past years. See Patrick J. Michaels, *Drought-Inspired Climate Panic*, WASH. TIMES, Sept. 16, 2002, (providing that “[i]f the surface warms while the air above does not, the surface air is more buoyant, and that will increase precipitation intensity” and that “U.S. precipitation has increased about 10% over the [twentieth] century, an increase of around [three] inches in the last 100 years”) available at <http://www.cato.org/research/articles/michaels-020916.html> (last visited Nov. 17, 2004).

⁷³ See IPCC CLIMATE CHANGE, *supra* note 9, at 94, 106, 163. This phenomenon is factored into their global climate models. *Id.* at 94.

⁷⁴ HOT TALK, *supra* note 58, at 12; See also PATRICK J. MICHAELS, SOUND AND FURY: THE SCIENCE AND POLITICS OF GLOBAL WARMING 45-49 (1992).

⁷⁵ *Id.* at 43-51.

⁷⁶ HOT TALK, *supra* note 58, at 12.

factors.⁷⁷ The skeptics realize, however, that these assertions may not be enough to convince one adhering to the precautionary principle.⁷⁸ The skeptics thus continue that even the disastrous implications of a warmer earth are simply imaginary.

Most prevalently, the skeptics oppose assertions that the increase in greenhouse gas concentrations necessarily leads to agricultural failures and ocean level increases. Studies indicate that plants grow significantly faster in a carbon dioxide enriched environment.⁷⁹ It follows that an influx of greenhouse gases creates more robust vegetation.⁸⁰ The modest levels of temperature increase predicted by the IPCC would also likely extend the growing season and reduce the occurrence of plant-damaging frosts during the growing season.⁸¹ Therefore, the greenhouse effect will have a positive influence on agricultural harvests much in the same way that the warmer temperatures of the "Little Climate Optimum" helped agriculture,⁸² only this time, there is the added benefit of a carbon enriched atmosphere. Additional studies indicate that proponents of the global warming theory overstate the doomsday levels of ocean rising.⁸³ These studies provide that the earth's waters will not rise because increased levels of evaporation from the ocean would transfer to the

⁷⁷ Singer agrees with leading scientists that say it will be "a decade before computer models can confidently link the warming to human activities." *Kyoto Panel Discussion*, *supra* note 51, at 772-73. Others believe it will take many decades to assert a causal connection. *HUMAN IMPACTS*, *supra* note 8, at 202.

⁷⁸ The Rio Declaration on Environment and Development provides a widely accepted definition of the precautionary principle. It provides: "[i]n order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." U.N. Environment Program, Rio Declaration on Environment and Development, Principle 15, *available at* <http://www.unep.org/Documents/Default.asp?DocumentID=78&ArticleID=1163>.

⁷⁹ *HUMAN IMPACTS*, *supra* note 8, at 181-82.

⁸⁰ *Id.*

⁸¹ *HOT TALK*, *supra* note 58, at 19, 58-59.

⁸² *Id.* at 17.

⁸³ *Id.* at 18-19, 57-58.

polar ice caps.⁸⁴ This transfer would thicken the ice caps enough to offset any melting due to temperature increases.⁸⁵

Skeptical scientists thus mistrust the science underlying the IPCC anthropogenic global warming predictions and the alleged severe consequences that would follow. Despite this skepticism, most scientists seem to agree that reducing greenhouse gas emissions and becoming more energy efficient is a good idea.⁸⁶ They disagree, however, with the IPCC allegation that such reductions necessarily would have an impact on climate change, because scientific data has simply not reached a point where one can confidently link human activities with climate change.

III. **Proposition Two: The Kyoto Protocol is a Scientifically Legitimate Response to the Threat of Anthropogenic Climate Change**

The Kyoto Protocol embodies the legal response to the global warming threat.⁸⁷ This response has proven to be just as, if not more, controversial than the problem it addresses. The subject of most criticisms of Kyoto's text can be categorized as either scientific or economic. Before considering these attacks and their responses, the substantive provisions of the Protocol must first be analyzed.

Article 3 contains the central terms of the Kyoto Protocol. This article requires the industrialized nations listed in Annex I of the agreement to reduce "their overall emissions by at least 5% below 1990 levels in the commitment period [of] 2008 to 2012."⁸⁸ The obligated countries may use 1995 levels of hydroflouorocarbons, perflorocarbons,

⁸⁴ *Id.* The IPCC agrees that the "Antarctic sheet is likely to gain mass," but they believe the Greenland sheet will "lose mass because the increase in runoff will exceed the precipitation increase." IPCC CLIMATE CHANGE, *supra* note 9, at 16.

⁸⁵ HOT TALK, *supra* note 58, at 19, 58-59. Singer admits that the data is "rather limited" on the correlation between sea level rise and ice accumulation in Greenland and Antarctica, although he does not qualify the data supporting the inverse relationship between tropical sea-surface temperature and sea level rise. *Id.* at 18-19.

⁸⁶ *Id.* at 44; see BJORN LOMBERG, THE SKEPTICAL ENVIRONMENTALIST: MEASURING THE REAL STATE OF THE WORLD, 322-23 (2001); see HUMAN IMPACTS, *supra* note 8, at 160.

⁸⁷ See *Climate Change: The Next Dimension*, *supra* note 52, at 355-58, for a succinct summary of the interim agreements and negotiating battles that led to the Kyoto Protocol.

⁸⁸ Kyoto Protocol, *supra* note 1, at art. 3, para. 1.

and sulphur hexafluoride as the baseline for their reduction commitments.⁸⁹ The Climate Change Secretariat equated these obligations to approximately a 30% reduction of Annex I output levels if no action were taken.⁹⁰

This overall net reduction will be achieved through varying emission reduction requirements for each individual country.⁹¹ For example, the agreement requires the U.S. to attain a 7% reduction; Germany, an 8% reduction; and allows a 1% increase for Norway.⁹² Developing nations do not have any binding obligations to reduce greenhouse gas emissions.⁹³ Instead, Article 10 encourages these nations to monitor and reduce greenhouse gas emissions “to the extent possible” with the aid of developed nations and through the implementation of “clean development mechanisms,”⁹⁴ which give developed nations reduction credits for projects that reduce emissions in developing countries.⁹⁵ Through this clean development mechanism, developing nations receive cleaner and more efficient industrial technology at the expense of industrialized nations, and the Annex I nations gain a cost-effective alternative to reaching all of their emission reductions independently.⁹⁶

The clean development mechanism was one of several provisions convention delegates negotiated to help ease the

⁸⁹ *Id.* at art. 3, para. 8.

⁹⁰ Brendan P. McGivern, *Introductory Note to Kyoto Protocol*, *supra* note 1, reprinted in 37 I.L.M. at 24 n.5.

⁹¹ Kyoto Protocol, *supra* note 1, at art. 3, para. 1. Such a system is known as “common but differentiated responsibility.” *Climate Change: The Next Dimension*, *supra* note 52, at 356.

⁹² Kyoto Protocol, *supra* note 1, at Annex B.

⁹³ *Id.* at art. 3. “Developing” is at times a bit of a misnomer, given the inclusion of South Korea and its thirteenth largest economy in the world. Sangim Shim, *Korea’s Leading Role in Joining the Kyoto Protocol with the Flexibility Mechanisms as “Side Payments”*, 15 GEO. INT’L ENVTL. L. REV. 203, 205 (2003) [hereinafter *Korea’s Leading Role*].

⁹⁴ Kyoto Protocol, *supra* note 1, art. 10, 12. The lack of obligations for the developing countries was a major reason cited by the Bush administration when rejecting the Protocol. *Kyoto at Bonn and Marrakech*, *supra* note 48, at 406-07.

⁹⁵ Kyoto Protocol, *supra* note 1, art. 12, para. 3.

⁹⁶ See *Korea’s Leading Role*, *supra* note 93, at 213-15. The Protocol does not allow Annex I nations to receive all of their reduction credits through this mechanism. *Id.*

implementation of the Protocol's obligations for the Annex I nations. Other provisions included an emission trading system, an allowance for considering carbon uptake capabilities, and a "joint implementation" provision. Perhaps the most controversial flexibility provision is the emission trading mechanism. Article 17 provides that obligated nations "may participate in emissions trading for the purposes of fulfilling their commitments under Article 3 of this Protocol."⁹⁷ The details of this provision were left largely undefined and only indicate that a country that surpasses its reduction obligations may sell its remaining emission volume to another country unable to achieve its reduction obligation.⁹⁸ In addition, the Protocol factors the carbon uptake capabilities, or "carbon sinks," of the individualized nations into their emission reductions.⁹⁹ Because of this provision, a nation need not achieve its reductions purely through output reduction and may include "reforestation" and "afforestation."¹⁰⁰

Another aspect of the Protocol, the "joint implementation" provision, operates similarly to the clean development mechanism. Through this Article 6 provision, an Annex I state may acquire or transfer "emission reduction units resulting from projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of greenhouse gases" to another Annex I state.¹⁰¹ The exact function of this Article 6 provision was left to be determined "as soon as practicable."¹⁰²

These substantive provisions of the Kyoto Protocol have been the subject of intense scientific scrutiny and debate since the Protocol's

⁹⁷ Kyoto Protocol, *supra* note 1, art. 17.

⁹⁸ *Id.* For a discussion of the mechanical problems associated with a trading scheme and methods of ensuring compliance, see Brett Frischmann, *Using the Multi-Layered Nature of International Emissions Trading and of International-Domestic Legal Systems to Escape a Multi-State Compliance Dilemma*, 12 GEO. INT'L ENVTL. L. REV. 463 (2001).

⁹⁹ Kyoto Protocol, *supra* note 1, art. 3, para 3.

¹⁰⁰ *Id.* Afforestation is the "the direct human-induced conversion of land that has not been forested for a period of 50 years to forest land through planting, seeding and/or the human-induced promotion of natural seed sources." U.N. Framework Convention on Climate Change, Review of Implementation of Commitments and of Other Provisions of the Convention 5 *available at* <http://unfccc.int/resource/docs/cop6secpart/02a03r01.pdf> (Oct. 27, 2003).

¹⁰¹ *Id.* at art. 6, para. 1.

¹⁰² *Id.* at art. 6, para. 2.

adoption in December of 1997. The views on the Protocol's effectiveness range from insignificant to earth-saving effects. Most scholars agree, however, that the U.S. withdrawal greatly reduced its likely impact, because the U.S. accounts for approximately 36.1% of the Annex I emissions.¹⁰³

A. The Kyoto Protocol is a Scientifically Legitimate Response

Those who consider the Kyoto Protocol a scientifically legitimate response argue that one cannot consider the Protocol in isolation.¹⁰⁴ It is not a final solution to anthropogenic climate change; it is a necessary first step from the wealthiest of nations.¹⁰⁵ Some speculate that subsequent treaties will include additional measures for developing nations to implement.¹⁰⁶ Frank Loy, the Under Secretary of State for Global Affairs with the Clinton Administration summarized this view:

[S]tanding alone, the Kyoto targets would represent little more than a momentary pause along a steep path of rising global emissions. The importance of the Kyoto Protocol, therefore, lies less in the initial emission reduction numbers than in the structural elements of its climate change regime. I refer to the decisions to include a basket of the six major greenhouse gases rather than just carbon; a multiyear commitment period rather than a single target year; and activities that take carbon out of the air and store it in the ground, commonly called carbon sequestration or sinks.¹⁰⁷

¹⁰³ *Kyoto Protocol Thermometer*, *supra* note 2.

¹⁰⁴ See Frank E. Loy, *The United States Policy on the Kyoto Protocol and Climate Change*, 15 NAT. RESOURCES & ENV'T 152 (2001) [hereinafter *US Policy on Kyoto*]; Daniel A. Farber, *Building Bridges over Troubled Waters: Eco-Pragmatism and the Environmental Prospect*, 87 MINN L. REV. 851, 868 (2003) ("We have not yet succeeded in averting this particular 'tragedy of the commons,' but we have made more progress than might have been expected.").

¹⁰⁵ *US Policy on Kyoto*, *supra* note 104, at 155.

¹⁰⁶ See *id.*

¹⁰⁷ *Id.* at 152.

According to Loy, it is improper to get wrapped up in a debate as to Kyoto's direct scientific impact on global warming.¹⁰⁸ Consistent with the precautionary principle, nations must act immediately and then tighten the noose around the neck of global warming as better data fosters improvements to the mechanisms in place. In the meantime, there will be notable benefits with respect to emissions and sustainable development.

Proponents of the Protocol point to the simple fact that Kyoto will equate to real reductions in emissions.¹⁰⁹ Compliance proceedings developed at convention meetings in Bonn and Marrakech strengthened this point.¹¹⁰ Under these new mechanisms, nations will face actual penalties for failing to comply, such as revoking emission selling rights and forcing violators to develop a "compliance action plan."¹¹¹ The proceedings allow for many nations, including island states with a strong interest in a successful Protocol, to participate in monitoring activities.¹¹² Thus, even if the reduction commitments are not as significant as hoped, they are still substantive and will result in less greenhouse gases than if there were no Kyoto Protocol.

Developing countries will reap secondary benefits from the implementation of the Protocol. Currently, these countries are industrializing without utilizing available clean technology.¹¹³ Through Kyoto's clean development mechanism, Annex I nations will receive emission reduction credit for implementing the use of clean technology in countries such as Paraguay, Argentina, and Thailand.¹¹⁴ Therefore, Kyoto will further sustainable development by improving the immediate environment of such developing nations, because clean technology will spread to areas of the world where it would not otherwise be employed.

¹⁰⁸ *See id.*

¹⁰⁹ *See id.*

¹¹⁰ *Kyoto at Bonn and Marrakech, supra* note 48, at 413-16. These meetings occurred after the U.S.'s withdrawal. *Id.* at 397-98.

¹¹¹ *Id.* at 413-16.

¹¹² *Id.*

¹¹³ *US Policy on Kyoto, supra* note 104, at 155.

¹¹⁴ *See* U.N. Framework Convention on Climate Change, Status of Ratification, at <http://unfccc.int/resource/kpstats.pdf> (last modified Oct. 5, 2004).

B. The Kyoto Protocol is Not a Scientifically Legitimate Response

The Kyoto Protocol, like most compromises, received criticisms from both sides of the debate. Some environmentalists viewed Kyoto as merely a symbolic document with virtually no substantive impact.¹¹⁵ Greenpeace initially labeled it as a “tragedy and a farce.”¹¹⁶ Skeptical scientists criticized Kyoto for the minimal amounts of warming it will likely avoid and the potentially negative effect the agreement will have on developing nations.

Kyoto’s critics argue that even if all of Kyoto’s obligations were met, its effects would be negligible. The middle range global climate model of the IPCC predicts 1.4 degrees Celsius of warming to occur by 2050.¹¹⁷ A perfectly followed Kyoto would equate to an avoidance of 1/20 of a degree under that model.¹¹⁸ Climatologists estimate that Kyoto’s emission reductions would need to be 40 - 50% greater to actually stabilize the greenhouse gas-induced warming.¹¹⁹ It follows that the Kyoto Protocol fails to substantively curb emissions or warming.

At the heart of the debate over Kyoto’s scientific legitimacy are developing nations, which helped negotiate the document, but are not required to curb emissions under it. This lack of obligation seems nonsensical, because developing nations are quickly becoming primary emitters of greenhouse gases.¹²⁰ Recent estimates tag developing nations as the source for 44% of the global fossil fuel emissions.¹²¹ The increases in carbon concentrations due to the large amounts of

¹¹⁵ See Richard N. Cooper, *The Kyoto Protocol: A Flawed Concept*, 31 ENVTL. L. REP. 11484 (2001) [hereinafter *Kyoto: A Flawed Concept*].

¹¹⁶ Steinar Andersen, *The Development of the Climate Regime: Positions, Evaluation, and Lessons*, Columbia International Affairs Online, , at www.ciaonet.org/wps/ans01/ans01.html (January 1998), quoted in Laura Thoms, *A Comparative Analysis of International Legal Regimes on Ozone and Climate Change with Implications for Regime Design*, 41 COLUM. J. TRANSNAT’L L. 795, 821 (2003).

¹¹⁷ *Kyoto Panel Discussion*, supra note 51, at 777.

¹¹⁸ *Id.*

¹¹⁹ *Kyoto at Bonn and Marrakech*, supra note 48, at 419. Some estimate that the emission reductions may be even less significant because of recent carbon sink concessions made to Russia. *Id.* at 419-20 (“Concessions made on sinks alone lower the Protocol’s ability to cut emissions from its goal of 5.2% to 1.8%.”).

¹²⁰ *Kyoto: A Flawed Concept*, supra note 115, at 11486.

¹²¹ *US Policy on Kyoto*, supra note 104, at 155.

deforestation and other land use changes now occurring in developing nations are actual but less quantifiable.¹²² Those critical of Kyoto thus maintain that the solution to the climate change threat must include developing nations to be legitimate. However, developing nations largely face uncertain futures, which makes substantive involvement in future agreements spawned by the United Nations Framework Convention on Climate Change unlikely.¹²³

Kyoto's critics also fear that the developing nations will be harmed by the agreement because it undermines sustainable development.¹²⁴ The Protocol fails to guide developing nations on the most economically feasible and environmentally conscious path, and undermines the ability of future generations to utilize their natural resources.¹²⁵ These critics argue that "[b]y exempting developing countries from any form of self restraint, they have been freed and authorized to pollute by relying on as much fossil fuel energy as they may choose."¹²⁶ For example, China, which is without any obligation to reduce greenhouse gas emissions, is on track to produce 40% of the world's greenhouse gas emissions by 2025.¹²⁷ China's inefficient use of coal power in energy production will create this increase.¹²⁸ Their coal burning facilities are on average six times less efficient than US plants and often burn an environmentally harmful sulfur-rich coal, which causes a myriad of health problems.¹²⁹ Under Kyoto, China will continue to industrially develop without any obligation to protect the local or global environment.¹³⁰ This agreement allows China and other developing nations to achieve economic success at the expense of – as opposed to in keeping with – environmental health. The agreement is therefore at tension with the principles of sustainable development while failing to achieve any real impact on climate change.

¹²² *Id.*

¹²³ CLIMATE CHANGE POLICY AFTER KYOTO, *supra* note 13, at 57-58.

¹²⁴ *Climate Change: The Next Dimension*, *supra* note 52, at 359-62.

¹²⁵ *See id.*

¹²⁶ *Id.* at 363.

¹²⁷ *Id.*

¹²⁸ *Id.*

¹²⁹ *Id.* at 363-64. These health problems include "nausea, dizziness, lung cancer, bronchitis, pneumonia, and asthma." *Id.* at 364.

¹³⁰ *Id.* at 363-64

IV. **Proposition Three: The Kyoto Protocol is More Economically Palatable Than Inaction**

One fact becomes clear when analyzing the economic impact of the Kyoto Protocol: carbon dioxide is a crucial component of every economy in the world. This gas is truly “at the heart of modern economics, which depend intimately on productive agriculture and [inanimate] sources of energy.”¹³¹ The issue of the Protocol’s economic impact, therefore, is not whether there will be one; the issue is whether it will be too severe to merit ratification. The answer to this inquiry may vary significantly from nation to nation. Nations such as Great Britain, which would have to continue its current movement away from nuclear power without burning more fossil fuels,¹³² will have a more severe economic impact than Russia, whose economic downswing and crafty negotiating made its goals achievable without any action.¹³³ However, if Kyoto leads to an avoidance of massive agricultural failures and deadly ocean rise, then a successful Protocol would positively impact every nation’s economy regardless of the immediate costs.

A. **The Economic Impact is Too Severe**

The critics of the Kyoto Protocol complain that the agreement is too economically inefficient to merit ratification. They primarily argue that the rigid 2010 goal is too soon and that the emissions trading scheme is unworkable in the international sphere. These efficiency problems are further exacerbated by the uncertainty of the extent of damages the agreement will avoid. Thus, the agreement’s costs are known to be high, but its value is purely speculative.

The Kyoto Protocol sets an impending 2008 target for the reduction of carbon emissions.¹³⁴ Critics argue that this deadline is far too imminent.¹³⁵ Instead of meeting a rigid short-term closing date, it

¹³¹ *Kyoto: A Flawed Concept*, *supra* note 115, at 11489.

¹³² The UK’s return to coal burning caused greenhouse gas emissions to rise 2% in 2003. Increase in UK Greenhouse Gas Emissions, Sustainable Development International, at <http://www.sustdev.org/industry.news/2004/01.04.04.html>.

¹³³ *Kyoto at Bonn and Marrakech*, *supra* note 48, at 403.

¹³⁴ Kyoto Protocol, *supra* note 1, at art. 3, para. 1.

¹³⁵ See *Climate Change: The Next Dimension*, *supra* note 52, at 369-70. See Michael F. Duffy, *Prometheus Re-bound: How Adoption of the Kyoto Protocol on Climate Change would Devastate the Western U.S. Coal Industry* 77 DENV. U. L. REV. 265, 275-86 (1999), for a summary of the deadline’s projected impact on the U.S. economy.

would be better to gradually phase out inefficient equipment and processes.¹³⁶ A later deadline would allow energy saving equipment to naturally replace old equipment instead of requiring inefficient “retrofitting.”¹³⁷

The emissions trading system – the supposed economic saving grace of Kyoto – will also prove unworkable. The Protocol fails to address the situation created by the economically induced greenhouse gas reductions. Some countries, particularly the Ukraine and Russia, whose growth in emissions was significantly offset by economic downturn, may be able to receive a windfall through emission trading because the growth was overestimated.¹³⁸ The U.S. withdrawal from negotiations worsened the situation. Russia’s increased bargaining power enabled it to negotiate a greater allowance of carbon sinks that count towards their emission reductions, from 17.6 million tons of carbon per year to 33 million tons per year.¹³⁹ Despite this economic potential, Russia is reluctant to ratify the Protocol.¹⁴⁰ This inaction may be evidence that David Victor, a commentator critical of the emission trading scheme, was correct when he predicted in 2001 that “[t]he next rounds will prove Kyoto to have been an aberration – the imaginary can opener, not proof that it is feasible to hand out and secure assets worth trillions of dollars under international law.”¹⁴¹ This “aberration” is due to the speculative nature of emission fluxes and a general mistrust of an international property right.¹⁴² If Russia, a country that stands to gain from the economic potential of emissions trading, is reluctant to join the

¹³⁶ *Climate Change: The Next Dimension*, *supra* note 52, at 369.

¹³⁷ *Id.* at 370.

¹³⁸ *Kyoto at Bonn and Marrakech*, *supra* note 48, at 408-09.

¹³⁹ *Id.* at 410.

¹⁴⁰ Colby Cosh, *You can Stick a Fork in Kyoto*, NAT’L POST, Apr. 2, 2004 (stating that President Putin’s economic advisors believe that the short term benefits of joining Kyoto will be less than the economic loss it will ultimately create), *available at* <http://www.canada.com/national/nationalpost/columnists/story.html?id=b45c57c3-7046-4091-b099-3a8bb35f8fed> (on file with the University of Miami International & Comparative Law Review) (ANOTHER DEAD LINK). One estimate places Russia’s potential windfall at around \$750 million. COLLAPSE OF KYOTO, *supra* note 10, at 9.

¹⁴¹ *Id.* at 29.

¹⁴² *Id.* at 11.

Protocol, then one should not be surprised that other nations without such potential are unwilling to join.

The uncertain level of global warming risk and the monetary damages that would follow aggravates the uneasiness surrounding the economic mechanics of the agreement. Predicting 100 years of emission levels is extremely difficult.¹⁴³ The large range of scenarios predicted by the IPCC proves this difficulty.¹⁴⁴ Will the atmospheric carbon levels be 75% or 350% above pre-industrial levels?¹⁴⁵ Will the average surface temperature be 1.4 degrees or 5.8 degrees above 1990 levels?¹⁴⁶ Because the IPCC does not claim that one prediction is more probable than the other,¹⁴⁷ answers to these questions are unknown. The IPCC also does not claim to know the levels of economic damages given actual climate change. They only have “medium”¹⁴⁸ confidence that the “aggregate market-sector impacts” of a small temperature increase will be “plus or minus a few percent” of the world’s gross domestic product.¹⁴⁹ Thus, the world could gain a net benefit of a few trillion dollars or experience a loss of a few trillion if the temperature increase is on the lower end of the global climate model scale.¹⁵⁰ The IPCC does not know. It follows that because the value of Kyoto is in the damages it would avoid, its true value is unknown.¹⁵¹

The speculative nature of the possible damages caused by global climate change highlights the costs associated with implementing the agreement. The costs of reaching Kyoto’s targets also involve a level of speculation, although they share a common large price tag.¹⁵² One study

¹⁴³ CLIMATE CHANGE POLICY AFTER KYOTO, *supra* note 13, at 28.

¹⁴⁴ *Id.*

¹⁴⁵ *See id.*

¹⁴⁶ *See id.*

¹⁴⁷ *See* IPCC CLIMATE CHANGE, *supra* note 9, at 13.

¹⁴⁸ “Medium” represents a “confidence level” of “33-67%.” IPCC: Impacts, Adaptation, and Vulnerability, *supra* note 44, at 24.

¹⁴⁹ *Id.* at 70 (emphasis added). In these estimates, the IPCC does not “consider potentially important factors such as changes in extreme events, advantageous and complementary responses to the threat of non-climate-driven extreme events, rapid change in regional climate (e.g., resulting from changes in ocean circulation), compounding effects of multiple stresses, or conflicting or complementary reaction to those stresses.” *Id.*

¹⁵⁰ *See id.*

¹⁵¹ *See* CLIMATE CHANGE POLICY AFTER KYOTO, *supra* note 13, at 52.

¹⁵² *Id.* at 38.

estimates that the United States would spend approximately 1.4% of its gross domestic product by 2010 in efforts to reach its goal.¹⁵³ Meanwhile, Japan and the EU would spend 0.8%.¹⁵⁴ Another study indicates that the worldwide costs would fall between \$800-1,500 billion with perfectly efficient implementation, and the benefits would be \$120 billion.¹⁵⁵ Yet another estimate places the costs at \$1.5 trillion.¹⁵⁶ Given these economic uncertainties, opponents argue that a fiscally sensible government should not ratify the Kyoto Protocol.

B. The Economic Impact is Not Too Severe

Supporters of the Kyoto Protocol generally respond to concerns over its economic impact with three arguments. First, they reason that there is significant value in the damages avoided. Next, they assert that the flexibility of the agreement will allow the economic burden to be relatively light. Lastly, they maintain that Kyoto presents significant benefits that cannot be calculated economically, but nevertheless offset the Protocol's costs.

The value of the Protocol is in the climate change damages avoided by its implementation. Proponents of Kyoto understand that while the costs of implementing such agreements may be estimated through various means, the economic benefits are inherently difficult to measure.¹⁵⁷ They argue that this difficulty does not indicate that benefits do not exist; instead, a variety of benefits arise in direct and indirect forms.¹⁵⁸ An example of this theory is easily demonstrated through the Clean Water Act (CWA).¹⁵⁹ The CWA burdens industries with the costs of controlling the amount of pollution they discharge into rivers and streams.¹⁶⁰ However, these costs in the aggregate are offset by the avoided direct damages to the water and by the fishing and recreational activities that either would not occur or would occur less frequently if the pollution was not controlled.¹⁶¹

¹⁵³ *Id.*

¹⁵⁴ *Id.*

¹⁵⁵ *Id.* at 52.

¹⁵⁶ *Id.* at 53.

¹⁵⁷ THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 162-63 (John Eatwell et. al. eds., 1991) [hereinafter PALGRAVE DICTIONARY].

¹⁵⁸ *Id.*

¹⁵⁹ Federal Water Pollution Control Act, 33 U.S.C. §§ 1251-1387 (2000).

¹⁶⁰ *See id.*

¹⁶¹ *See* PALGRAVE DICTIONARY, *supra* note 157, at 162.

Similarly, the Kyoto Protocol pays for a “stream of damages” before they occur.¹⁶² It would be shortsighted to assume that the agreement is not economically palatable without first considering the extent of damages it would possibly avoid. Support already exists for the theory that global warming causes ocean level rise and crop failures. A recent study indicates that achieving an atmospheric carbon dioxide concentration of 450 ppm would cause Greenland’s ice sheet to begin to melt faster than precipitation could replace it.¹⁶³ This study also concludes that the earth is on track to reach this concentration by 2050.¹⁶⁴ If emissions continue to go unchecked, the melting rate may irreversibly increase in 2350 and cause an overwhelming sea level rise of seven meters in the next 1,000 years.¹⁶⁵

Global warming could also spawn devastating crop failures in Europe and Africa. European agricultural systems could suffer from global warming, causing the Gulf Stream to shift so that it no longer warms the area.¹⁶⁶ Meanwhile, serious droughts could plague Africa.¹⁶⁷ Some scientists believe that an observed downward trend in rainfall in Africa over the past twenty years directly correlates to climate change.¹⁶⁸ Africa has been slow to respond to the possibility that their agricultural systems may have to morph to meet new challenges that the changing climate creates.¹⁶⁹ The situation could result in an increase in U.S. and European resources required to sustain the African continent. The nature of the economic damages Kyoto avoids is slowly coming into focus.

Kyoto’s proponents also argue that the agreement is more flexible than opponents are willing to recognize. The tradable permits, joint implementation, and clean development mechanisms reduce the cost of meeting the nations’ individual targets and the risks associated

¹⁶² CLIMATE CHANGE POLICY AFTER KYOTO, *supra* note 13, at 32.

¹⁶³ *Global Warming Could Melt Greenland Ice Sheet – Study*, Planet Ark (citing a study by Jonathan Gregory, a meteorologist at the University of Reading, England),

at <http://www.planetark.com/dailynewsstory.cfm/newsid/24639/story.htm>.

¹⁶⁴ *Id.*

¹⁶⁵ *Id.*

¹⁶⁶ CLIMATE CHANGE AND LIFE, *supra* note 34, at 250.

¹⁶⁷ See Emmanuel Koro, *Africa Braces for the Fallout of Global Warming*, People & the Planet, at <http://www.peopleandplanet.net/doc.php?id=2170> (Mar. 17, 2004) [hereinafter *Africa Braces*].

¹⁶⁸ *Id.*

¹⁶⁹ *Id.*

with meeting them.¹⁷⁰ The tradable permits proved to be cost effective when they were utilized in the U.S. Clean Air Act (CAA).¹⁷¹ Even the limited amount of permit trading that has occurred is estimated to have resulted in savings of \$500 million to \$12 billion.¹⁷² Meanwhile, sulphate trading under the CAA saves approximately \$1 billion annually.¹⁷³ The joint implementation scheme will allow domestic firms to cheaply attain reductions by investing in projects that reduce greenhouse gas emissions in other Annex I nations.¹⁷⁴ Clean development mechanisms will similarly alleviate the pains of reaching Kyoto's goals.¹⁷⁵ These mechanisms give industries the viable option to find cost-effective alternatives to reducing emission themselves and will ease the burden on industry more than Kyoto's opponents would like to admit.

Other factors in determining economic impact include those significant benefits that cannot be calculated purely through economic analysis. Recent studies indicate that even modest global warming could result in massive species loss.¹⁷⁶ Such losses are economically difficult to quantify, but there is important value even if the species itself does not have inherent economic value. For example, consider the plight of the

¹⁷⁰ *Korea's Leading Role*, *supra* note 93, at 215.

¹⁷¹ *Id.* at 210.

¹⁷² *Id.* at 209.

¹⁷³ *Id.* at 210.

¹⁷⁴ See Glenn Wisner, *Joint Implementation: Incentives for Private Sector Mitigation of Global Climate Change*, 9 GEO. INT'L ENV'T. L. REV. 747 (1997).

¹⁷⁵ *Korea's Leading Role*, *supra* note 93, at 215. It was this mechanism that is credited for helping convince developing nations to climb on board, because they would benefit from the clean technology transfer. *Id.* at 213-15.

¹⁷⁶ See *Africa Braces*, *supra* note 167; see also The Sydney Morning Herald, *Global Warming 'Threatens Earth with Mass Extinction'*, available at <http://www.smh.com.au/articles/2003/06/19/1055828440526.html> (June 20, 2003); Associated Press, *Global Warming Cited in Island's Shift of Wildlife Numbers*, Detroit News (providing that global warming may offset the balance between moose and wolves), available at <http://www.detnews.com/2004/metro/0403/07/b06-84067.htm> (on file with University of Miami International & Comparative Law Review); cf. Jeremy Lovell, *Fresh Studies Support New Mass Extinction Theory*, Reuters (quoting British researcher as saying that man's habitat destruction is the culprit in Britain's species loss and that "[i]f it wasn't for global warming the species loss would have been even greater"), at <http://www.planetark.com/dailynewsstory.cfm/newsid/24346/story.htm> (Mar. 19, 2004).

snail darter in *Tennessee Valley Authority v. Hill*.¹⁷⁷ The U.S. Supreme Court determined that the \$100 million spent on a dam construction project did not override the protection granted to the snail darter by the Endangered Species Act (ESA).¹⁷⁸ Congress disagreed and responded to the decision by exempting the dam from the ESA.¹⁷⁹ Congress's judgment was that the value of the dam outweighed the risk of extinction of the small fish species. However, the historic levels of extinction predicted by global warming extend far beyond that of a fish species. It would be unconscionable to allow the permanent loss of multitudes of species simply because the immediate economic costs are too great. Kyoto's value is thus in the economic *and* incalculable damages it avoids. The gravity of these potential damages compared to the costs of implementing the flexible agreement signifies widespread ratification as the necessary choice.

V. Concluding Remarks

The future of the Kyoto Protocol appears to be assured in one primary aspect: it is not the ultimate solution to the threat of anthropogenic climate change. Too many of the major greenhouse gas emitters have either rejected the agreement or are without any obligation to reduce emissions under the Protocol. However, this situation does not signify the certain failure of future agreements developed to curb the addition of greenhouse gases to the atmosphere. A future agreement will have to succeed where Kyoto failed. It will have to be based on enough scientific data to merit a genuine, as opposed to a purported, scientific consensus that greenhouse gas emissions are likely causing temperatures to rise, and that the damages associated with rising temperatures will be severe. The importance of carbon to the world economy is currently too great for truly global and substantive emission reductions to occur without a more concrete scientific basis. Thus, intensified research on the existence, cause, and potential effects of anthropogenic climate change must be initiated. This research would enable government leaders to respond confidently to the three propositions on which such an

¹⁷⁷ *Tenn. Valley Auth. v. Hill*, 437 U.S. 153(1978).

¹⁷⁸ *Id.*

¹⁷⁹ TOMAS J. SCHOENBAUM, ENVIRONMENTAL POLICY LAW, PROBLEMS, CASES, AND READINGS 340 (2002). Additional snail darter populations were subsequently found in other local rivers and the species is now listed as threatened. *Id.*

agreement would rely. They will be able to conclude that the transnational solution is based on established science, that it is a substantive response to the global warming threat, and that it is more economically palatable than inaction.