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SHAPING A SUSTAINABLE WORLD

ALAN MARSHALL*

The U.S. presidential election of November 2000 is an event that will always remain clear in my memory. Do you recall the drama of those days? In the end it all came down to Florida. The result could have gone either way. Do you remember the “hanging chads”? They were votes where the voter’s preference was clear, but which were invalid because the aging voting machines had not clearly punched a hole next to the selected candidate’s name. If these votes were counted, the result may have been different. If the state government had not disenfranchised thousands of felons whose civil rights had been restored, the result would probably have been different.

The Democrats appealed for a recount in the Supreme Court of Florida and won. The Republicans then went to the Supreme Court of the United States, which ordered an end to the recount. With a constitutional crisis beckoning, Democrat candidate Al Gore conceded, claiming the nation could not afford a drawn out legal battle. (Don’t presume that my politics are left wing. In my own country I have voted for both major parties, and it would be fair to say my political instincts are close to the center.)

Living in Sydney, Australia, I was half a world away from the presidential contest. Yet I was following the campaign closely, and was disappointed to see Gore defeated. We had entered a new millennium facing frightening environmental challenges, in particular the threat of global warming. It seemed to me that, alone among the candidates, Gore had a deep appreciation of the problem and the will to tackle it, but now he was gone. My disappointment deepened into despair as the Bush administration lived in denial of global warming, putting an oil company lobbyist in charge of environmental policy. As revealed in the *New York Times*, White House memos from this official censored the scientists who were warning the public of the danger posed by global warming, a danger

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the administration did not want to believe was real.¹ As a Christian, however, I believed that God was sovereign and that history served His purposes. I waited to see how the story would unfold.

For several years public opinion moved slowly, distracted by the war in Iraq, and confused by the misinformation peddled by global warming skeptics. In 2006, there was a dramatic increase in public understanding of the global warming challenge. One of the reasons for this was the release in the U.K. of the report by Sir Nicholas Stern, which for the first time spelled out the economic cost of failing to act on climate change.² Perhaps the major influence on public opinion that year was Al Gore's film, and subsequent book, *An Inconvenient Truth*.³ Since losing the 2000 presidential race, Gore had been a tireless crusader, presenting his slide show on climate change more than 1000 times in university auditoriums and other venues. The idea for the film had grown out of the response to these presentations. When I saw the film with my father, I was stunned not so much with the evidence Gore presented, with which I was familiar, but with his moral insights. The parallel with the debate about the dangers of smoking decades earlier was chilling. Gore had lost a sister to lung cancer. If the scientific evidence on the dangers of smoking had not been opposed by the vested interests of the time, her life might have been saved.

I regard Al Gore as something of a prophet. Leaving the cinema where I saw his film, I understood why God had allowed him to lose, perhaps even be cheated out of, the presidency six years earlier. It was because Gore had a higher calling. Al Gore is a committed Christian, but he is not alone among Christians in his views on this issue. Christian environmental groups have been proliferating in recent years. As a Christian environmentalist, I have been invited by your journal to submit an article for this edition. I thank the editors for this privilege. This article is addressed to the law students of Notre Dame, although I understand the journal has a wider readership. I have chosen to write about the challenge facing the nations of the world in moving to the sustainable use of the Earth's resources, and the opportunity the students have, as leaders of tomorrow, in shaping our future. In keeping with the ethos of Notre Dame, I am looking at this from the Judeo-Christian perspective, yet I hope the essay will also be of interest to secular readers, as I believe there

1. Andrew C. Revkin, *Bush Aide Edited Climate Reports*, N.Y. TIMES, June 8, 2005, at A1; Editorial, *A (White) House Party for Lobbyists*, N.Y. TIMES, June 9, 2005, at A26.

2. NICHOLAS STERN, U.K. GOV'T, *THE STERN REVIEW REPORT ON THE ECONOMICS OF CLIMATE CHANGE* (2006).

3. AN INCONVENIENT TRUTH (Lawrence Bender & Participant Prod. 2006); see also AL GORE, *AN INCONVENIENT TRUTH: THE PLANETARY EMERGENCY OF GLOBAL WARMING AND WHAT WE CAN DO ABOUT IT* (2006).

is a logic to the arguments that transcends attachment to any particular faith.

To enable you to fairly evaluate my arguments, I should acknowledge what influences my own perspective. I am an evangelical Christian, and I view the Bible as trustworthy. From the calling of Abraham to Christ's sacrifice on the cross to Christ's return at the end of this age, it is a reliable record of God's redemptive work in human history.

That, however, does not necessarily mean that I accept the early chapters of Genesis as a literal account of natural history; for I do not believe that has ever been their purpose. These early chapters are sacred, they are inspired, but as the events they describe pre-date the invention of writing, they are arguably a different kind of literature. (I am not trying to persuade readers to this point of view, and I acknowledge some difficulties with it, just as there are difficulties with a literal interpretation.) Whether or not one views these chapters as a literal account, I believe they tell us profound truths about God, man, and the relationship of man with God and creation, and I will draw on these truths as I build a case for environmental responsibility.

Another major influence on me is science, in which I was schooled from an early age, and I certainly don't see science as being antagonistic towards faith. All truth is God's truth. Science, properly undertaken, reveals God's testimony about the natural world. The Bible, properly interpreted, is God's testimony about the spiritual world and God's interaction with man. Christians should not be afraid of scientific knowledge. It has come to light by God's sovereign hand. Indeed, the Bible prophesies that "knowledge [of all kinds] shall be increased."⁴

Having laid out this background to my own perspective, I will now discuss the relationship of mankind to the world in which we live, and examine the negative impact of mankind on the environment in three areas. These are the problems of industrial pollution, loss of habitat, and global warming. Some of this material comes from an earlier essay, *Christians and the Environment—A Study Guide*.⁵

The Bible reveals that through His living Word, later revealed to us in the person of Jesus, God brought the universe into being.⁶ Life has its origin in Him, and the many forms which it now takes have been formed according to His design, and declared by Him to be "good."⁷

It also teaches that man is special to his Creator and has a special place in creation. Man is said to be made "in the image of God,"⁸ which

4. *Daniel* 12:4.

5. Alan Marshall, *Christians and the Environment—A Study Guide* (rev. Oct. 2005) (1998), <http://www.oceansoft2000.com/alan/essays/christians&environment.htm>.

6. *See, e.g., Genesis* 1:21, 25.

7. *Id.* 1:31.

8. *Id.* 1:27.

means, among other things, that he is unique among creatures, and has authority to rule this world with all the power and responsibility that brings. This is stated explicitly in these memorable words: "Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth."⁹ This is the first, universal command of God to mankind. It is often referred to as the "creation mandate." It gives man authority to rule the Earth, but is not a license for him to do as he pleases. Rather, it involves the duty of a caretaker.

So what have we done with God's "good" creation? Unfortunately, it is a long and sorry story. The great respect that most indigenous peoples have for their environment suggests that we started out reasonably well, although man is a strong suspect in the extinction of many of the larger land mammals. Since the first real cities some 5000 years ago, man has placed sustained pressure on the environment in the surrounding areas. However, it was not until the industrial revolution of the late eighteenth century, just a little over 200 years ago, that damage to the environment began to accumulate. Up until forty years ago, public consciousness of this was limited, though the earlier declaration of national parks, such as Yellowstone and Yosemite, reminds us that there have always been far-sighted individuals. They were the "greenies" of their day. Today we honor them.

The Earth bears the scars today of 200 years of increasing industrial pollution. Basically, we have trashed the planet. The impacts of acid rain, CFCs, heavy metals, pesticides, and plain simple rubbish have left their mark. While progress has been made on some of these issues, others seem almost insurmountable. It is unarguable that as a society we are in violation of the creation mandate.

In his message *Peace With God the Creator, Peace With All of Creation*, Pope John Paul II put it this way: "Faced with the widespread destruction of the environment, people everywhere are coming to understand that we cannot continue to use the goods of the earth as we have in the past."¹⁰

The head of the Pontifical Council of Justice and Peace, Cardinal Martino, uses these words: "The mastery of man over creation must not be despotic or senseless. Man must cultivate and safeguard God's creation."¹¹ Evangelical opinion is in agreement with these statements, at

9. *Id.* 1:28.

10. POPE JOHN PAUL II, MESSAGE FOR WORLD DAY OF PEACE: PEACE WITH GOD THE CREATOR, PEACE WITH ALL OF CREATION para. 1 (Jan. 1, 1990), available at http://www.vatican.va/holy_father/john_paul_ii/messages/peace/documents/hf_jp-ii_mes_19891208_xxiii-world-day-for-peace_en.html.

11. John Vidal & Tom Kington, *Protect God's Creation: Vatican Issues New Green Message for World's Catholics*, GUARDIAN, Apr. 27, 2007, at 23, available at <http://www.guardian.co.uk/world/2007/apr/27/catholicism.religion>.

least among the younger leaders. I endorse the Evangelical Declaration on the Care of Creation, from which I have taken the following extract:

We have ignored our creaturely limits and have used the earth with greed, rather than care. The earthly result of human sin has been a perverted stewardship, a patchwork of garden and wasteland in which the waste is increasing. . . . Thus, one consequence of our misuse of the earth is an unjust denial of God's created bounty to other human beings, both now and in the future.¹²

Catholic, Evangelical, and Jewish organizations in the U.S. concerned with the stewardship of the Earth are allied in an umbrella group called the National Religious Partnership for the Environment. I commend to you their affirmation on environmental stewardship.¹³

The next major impact of our environmental mismanagement is loss of habitat. Many creatures have been driven to extinction, and hundreds of species are endangered. "Biodiversity" may be a catch-cry of today's greenies, but it is something God cares about. There are profound lessons from the biblical flood story, whether or not one views it as a literal account. In fact, this story is also in the Koran,¹⁴ the Hindu sacred texts,¹⁵ and the folklore of numerous indigenous peoples.¹⁶

In the biblical account of the flood, God was careful to instruct Noah to preserve seven pairs of the clean animals, which were later to be bred for food. Yet He was careful to preserve one pair of every species, regardless of its utility to man.¹⁷ God understood the purpose for which those creatures not intended for food were created, and He did not want them to be destroyed. How dare we thoughtlessly drive to extinction species which God created for a purpose!

Later in the flood account is a significant passage that most Christian writers on the environment have overlooked. God makes a covenant not just with Noah and his family, but with "every living creature of all flesh that is upon this earth."¹⁸ This covenant is to last "for perpetual generations."¹⁹ God promises never again to flood the earth, never again to destroy the habitat of all living creatures. If this is so, our destruction

12. Evangelical Envtl. Network, An Evangelical Declaration on the Care of Creation (1994), *available at* <http://www.creationcare.org/resources/declaration>.

13. Nat'l Religious P'ship for the Env't, A Judeo-Christian Affirmation on Environmental Stewardship, http://www.nrpe.org/whatisthepartnership/mission_intro01.htm.

14. KORAN, *Sura 71*, translated in THE KORAN: WITH PARALLEL ARABIC TEXT 569-70 (N.J. Dawood trans., Penguin Books 5th ed. 1990).

15. 1 HISTORY AND CULTURE OF THE INDIAN PEOPLE: THE VEDIC AGE 271-72 (R.C. Majumdar et al. eds., George Allen & Unwin Ltd., 1951).

16. See Nw. Creation Network, Flood Legends From Around the World, <http://www.nwcreation.net/noahlegends.html>.

17. *Genesis* 6:19-21.

18. *Id.* 9:16.

19. *Id.* 9:12.

of the environment today works directly against the intent of this covenant!

This brings me to the environmental issue that encompasses all others—the challenge of global warming. By now, many of you will have seen Al Gore’s film, and debated the evidence in lecture theaters and coffee shops. I do not intend to describe the overwhelming evidence for global warming from many branches of science, other than to note that these independent confirmations converge to form a truth which can no longer be denied, even if it is for some, to use Al Gore’s phrase, an “inconvenient” one. The multiplicity of these confirmations causes me to reflect on the biblical principle underpinning our legal system, which held that “at the mouth of two witnesses, or at the mouth of three witnesses, shall a matter be established.”²⁰ We have the witness of the strong rising trend in annual average temperatures, the witness of a rising sea level which is now accelerating, the witness of retreating glaciers and melting polar ice, the witness of spring flowers blooming early, and the witness of other disruptions to the Earth’s ecosystems. There are sources available to you which will describe in detail all of this evidence.

It may disturb you to know that global warming was understood and accurately predicted long before these problems became evident. In his best-seller *The Weather Makers*, Australian scientist Tim Flannery explores the history of climate change science, and reveals that in the 1890s, Swedish chemist and Nobel Prize winner Svante Arrhenius calculated the warming that the best evidence now suggests will be a reality.²¹

Arrhenius did not have the wealth of data available to today’s scientists. He and his colleagues reached their conclusions through pure science, the basic principles of physics and chemistry which enabled them—and enable us—to understand, with 100% certainty, that greenhouse gases such as carbon dioxide (CO₂) trap heat. The reason we call them greenhouse gases is because they operate in a similar way to glass greenhouses, which farmers have used for centuries, trapping heat to grow tomatoes and other plants that could not otherwise be grown in the colder regions of the world. Like glass greenhouses, they allow sunlight to pass through unhindered, but trap heat radiation on its way out. The molecular structure of CO₂ is such that it is “tuned” to the wavelengths of infra-red (heat) radiation emitted by the Earth’s surface back into space.²² The molecules resonate, their vibrations absorbing the energy of the infra-red radiation. It is vibrating molecules that give us the sensation of heat, and it is by this mechanism that heat energy is trapped by

20. *Deuteronomy* 19:15.

21. TIM FLANNERY, *THE WEATHER MAKERS: HOW MAN IS CHANGING THE CLIMATE AND WHAT IT MEANS FOR LIFE ON EARTH* 40 (2005).

22. WILLIAM JAMES BURROUGHS, *CLIMATE CHANGE: A MULTIDISCIPLINARY APPROACH* 17 fig.2-3 (2007) (showing the spectrum of infra-red radiation emitted by the Earth, with a large hole around 15 micrometers, the wavelength absorbed by CO₂).

the atmosphere and re-radiated to the surface.²³ The molecular structure of methane (CH₄) is even more finely tuned to infra-red wavelengths, making it the next most important greenhouse gas, despite its relatively low concentration.²⁴ The greenhouse gases together act as the world's thermostat. The higher their concentration, the more heat is trapped. If it is getting too warm we need to turn down the thermostat by lowering the concentration of these gases.

Much of the controversy over global warming has related to the complexities of the Earth's weather systems. Ocean currents, precipitation over Antarctica, and other factors may indeed modify the rate at which the Earth warms, so I think it is more helpful to readers to focus on the final outcome. Therefore, rather than attempt to predict what the temperature will be in ten, twenty, or fifty years, I will discuss what the full temperature rise will be once the climate reaches a state of equilibrium. At the moment, the Earth is warming because the solar energy entering the atmosphere exceeds the infra-red energy that is radiated back into space.²⁵ If the concentration of greenhouse gases can be stabilized, a certain equilibrium temperature will eventually be reached where the radiated infra-red energy will balance the incoming solar radiation.²⁶ Just as your home air conditioner takes time to readjust the temperature of your home after you adjust the thermostat, the Earth takes a considerable period to rise to a new equilibrium temperature after its thermostat has been turned up by increasing emissions of greenhouse gases.

The change in the equilibrium temperature due to a given change in the concentration of greenhouse gases is known as the "climate sensitivity,"²⁷ and you may find it useful to search for this term when doing your own research. There are two approaches scientists take when attempting to calculate climate sensitivity. The first uses computer modeling using the known properties of CO₂ and other greenhouse gases, combined with estimates of the feedback loops which amplify the temperature rise.²⁸ Because of the difficulty in estimating the latter, there are large variations in the projections. For a doubling in CO₂, the projected rise in tempera-

23. Univ. Corp. for Atmospheric Res., *Cycles of the Earth and Atmosphere*, http://www.ucar.edu/learn/1_3_1.htm.

24. BURROUGHS, *supra* note 22, at 226.

25. *Id.* at 13–14. This imbalance is known as "radiative forcing" and the current value is around 2.5 watts per square meter.

26. U.S. CONG., OFFICE OF TECH. ASSESSMENT, *THE FUTURE OF REMOTE SENSING FROM SPACE: CIVILIAN SATELLITE SYSTEMS AND APPLICATIONS* 98 (1993).

27. Reto Knutti & Gabriele C. Hegerl, *The Equilibrium Sensitivity of the Earth's Temperature to Radiation Changes*, 1 *NATURE GEOSCI.* 735 (2008).

28. *Feedback Loops in Global Climate Change Point to a Very Hot 21st Century*, *SCI. DAILY*, May 22, 2006, <http://www.sciencedaily.com/releases/2006/05/060522151248.htm>.

ture varies from 1.5 to 5.2°C (2.7 to 9.4°F).²⁹ These are only medium-term models, however, and the long-term model,³⁰ on which I focus, projects a rise in temperature of 4.7°C (8.5°F).³¹

The second method of calculating climate sensitivity is more empirical. At the Vostok base in Antarctica, scientists have drilled into the ice to a depth of two miles.³² The ice samples they have retrieved show layers produced by seasonal differences in precipitation. As a result the scientists have a record of the Earth's climate for the past 420,000 years. Gas bubbles and isotopes within the ice layers reveal the relationship between the concentration of CO₂ in the atmosphere and the temperature over that time.³³

In his film, Al Gore noted the close correlation between changes in CO₂ and changes in temperature. In fact, the graphs fit almost perfectly. We need to consider the actual numbers, so I refer you to the graph in the online article *New Antarctic Ice Core Data*.³⁴ This graph plots the results through four ice ages and five interglacial periods. The pattern is consistent with the increase in CO₂ from 180 to 280 parts per million (ppm) associated with a rise in temperature at the poles of about 10°C, or 18°F. Notice that the increase in CO₂ is less than double, yet the increase in temperature is greater than projected in the computer models above. This indicates that the estimates for climate sensitivity above may be conservative.

Ice core data also tells us the pre-industrial concentration of CO₂, and NOAA has determined this to be 278 ppm.³⁵ The current concentration of CO₂ is 385 ppm,³⁶ so the pre-industrial level was 107 ppm lower than today's levels. If you then factor in the contribution of the other greenhouse gases, most of which are man-made, our predicament becomes worse. The combined concentration of all greenhouse gases

29. INTERGOVTL. PANEL ON CLIMATE CHANGE, WORKING GROUP I REPORT: THE PHYSICAL SCIENCE BASIS 804 (2007).

30. See Ronald J. Stouffer, *Time Scales of Climate Response*, 17 J. CLIMATE 209 (2004).

31. WORKING GROUP I REPORT, *supra* note 29, at 825–27.

32. Davies & Co., *New Antarctic Ice Core Data* (rev. May 30, 2000), http://www.daviesand.com/Choices/Precautionary_Planning/New_Data.

33. GORE, *supra* note 3, at 63.

34. Davies & Co., *supra* note 32.

35. Nat'l Oceanic & Atmospheric Admin., *After Two Large Annual Gains, Rate of Atmospheric CO₂ Returns to Average*, Mar. 31, 2005, <http://www.noaanews.noaa.gov/stories2005/s2412.htm>.

36. Nat'l Oceanic & Atmospheric Admin., *Carbon Dioxide, Methane Rise Sharply in 2007*, Apr. 23, 2008, http://www.noaanews.noaa.gov/stories2008/20080423_methane.html.

back in 2006 was 433 ppm of CO₂ equivalent,³⁷ so we are well on the way to the doubling in CO₂ discussed above.

If all this is starting to sound rather scary, then you are beginning to understand the magnitude of the problem we face, and will see that as we respond to this challenge, the industrial, economic, and political landscape of the world will fundamentally change. The world was transformed in the industrial revolution from dependence on animal power to dependence on coal, and with the later invention of the motor car, to dependence on oil. The industrial, economic, and political changes will be just as great as we move into a world freed from its addiction to fossil fuels, and powered instead by sustainable energy.

As the leaders of tomorrow, your generation has the challenge and opportunity to manage this change in such a way that the outcomes are effective, environmentally and economically sound, equitable, and democratic.

In a letter I wrote to the Prime Minister of Australia, I set out to show that the current Kyoto formula of requiring all nations to reduce emissions by similar percentages is inequitable, and that the only formula that developing nations could agree to is one that sets long-term targets, not according to 1990 emissions but according to current populations.³⁸ The world is now moving towards mechanisms that rightly set a dollar value on greenhouse emissions. The emissions that nations are permitted to release under any international agreement will consequently also have a theoretical dollar value, and the only way to fairly distribute this is according to population.

Much of the world's wealth is based on energy that is too cheap, that has not factored in the cost of protecting the environment. Given that it is the developed world that is responsible for the bulk of greenhouse gases in the atmosphere, there is justice in a formula that puts less developed nations on an equal footing with the wealthier nations in staking a claim to the Earth's resources. If they are low consumers of fossil-fuel energy, they can trade their surplus quota. For many it will be their most valuable export.

The current Kyoto formula was signed by the U.S. in November 1997, but was vigorously opposed by the Senate during President Clinton's term, and by President Bush during his administration. The argument used by both the Senate³⁹ and President Bush to justify their opposition is that they will not ratify a treaty that they think puts the

37. EURO. ENV'T AGENCY, ATMOSPHERIC GREENHOUSE GAS CONCENTRATIONS (CSI 013, Apr. 2008), *available at* http://themes.eea.europa.eu/IMS/IMS/ISpecs/ISpecification20041007131717/IAssessment1201517963441/view_content.

38. Letter from Author to John Howard, Prime Minister and Member for Benelong Parliament House (Nov. 18, 1997), *available at* <http://www.oceansoft2000.com/alan/essays/GreenhouseHoward.doc>.

39. S. Res. 98, 105th Cong. (1997).

U.S. at a disadvantage relative to developing nations such as China and India. While the total emissions from China are growing and may one day overtake the U.S., we must remember that China has four times the population. In 2004, the latest year for which I have data, its emissions were just 3.84 metric tons of CO₂ per person compared to 20.38 metric tons per person in the U.S.⁴⁰ If the U.S. was to comply with its Kyoto target, it would still massively out-pollute China on a per-capita basis. The opposition of the White House and the Senate is therefore without any moral foundation and is an unfortunate manifestation of ignorance. The U.S. now stands alone as a pariah state among developed nations in refusing to ratify the treaty.⁴¹ When the U.S. signed the Kyoto Protocol, the concentration of CO₂ in the atmosphere was 22 ppm lower than it is now.⁴² The increase in global emissions since 1997 represents a staggering 21% of the CO₂ emitted since pre-industrial times.⁴³ History will judge these politicians harshly for doing nothing. They must be held accountable at the ballot box, though at a personal level we must be prepared to forgive them.

The leaders of other developed nations are now preparing for the economic changes that are required to mitigate greenhouse emissions. In 2007, the Intergovernmental Panel on Climate Change (IPCC) released a series of landmark reports, the last of which calls for a reduction in emissions on the order of 25% to 40% for developed countries by 2020, and much deeper cuts by 2050.⁴⁴ The European Union⁴⁵ and Japan⁴⁶ favor a 50% reduction target for 2050, while Australia has committed to a

40. Millennium Dev. Goal Indicators, Carbon Dioxide Emissions, <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=751&crd=>.

41. See Associated Press, *Australia Ratifies Kyoto Global Warming Treaty*, Dec. 3, 2007, available at <http://www.msnbc.msn.com/id/22081582>.

42. U.S. Dep't of Commerce & Nat'l Oceanic & Atmospheric Admin., Trends in Carbon Dioxide, <http://www.esrl.noaa.gov/gmd/ccgg/trends/>.

43. *Id.* In 1997 the concentration of CO₂ was 363 ppm. By 2008, it had grown to 385 ppm, an increase of 22 ppm. Taking the pre-industrial concentration as 278 ppm, the proportion of CO₂ generated by mankind since Kyoto = 22/(385-278) = 21%.

44. INTERGOVTL. PANEL ON CLIMATE CHANGE, WORKING GROUP III REPORT: MITIGATION OF CLIMATE CHANGE 776 box 13.7 (2007).

45. *In Bali, EU Floats 50% Greenhouse Gas Cut*, BUS. WK., Dec. 4, 2007, available at http://businessweek.com/globalbiz/content/dec2007/gb2007124_968205.htm.

46. Justin McCurry, *Japan Calls for 50% Reduction in Emissions by 2050*, GUARDIAN, May 24, 2007, available at <http://www.guardian.co.uk/environment/2007/may/24/japan.climatechange>.

60% reduction.⁴⁷ Out in front are the U.K.,⁴⁸ and the Republican governor of California, who has committed to an 80% reduction by 2050.⁴⁹

Such ambitious targets are unlikely to cause a radical fall in our standard of living, but even if they do, we have little choice. The reason there will not be a marked fall is because renewable energy is abundant. It only needs to become cost-competitive—which it will once the cost of protecting the environment flows through into the price of fossil fuels paid by consumers. If the average price of electricity is doubled from its current very low base, a whole raft of renewable energy sources become economically viable. These include photo-voltaic, solar-thermal, wind, tidal, and ocean-thermal power. This is the future. Emission targets can and will be met. All that is necessary, and all that quotas or carbon taxes are designed to do, is to produce a rational market for energy.

I have little doubt that as time goes by these targets will be set higher and higher, which leads me to an interesting observation. At a net 100% reduction, the per-capita formula and the present Kyoto formula, based on proportionate reductions from historic (1990) levels, converge to exactly the same outcome. The requirement is simply that each nation reduces its emissions to a net zero. This can be accomplished only if the use of fossil fuels is entirely replaced by renewable energy, with any residual industrial emissions offset by carbon sinks. In effect, this requires each nation to “clean up its own mess.” A 100% net reduction would be a very challenging, but arguably fair, target for all nations. Now if carbon neutrality is going to be our target for 2050, how do we get there?

When considering the economic mechanisms proposed for reducing emissions, we need to consider firstly an international framework that fairly shares this responsibility between nations. Secondly, we need to consider the mechanisms that nations may choose from in meeting the obligations they have agreed to under the international framework. I suggest we need to carefully evaluate both the international framework, and the options available to national governments according to three criteria. We should choose between them by comparing their effectiveness, equity, and simplicity.

47. Kristen Gelineau, *Australian Climate Adviser Wants Deep Greenhouse Gas Cuts*, USA TODAY, Sept. 30, 2008, available at http://www.usatoday.com/weather/climate/globalwarming/2008-09-30-australia-greenhouse-cuts_N.htm.

48. Rosa Prince & Louise Gray, *Greenhouse Gas Emissions to be Cut by 80 Per Cent, Says Government*, TELEGRAPH, Oct. 17, 2008, available at <http://www.telegraph.co.uk/news/newsttopics/politics/labour/3211494/Greenhouse-gas-emissions-to-be-cut-by-80-per-cent-says-Government.html>.

49. Steven R. Schiller, *Implications of Defining and Achieving California's 80% Greenhouse Gas Reduction Goal* (Sept. 13, 2007), http://www.climatechange.ca.gov/events/2007_conference/presentations/2007-09-13/2007-09-13_SCHILLER_STEVEN.PDF.

The existing international framework for distributing emissions rights between nations is the Kyoto Protocol which expires in 2012. We have already looked at how it works.

The leading model for distributing emissions rights between nations on a per-capita basis is the proposed international framework called "Contraction and Convergence."⁵⁰ Formulated in the U.K. by the Global Commons Institute, it is really a more advanced version of the per-capita formula I described previously, and therefore has my full support. It recognizes that because the emissions cuts required by developed nations are so deep, convergence to per-capita emissions rights is only possible over time. Between the post-Kyoto start year (2013), and the convergence year (e.g., 2040), the emission quotas for all nations would contract (or increase) in a linear fashion. From the convergence year onwards, the emissions of all nations would contract on a per-capita basis.⁵¹ This model is gaining support from scientists, businessmen, politicians, and faith groups such as the Anglican Church (U.K.), Christian Aid, and Tearfund.⁵² At Oxford University in the U.K., university students have initiated the Climate Justice Project to campaign for this solution. Their website⁵³ explains how the model works. Contraction and Convergence is a means of setting targets for nations, but it is still dependent on national governments choosing one of the three main mechanisms below to reduce their own emissions.

The oldest and most well known mechanism is called "Cap and Trade."⁵⁴ The national emission target set by the international framework is auctioned to large producers of greenhouse gases. Emission rights can then be traded between these producers. This trade includes carbon credits generated by sequestering carbon. The trading system sets a market price for greenhouse gas emissions. As targets are tightened, this price increases over time until it is more economical for industry to use renewable energy.

There is an alternative mechanism to Cap and Trade called "Cap and Dividend."⁵⁵ Formulated by U.S. think tank On the Commons, it also is based on per-capita emissions rights, but these are used to limit the production of fossil fuels rather than to monitor emissions as these fuels

50. GLOBAL COMMONS INST., CARBON COUNTDOWN: THE CAMPAIGN FOR CONTRACTION AND CONVERGENCE (2008), http://www.gci.org.uk/kite/Carbon_Countdown.pdf.

51. *Id.* at 9, 20–23.

52. *Id.* at 31.

53. The Climate Justice Project: A Student-led Campaign for Contraction and Convergence, <http://www.climatejustice.org.uk/>.

54. U.S. Evtl. Prot. Agency, Cap and Trade (rev. Aug. 25, 2008), <http://www.epa.gov/airmarkets/cap-trade/index.html>.

55. See Peter Barnes, *The Cap and Dividend Solution*, ONTHECOMMONS.ORG, Sept. 25, 2008, <http://www.onthecommons.org/content.php?id=2240>.

are consumed. It may be simpler and more effective in controlling the main cause of global warming, which is CO₂ emissions from fossil fuels. However, it doesn't control CO₂ emissions from land clearing, or other greenhouse gases such as methane, nitrous oxides, and CFCs. The model is not yet as well-developed as Cap and Trade. I haven't yet taken a position on it, but I think it is worthy of consideration. A similar mechanism to Cap and Dividend is the "Cap and Share" scheme⁵⁶ promoted by Fiesta. The latter distributes emission rights to individuals as vouchers, which they sell to producers of fossil fuels.

The alternative to all "Cap" mechanisms is a carbon tax. While it is a new tax, it does not need to add to the overall tax burden, because the revenue can be used to reduce or abolish other taxes. The tax mechanism I think has considerable merit is the "Tax and Dividend" scheme promoted by climate scientist James Hansen.⁵⁷ Norway has levied a carbon tax since 1991.⁵⁸ Other nations that have a carbon tax are Sweden, Finland, the Netherlands, and Italy.⁵⁹

Each of the mechanisms above is theoretically capable of dramatically reducing emissions at a national level. Each will result in windfall revenues which to be politically acceptable will need to be offset with reductions in income tax, reductions in other taxes, and rebates or other measures to compensate the less well-off. Each mechanism can also be coordinated in order to facilitate an international framework.

Provided a method can be devised for crediting sequestered carbon, I tend to prefer a carbon tax, or Cap and Dividend, to Cap and Trade. I leave you to research these mechanisms further to form your own opinion of their relative effectiveness, equity, and simplicity.

Beyond 2050, I suggest our goal needs to be not only to cease adding to the problem; I believe there is a duty to begin to remedy the damage that has already been done. We should seek not just to stop the concentration of CO₂ from increasing, but actually reduce the concentration by stripping it out. This is both technically and economically possible. In fact, we are already doing it in a small way with carbon credits for forestry programs. To remove CO₂ from the atmosphere on an industrial

56. See Cap and Share, <http://www.capandshare.org/>.

57. See *Hearing Before the H. Comm. on Ways & Means*, 111th Cong. (Feb. 25, 2009) (testimony of Dr. James E. Hansen, Dir., NASA Goddard Inst. for Space Stud.), available at http://www.columbia.edu/~jeh1/mailings/2009/20090226_WaysAndMeans.pdf.

58. Leila Abboud, *An Exhausting War on Emissions*, WALL ST. J., Sept. 30, 2008, at A15, available at <http://online.wsj.com/article/SB122272533893187737.html>.

59. Kenneth Davidson, *A Carbon Tax is the Way to Cut Emissions*, AGE [MELBOURNE, VICT.], Mar. 19, 2009, available at <http://www.theage.com.au/opinion/a-carbon-tax-is-the-way-to-cut-emissions-20090318-923b.html?skin=text-only>.

scale will require new technologies, and a number of these have already been proved in concept.⁶⁰

As explained above, the concentration of CO₂ in the atmosphere is already 107 ppm above its optimum level. The Earth will not return to the conditions best suited for life unless at some point we actively remove greenhouse gases. I suggest we need an international agency, at this point in time the IPCC, to determine the safe maximum and minimum CO₂ concentrations, and that all international agreements have the ultimate goal of getting the concentration of CO₂ back to within this band.

Apart from global warming, increasing levels of CO₂ are causing acidification of the oceans. Increasing acidity poses a threat to corals and shellfish by eroding their exoskeletons. The Caribbean is currently the playground of the rich and famous. I wonder how many of them understand that, due to the combined problems of global warming and ocean acidification, many species of coral in the Caribbean are threatened with extinction.

The Earth suffers its current polluted state because of the power given to man by God that we looked at earlier, a power man has abused. But if man has been given authority to rule over the Earth, he must also have the power (if not yet the will) to remedy the damage he has done. The creation mandate has been violated and requires a faith response. Whether one's faith is Christianity, Judaism, or Islam, the proper response is repentance. I believe we need to repent at a national level, acknowledging that we have not cared for creation as God intended. If we are sincere, the Bible holds a promise of restoration, including the statement that God will "heal their land."⁶¹

Of course, from the Christian perspective, our abuse of the environment is just one aspect of a broader disregard for the ways of God. Therefore acknowledging the harm mankind has done to the planet is just part of the deeper reconciliation we all need to make with our Creator. For the Christian, whatever healing we are able to bring to the planet will flow out of the healing we have found through God's grace to us in Christ. As Christians we need to maintain our perspective. We worship the Creator, not the creation. Yet if we love the Creator, we will care for His creation.⁶²

According to the Bible, nation states have existed for thousands of years,⁶³ and will continue to exist,⁶⁴ though boundaries may change. It is also clear, however, that the movement of the oceans and the atmos-

60. *First Successful Demonstration of Carbon Dioxide Air Capture Technology Achieved*, PHYSORG.COM, Apr. 25, 2007, <http://www.physorg.com/news96732819.html>.

61. 2 *Chronicles* 7:14.

62. *Genesis* 2:15.

63. *Id.* 11:5-9.

64. *Revelation* 20:8.

phere are beyond the control of nations. As Jesus said, "The wind blows wherever it pleases."⁶⁵ Therefore, beyond territorial boundaries, the substance of the ocean and the atmosphere is the common property of mankind. The only way the pollution of the ocean and the atmosphere can be managed, and the only way that the living ecosystems and mineral resources of the high seas can be managed, is by international agreements.

I am aware of the distrust some groups within the Christian Right have towards these agreements, but we should remember that the United States was instrumental in the founding of the United Nations.⁶⁶ These groups also tend to be skeptical of global warming, and I believe they influenced the administration of President Bush. My response to their concerns is to look to the wisdom of Jesus. He was able to distinguish those things that are the responsibility of Christian teachers from those things that are properly the responsibility of governments. He commanded us that we should "give back to Caesar the things that are Caesar's, and to God the things that are God's."⁶⁷ Paul also commanded that we should cooperate with government in seeking the common good.⁶⁸ These scriptures refer specifically to the right of governments to levy taxes, and their duty to preserve law and order. I would argue that protecting the environment is also very much the business of government, both at the national level and in appropriate international agreements.

I believe Christians who have the opportunity can serve God through involvement in the political process. I believe that government is better, and outcomes are fairer, where people of faith are involved. It was the case in biblical times, when Joseph⁶⁹ and Daniel⁷⁰ brought prosperity and justice to Egypt and Babylon. It was the case with the founding fathers of America.⁷¹ It is the case now.

What kind of difference can Christians living in a free society make to the structures and agreements that will shape the new economy of a sustainable world? I would hope that Christians will follow Jesus' command and show a real concern for their neighbor,⁷² particularly for those living in parts of the world that will be more severely affected by global

65. *John* 3:8 (God's Word Translation).

66. See Office of the Historian, U.S. Bureau of Pub. Aff., *The United States and the Founding of the United Nations, August 1941–October 1945* (Historical Background Paper Oct. 2005), available at <http://www.state.gov/t/pa/ho/pubs/fs/55407.htm>.

67. *Matthew* 22:21 (Int'l Standard Version).

68. *Romans* 13:1–7.

69. *Genesis* 41:41–57.

70. *Daniel* 5:29–6:3.

71. See George Washington, Farewell Address para. 27 (Sept. 19, 1796) ("Of all the dispositions and habits, which lead to political prosperity, Religion and Morality are indispensable supports.")

72. *Matthew* 22:39.

warming. I hope they will encourage their governments to lead the national debate, and engage constructively in the international debate. I hope they will discourage their governments from putting the national interest ahead of the interest of mankind. I hope they will play an active role in helping formulate national policies and international agreements which are equitable. I think that Christians, believing that God is in control of all things, can bring a sense of hope that the challenge of climate change can be met.

I do agree with the sentiments of the Christian Right on one point, and that is that if radical changes to the economy are necessary, they should make minimal intrusion to individual freedom. For this reason, I personally favor the use of market mechanisms, such as taxes, to encourage the use of sustainable energy sources, rather than intrusive measures such as rationing. For example, I think it is much better to raise the price of gasoline to the point where motorists will be encouraged to choose more environmentally friendly cars, than to ration how much gasoline we can buy, or how many miles can be driven.

Let us not lose sight of the fact that mankind is faced with a common problem that we have not faced before. Unless nations work together, we will fail. Strong international agreements on limiting greenhouse emissions will tie the world together economically as never before, through mechanisms such as emission quotas or a common price on carbon.

In the summer of 2007, the fabled Northwest Passage was fully open to navigation for the first time in recorded history. It is expected that within a very few years, the annual summer thaw will leave the North Pole completely free of ice. The global warming skeptics have delayed effective action for long enough. In November 2008, a new president was elected in the United States. This time around, "hanging chads" in Florida didn't make any difference. A groundswell of new, young voters helped effect Obama's "Change." I indeed hope the new president will restore the U.S. to a position of global leadership on the issue of climate change. I hope that he fully engages in the drafting of a new international agreement to follow Kyoto, a process that is expected to make progress in Copenhagen in December 2009.

My hope for the Copenhagen conference is that the developed nations accept their moral responsibility, taking seriously the IPCC's call for medium-term (2020) reductions of up to 40%, and commit themselves to deep cuts to their emissions, irrespective of what commitments are made by the developing nations. It will still take some years for the world to agree on a long-term framework, and it is important to debate that in order to agree on the simplest, most equitable and effective solution. Whether the long-term framework is one of the models I have discussed, a variation, or an entirely different solution, the mid-century

goal is likely to approach global carbon neutrality. Therefore the above medium-term target for Copenhagen is not too ambitious.

This conference will be the beginning of the international effort. Moving from a fossil fuel economy to a renewable economy will take a generation. Young people of today have the challenge and opportunity to help bring about that transformation, and the end result depends much on their wisdom.

As Al Gore puts it in the introduction to his book:

The climate crisis also offers us the chance to experience what very few generations in history have had the privilege of knowing: *a generational mission*; the exhilaration of a compelling *moral purpose*; a shared and unifying *cause*; the thrill of being forced by circumstances to put aside the pettiness and conflict that so often stifle the restless human need for transcendence; *the opportunity to rise*.⁷³

I echo those sentiments, but wish to add a caution. Our understanding of human nature and history caution us as to how difficult the task will be. Things will get worse before they get better. We shouldn't be seduced by Utopian dreams. Yet Christian hope is central to our faith,⁷⁴ and it is a Christian virtue to find opportunity in adversity.⁷⁵ You have the opportunity to make the world a better place. What part will you play?

The observations, ideas, and solutions I have presented in this essay are my own limited contribution. The coming few years may well shape our society for decades to come. As tomorrow's leaders, I hope you will make your own contribution. You can help shape a sustainable world.

73. GORE, *supra* note 3, at 11.

74. See 1 *Corinthians* 13:13; *Ephesians* 2:11–13; *Hebrews* 6:19.

75. See 2 *Corinthians* 8:2–4; 1 *Peter* 1:6–7, 4:12–13.

