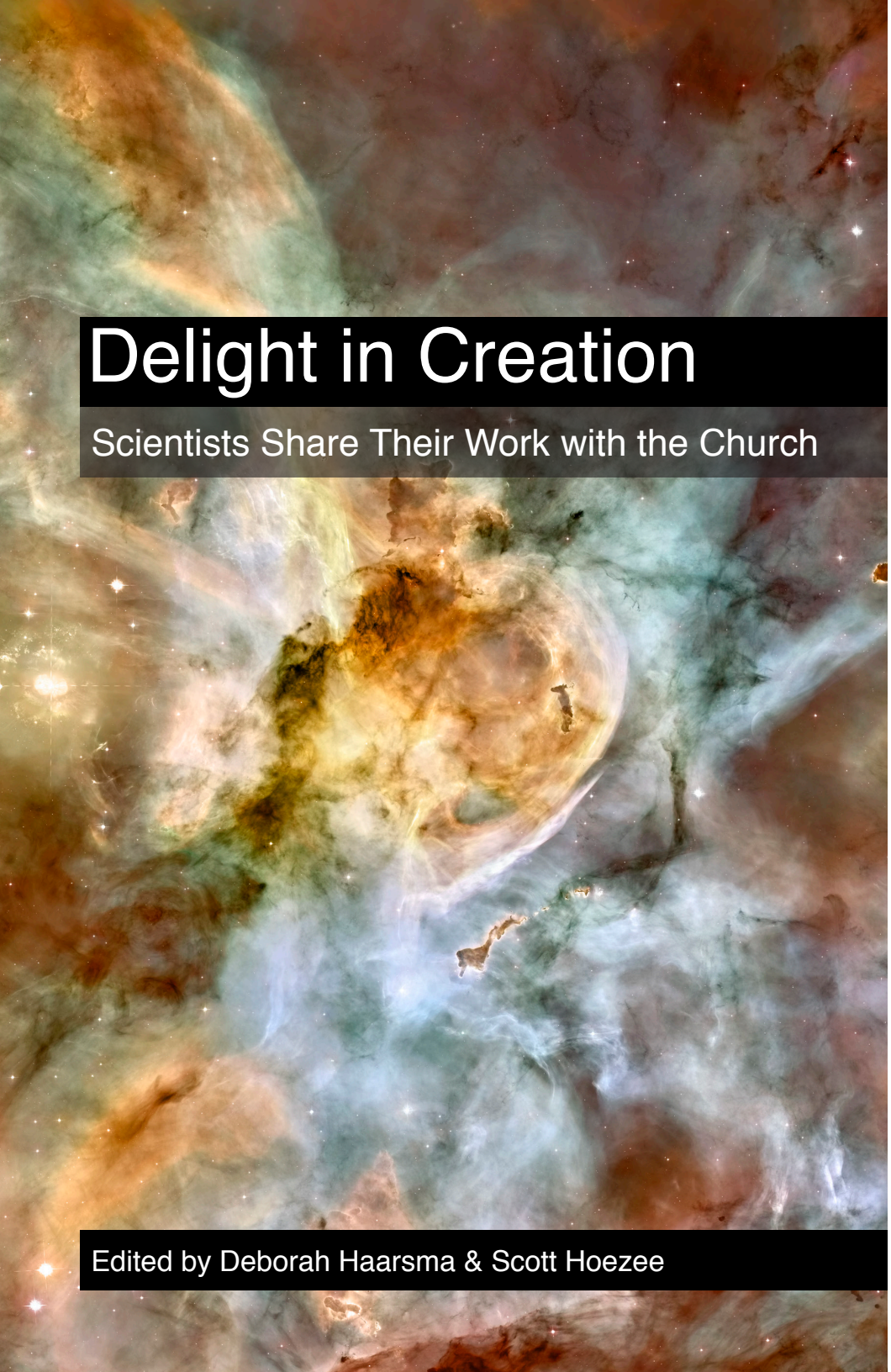


7 Sustainability and the Environment

by Kenneth Piers

Kenneth Piers is a Professor Emeritus of Chemistry at Calvin College in Grand Rapids, Michigan. His interests currently focus around the issues of worldviews, energy resources, and sustainability.

Sustainability will be one of the key issues, if not the preeminent issue, facing humanity in this century. Increasingly, scientists, cultural commentators, journalists, and even some of our economists and political leaders are raising doubts about the survivability of modern civilization. Economic growth and expansion of human opportunity can no longer simply be assumed. Instead, we hear the opposite. "Collapse" is a word that is frequently on the tongues of those who view our present pathway as unsustainable. I will explore here some of the reasons these commentators have such a pessimistic view of the future of modern civilization and try to present some of the options we have for avoiding the collapse that some foresee.

In their U.N.-sponsored report on global development in 1987, the Brundtland Commission defines sustainability this way: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Of course, numerous questions arise: is development the same as growth? If not, how are they different? What would development without growth look like? What exactly do we owe future generations? How do needs differ from wants? Do such needs include the needs of non-human creatures? Does scripture cast any light on sustainability questions?

I have developed a somewhat broader definition. A sustainable civilization:

- Continues to unfold or develop into the indefinite future.
- Supports the entire human population at a sufficient level of prosperity to enable life with dignity and responsibility.
- Supports human life without compromising either the health of the environment or the existence of other living creatures with whom we share this planet.
- Does not lead to irresolvable political conflict between or among the world's peoples and nations over access to necessary resources.

This definition not only recognizes the value of sustaining human culture,

but also includes the responsibilities that humans have for avoiding pollution of the physical environment (land, water, air) and for maintaining the well-being of other creatures. It recognizes that our flourishing is intimately connected to the flourishing of the natural environment and to fair access to natural resources for all humans.

Despite a strong emphasis in many Christian traditions on the doctrine of creation and the prime place of humans within that creation, the Christian church in North America has been slow to take up the challenge of creation care in its life and ministry. Nevertheless, human responsibilities for the care of creation are clearly specified in the biblical story of creation as found in the first two chapters of Genesis. These stories teach us that our relationship to the earth as humans is both intimate (we are made from the earth) and transcendent (we are made in the image of God), which is different from every other creature.

Perhaps the best way to understand the obligations that humans have toward the rest of creation is by way of the ancient, but rich, Hebraic concept of *shalom*. Shalom is God's dream and promise for the fulfillment of his creation, the knitting together of all the brokenness in the cosmos. Shalom has to do with the healthy and fruitful development of all relationships relevant for life—including those between God and nature, God and humans, humans and humans, and humans and nature—as these relationship were originally intended by the Creator. The picture of shalom is a picture of the mutual flourishing of both human and non-human life. (See Ps. 8, Ps. 104, and Is. 65. For more on the application of scripture to stewardship of creation, in particular the creation stories of Genesis, see David Warners' essay in chap. 6 of this book.)

By exercising a healthy sense of creation care, one would expect that human stewardship activities would help usher in conditions that exemplify elements of shalom. However, entering the twenty-first century, it is now quite clear that modern civilization is beginning to transcend the limits of what the global ecosystem can sustain. We who live in the highly developed West must acknowledge that we have paid too much attention to the verbs of Genesis 1 (subdue and rule) and not enough attention to those of Genesis 2 (till and keep).

Human Flourishing and Ecological Footprint

To begin to see how contemporary human beings are testing the limits of creation, it's helpful to think in terms of our ecological footprint, a concept that was first introduced by the Canadian socio-economic ecologists William Rees and Mathis Wackernagel in the early 1990s. Ecological footprint analysis compares human demand on nature with the biosphere's ability to regenerate resources and provide services. It does this by assessing the biologically productive land and marine area required to produce the resources that a population consumes and which is needed to absorb the resulting wastes, using prevailing technology. Essentially it is a measure of whether or not a population is living within or exceeding the carrying capacity of the region or the globe.

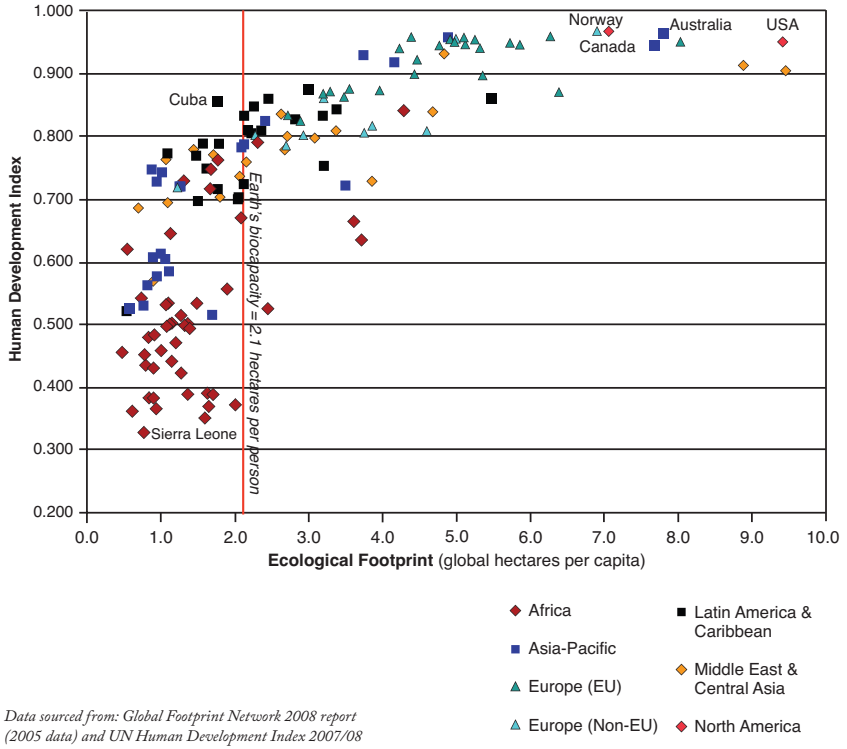
In 2005, the average available biologically productive area per person worldwide was approximately 2.1 global hectares (gha) per person. (A hectare is about 2.5 acres. A global hectare refers to the total area of the of the earth's bio-productive land and water [about 13.5 billion ha. in 2005] divided by the world's population [about 6.5 billion in 2005].) The U.S. footprint per person was over four times the global average and that of Canada was over three times larger, while China's was right at the global average. We Americans, with less than 5% of the world's population, demand over 20% of its bio-productive capacity to support our lifestyles. Here is another way of looking at North American demands on the earth: if everyone in the world had the same lifestyle as that of the average U.S. citizen, we would need an additional three-and-a-half planets like the earth to provide for all of the resources that would be required. The World Wildlife Fund has estimated that, despite the great range of consumption levels among humans in various countries, we have exceeded the capacity of the planet to provide the needed resources by about 20-25%.

According to statistics, a higher level of consumption does not necessarily correspond with a higher quality of life. The United Nations measures lifestyles using the Human Development Index (HDI), a U.N.-developed index based on a number of parameters including gross domestic product, education levels, and life expectancy. Figure 1 relates a nation's HDI to its ecological footprint. The graph shows that countries with a low

level of development (low HDI) also have a low ecological footprint (less than the global average of 2.1 gha per person), and that nations with higher HDI also have larger ecological footprints. What is interesting is that once you get much beyond the global average ecological footprint, the HDI more or less stops increasing; even though more environmental resources are consumed, the measure of human well-being does not increase much. From this graph we might conclude that it is possible to meet the needs of all people on the globe without exceeding the biological productive capacities of the planet.

Ecological footprint experts generally suggest that, in order for a nation's people to have a comparatively high level of human well-being, the HDI should be above 0.8. In order for that nation's people to be living

FIGURE 1. *Human welfare and ecological footprints compared.*



Data sourced from: Global Footprint Network 2008 report (2005 data) and UN Human Development Index 2007/08

IMAGE CREDIT: VICTORIA SEABURG FOR THE MINISTRY THEOREM AFTER WIKIPEDIA COMMONS GRAPH

sustainably, their ecological footprint should not exceed the global average. By these measures, there is only one country in the entire list in Figure 1 that meets these criteria: Cuba. This data does not mean that we should all aspire to the lifestyle of the average Cuban, but it does suggest that we who live in the U.S. and Canada must substantially decrease our demand on the biological capacities of the planet if we are to achieve sustainability.

As Christians who order our lives around the commandments to love God and neighbor, the excessive demand that we North Americans place on the bio-productive capacity of the planet is ultimately an ethical issue. When the average American requires nearly twenty-five acres of bio-productive resources while over one billion people lack basic necessities like food and clean water, we have a moral crisis. In today's world, with our access to nearly unlimited global media, the world is our neighborhood and we are called to ensure equitable access to resources. This responsibility means that we may have to reduce our demand on such resources, requiring a comprehensive, critical evaluation of our individual and corporate lifestyles, from our purchasing habits to the food we eat.

Toward the goal of self-evaluation, I want to look at three specific ways in which our current behaviors threaten the biophysical limits of the planet: human population, climate change, and energy consumption. Each of these areas of research has strong implications for the lifestyle choices of humans in general, and especially Christians.

Human Population

No discussion of sustainability can avoid a careful consideration of the increasing press of human population. Though human population is nearing seven billion, some population experts are encouraged that the global growth rate has fallen to less than 1.2% per year, which is down from 2% per year in 1965. However, even with this declining growth rate, because of the increasing number of humans, the absolute number of people added to the world population in 2009 was around eighty million people, whereas in 1965, fewer than seventy million were added. Barring major catastrophes, human population is expected to top eight billion by

2025. Over 50% of the world's people now live in urban areas, a number that will grow to more than 75% in twenty-five years if trends continue. (For a very striking multimedia collection that addresses the plight of the millions now living in urban slums, see the web site for *The Places We Live* by Jonas Bendiksen at http://www.theplaceswelive.com.)

Worldwide fertility rates have declined to an average of 2.6 births per female, but this is still well above the replacement rate of 2.1 births per female. However, deeper analysis of these numbers shows that fertility rates range from a low of 1.7 in some of the more developed countries of the world to greater than 6.0 births per female in some of the least developed and most troubled countries on this planet. If the trend continues, virtually all of the increase in population over the next twenty-five years will occur in those parts of the world that are already struggling to provide adequate resources for the existing population. In many of these nations, the population will more than double in the next twenty-five years. Even a rapidly developing country like India, which is slated to become the world's most populous country by 2020, will be severely challenged to meet the needs of its population. China, even with its one child per family policy, is expected to add about 150 million people to its population by 2025, placing even greater stress on its biological productive capacities.

Lest we think that population problems are all in the developing world, the U.S. population is expected to rise by about 50 million people to over 350 million by 2025. Even though this rate of growth is relatively slow, the very large ecological footprint demanded by the average American lifestyle will result in an increased demand on the biologically productive resources of the planet equivalent to adding over 220 million people in China at current consumption levels. These statistics confront us with the conclusion that humans around the globe must take urgent steps to curb their numbers. As physicist Albert Bartlett declared in his well-known lecture on exponential growth, either we must voluntarily undertake humane, effective steps to limit our numbers or nature and conflict will do so for us in inhumane ways like famine, drought, pestilence, plagues, wars, and genocide.

Addressing population control is a sensitive issue for the church. Throughout its history, the Christian church has generally adopted a

strong pro-natalist position. Large families have been characterized as a blessing from the Lord. God calls humans to "be fruitful and multiply and fill the earth" (Gen. 1:28, 9:1). Indeed, many Christians today still see the use of certain birth control methods as a violation of God's command to be fruitful. Throughout much of human history, practicing our reproductive capacities was, from an ecological point of view, an acceptable—perhaps even necessary—thing to do and there was no real concern that humans were in danger of overfilling the earth.

However, with the close of the twentieth century and the dawn of a new millennium, we are at a new stage in human history. No habitable part of the planet remains unoccupied by humans. Human alteration and impact in our ecosystem structure is leading to widespread extinction of animal and plant species. Human injection of wastes into the ecosphere is causing measurable changes in its composition and its health. In other words, the earth is more or less full of us. In this context, what does it mean to "be fruitful and multiply?"

Given what we believe about shalom and the flourishing of all of creation, I don't think it means that we should seek to expand the human population. In embracing an interpretation for our current context, we can honor the call to multiply by bearing children at or below our replacement level. Likewise, fruitfulness can be practiced as a mandate to develop every person's capacity to serve God and to steward the rest of creation so that every life form with whom we share the bounty of the earth is able to flourish in its own creaturely way. Slowing the growth of the human population is critical in this effort, which is a reality the Church can address in teaching and community development practices, both at home and abroad, as we proclaim both the gifts and the responsibilities of creation.

As a model for change, consider Kerala, India. Kerala is a small, poor state in southwestern India with a population of 31 million people (almost equal to that of Canada) and a very high population density (819 people/ km^2). Kerala doubled its population in the forty-year period from 1951 to 1991, but has since slowed its population growth dramatically and now has the lowest fertility rate (1.6 children per family on average) of all Indian states. How did it do this? It did not institute any draconian

polices of birth control. Instead, it has engaged in a vigorous program of education aimed at both boys and girls, established a healthcare system that providesd healthcare and nutrition education to all its citizens (especially to women and families), and it has built a largely democratized economy aimed at eliminating the most severe pockets of poverty within the state. As a consequence, the human development index HDI (again, based on educational attainments, gross state domestic product, and life expectancy) for the people of Kerala is now among the highest of all the states in India, despite the fact the Kerala remains one of the poorest states in the country.

Climate Change

The emergence of global climate change may provide the strongest evidence that human civilization is already exceeding certain biophysical limits. The issue of human-induced climate change has generated a great deal of public controversy. While it is true that there are a number of climate change skeptics among our politicians and a few vocal skeptics in popular media, there are very few climate skeptics among those who have most seriously studied the issue and have the scientific and professional qualifications to make judgments on these issues. Solid statistical evidence has appeared in many peer-reviewed journals and secondary scientific literature produced by professionals in climatology. In the following discussion of climate change, I will report on the findings of the Intergovernmental Panel on Climate Change (IPCC) in their most recently published update, the Fourth Assessment Report (AR4). (The entire report is available online at http://www.ipcc.ch.)

Some of the most significant data focuses on temperature change and carbon dioxide levels. Figure 2.1 shows the annual average global temperature for the past 120 years relative to the average temperature from 1950 to 1980. Figure 2.2 shows the global surface temperatures for 2010, again relative to the average temperatures for 1950-1980. Notice the darker shadings in the high northern latitudes, which indicate very strong warming (as much as 3.3°C or 5.9°F) in these regions. At the same time, the carbon dioxide concentrations in the atmosphere are increasing at greater

FIGURE 2.1. *Global average temperature for the last 120 years.*

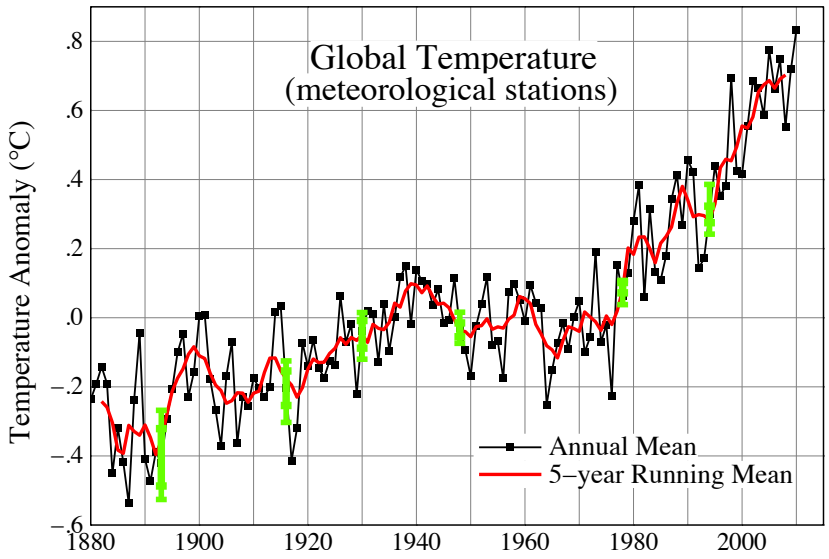
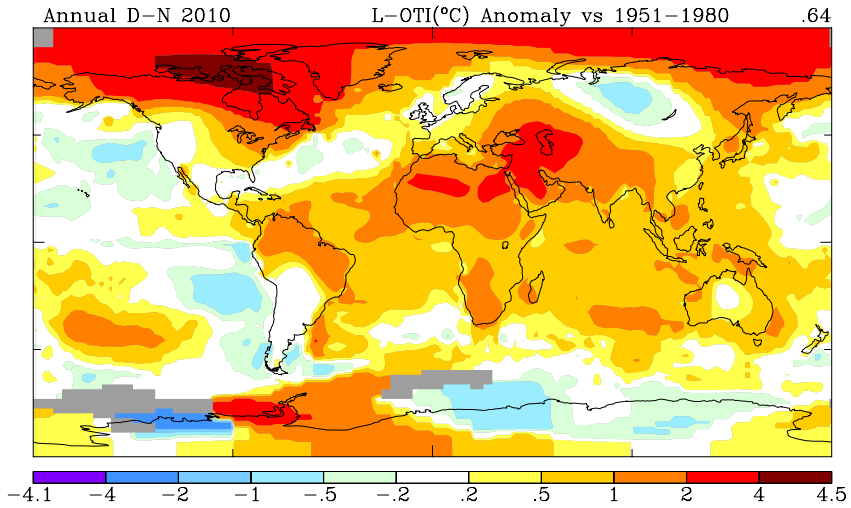


FIGURE 2.2. *Surface temperature around the globe in 2010.*



Note that the zero point in the graphs is the 1950 to 1980 30-year average global temperature.

IMAGE CREDITS: NASA & NASA GODDARD INSTITUTE FOR SPACE STUDIES

rates as time goes on. Figure 3 shows the change in atmospheric carbon dioxide concentrations since 1958 as measured at Mauna Loa, Hawaii. (The figure also shows variations within each year due to seasonal changes. Concentrations fall throughout the summer due to plant photosynthesis but rise again during the winter.) Carbon dioxide concentrations are currently increasing at a rate of about two parts per million (ppm) per year.

Here is where most of the public controversy arises: is the increase in temperature (Figure 2) due to the increase in carbon dioxide levels (Figure 3)? If so, is the increase in carbon dioxide levels due to human activity? Despite what some have claimed, the scientific climate study community generally agrees that the answer is yes. The IPCC reports the scientific consensus that there is a greater than 90% probability that human activities—primarily the burning of fossil fuels (coal, petroleum, natural gas) and changing land use patterns (modern agriculture, deforestation)—

FIGURE 3. *Carbon Dioxide levels over the last 50 years.*

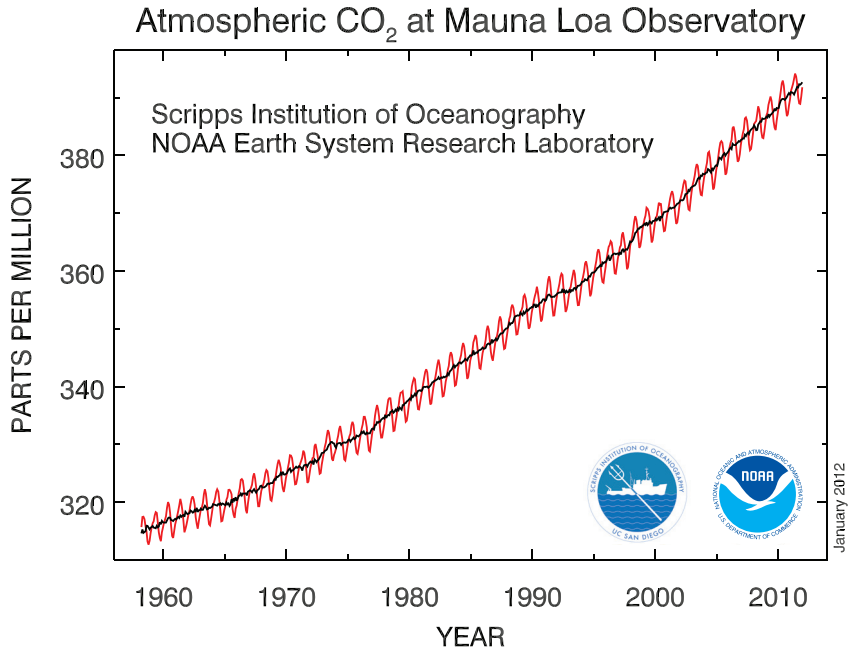


IMAGE CREDIT: DR. PIETER TANS, NOAA/ESRL (WWW.ESRL.NOAA.GOV/GMD/CCGG/TRENDS/) AND DR. RALPH KEELING, SCRIPPS INSTITUTION OF OCEANOGRAPHY (SCRIPPSCO2.UCSD.EDU/).

are the principal causes of warming temperatures and changing climate patterns on a global scale.

Addressing Climate Change

The changing climate is the not the only environmental event in recent times that requires a global response. Another event, begun in the 1980s and continuing today, is the threat to the protective stratospheric ozone layer due to human use of synthetic refrigerants called *chlorofluorocarbons* or *CFCs*. In 1988, an international agreement adopted in Montreal successfully addressed the problem of ozone depletion. The technical solution was relatively simple: the manufacture of new, alternative materials that posed a lower environmental threat to the ozone layer. Today, the ozone hole has begun to close and ozone levels are expected to return to 1980 levels by about 2070. Unfortunately, no such simple technical solution exists for addressing climate change today. If some of the world's major economic powers do not participate and cooperate, a successful solution to the challenges of climate change is very much in doubt.

Two approaches, sometimes seen in competition with each other, have been suggested as ways for humans to address the challenge of climate change: *mitigation* and *adaptation*. Mitigation implies that we should make efforts to reduce the causes of climate change. Specifically, mitigation calls for reducing the greenhouse gas emissions that result from human activities (especially carbon dioxide) to acceptable levels. Adaptation implies that we should find ways to adapt to the climate as it changes, taking steps to prevent the worst effects of climate change from harming people. The IPCC advocates for undertaking both of these strategies.

To mitigate climate change, many climatologists believe the level of greenhouse gases in the atmosphere (currently increasing as shown in Figure 3) should not be allowed to exceed 450 ppm. This limit is necessary to avoid the very worst effects of climate change and to reduce the risk of irreversible and surprising changes. All climatologists say that the sooner we can bring the rise of greenhouse gas concentrations to a stop, the more likely we will achieve sustainability in the future. In order to reduce the chance of greenhouse gas levels rising above 450 ppm, it will be necessary

to reduce annual emissions by about 75%. By 2050, global greenhouse gas emissions must be only one quarter of what they are now—a tall order indeed! The assumption that the global economy must (and will) continue to grow throughout this period complicates the challenge.

Adaptation includes taking steps to reduce the negative effects of climate change. One example of an adaptive measure that could have been taken is reinforcing the levees protecting New Orleans before the onslaught of Hurricane Katrina in 2005. Unfortunately, ignoring such adaptive possibilities had disastrous consequences for the entire city, especially its poorest residents.

Personal and Congregational Action

Pretending that climate change is not real or is not caused by what we humans are currently doing is not an option and leaving matters to individual initiative or to the market will not be sufficient. Mitigation and adaptation strategies require local, regional, national, and global discussions and we need to begin enacting policy change, starting with the least costly options. However, we as individuals also bear responsibility. So what are some of the things we can do?

To start, we can seek out trustworthy sources of information. On the one side is a worldview of unending human progress through economic growth, which relies on technology and expanding levels of consumption to pull us through the tough spots. On the other side, a biocentric worldview worships creation above the Creator and puts the needs of humans below those of other life forms in the ecosystem. However, in order to exercise good discernment, Christians must avoid both the lure of never-ending growth and the leveling tendencies of biocentrism. Instead we must seek to articulate and live out of a vision of creation care that is unabashedly theocentric. (See the resources for further reading at the end of this essay for suggested texts that demonstrate a theocentric approach to creation care.)

We can also engage in daily practices that emerge from a biblical foundation of stewardship. Each of us makes choices about consumption every day of our lives, from transportation to clothing, from appliances to

entertainment, from our houses to our neighborhoods. Even the food we choose to eat can contribute to a more sustainable society. Eating food that is produced locally or reducing our meat consumption cuts down on the resources required to nourish us adequately. Every lifestyle decision we make has implications for creation care, especially for energy use and climate change.

In my own household, my wife and I made several changes over the last ten years to reduce our personal carbon footprint. The biggest change was our move from a large suburban house to a small urban house. Not only did this move reduce energy usage in our house, but the new location is closer to work, church, and shopping, so our car trips are shorter. More destinations are now close enough to walk, bike, or take the bus, so we were able to downsize from two cars to one. Clearly not everyone can move to a new house, but there are many ways you can modify your house to make it more energy efficient. We purchased a programmable thermostat, and keep it set low in the winter (68 degrees in the day, 60 at night) and high in the summer (77 degrees before the air conditioner turns on). We also replaced incandescent light bulbs with compact fluorescent bulbs, and added twelve inches of insulation to the attic space. Such changes are a relatively small investment and soon pay for themselves in reduced monthly energy bills. If you can afford a larger investment, consider replacing major appliances, windows, or the furnace with energy-efficient models. While none of these efforts alone will save the world, such practices lend integrity to the belief that humans play a special role as stewards of creation.

In additional to individual household practices, Christians also need to consider the role and responsibilities of the Church. The wider evangelical community is split into two main groups with respect to how we should address climate change. On the one hand is a group like the Evangelical Environmental Network, which is represented by the signatories of the 2006 Evangelical Climate Initiative. These Christians believe that climate change is real, is caused by human activities, and will affect the poor most strongly and negatively. They state that seeking to mitigate climate change is a moral requirement and advocate public policy based on the best research currently available.

On the other hand, a group like the Interfaith Stewardship Alliance (or the Cornwall Alliance) doubts that human actions will negatively impact the global climate. In fact, they point to potential positive effects of rising carbon levels in the atmosphere, like an increased rate of plant growth. This group believes that adopting a program of climate mitigation would be economically disastrous for the world's developed countries precisely at a time when the need to grow world economies is urgent. By their reasoning, countries with strong economies will be in a better position to assist poor nations if there are any negative effects associated with a changing climate.

So how do we choose between these two views? They differ not just in politics and strategy but at a fundamental level in the way they view the scientific evidence. For a matter of scientific inquiry like climate change, we would be responsible in our discernment to adopt the consensus position of the scientific community as reported in peer-reviewed publications and supported by observational and conceptual evidence. This evidence suggests that climate change is real, it is mainly caused by human actions, it poses a severe threat to the future well-being of all forms of life on this planet, and it needs to be addressed in a timely and effective manner.

In this context, the local church has both the opportunity and the obligation to proclaim the good news of creation care. In his resurrection, Christ redeems not just humans but the entire creation (Col. 1:20). Indeed, the entire creation "waits in eager anticipation for the children of God to be revealed" (Rom. 8:19). For humans, this means that we have an obligation to see to it the human actions do not lead to the demise of civilization or the devastation of other species with which we share this planet. This obligation is first of all an obligation to our Creator and our Redeemer, and will remain so until Christ's return. It is also an obligation to all of the fellow humans with whom we live on earth, and an obligation to the generations of life that we expect to follow us in the future.

In the context of climate change, caring for the earth here in the developed world means changing our lifestyles. If there is to be any kind of a transition to a more sustainable civilization that provides for the needs of all people, each of us will have to pursue radical simplification of our lives by reducing luxury consumption and convenience. For Christians who

affirm that our hope is in God and not in the corruptible goods of this world, such a message should be welcome.

Models of Care

Matthew Sleeth, author of *Serve God, Save the Planet,* gave up the lifestyle of a successful doctor in favor of a simplified lifestyle driven by principles of creation care. His family provides a good model for conscientious change. About his family's shift, Sleeth writes,

> Spiritual concerns have filled the void left by material ones. Owning fewer things has resulted in things no longer owning us. We have put God to the test, and we have found his Word to be true. He has poured blessings and opportunities upon us. When we stopped living a life dedicated to consumerism, our cup began to run over. We have seen miracles…. The earth was designed to sustain every generation's ***needs***, not to be plundered in an attempt to meet one generation's ***wants***.

Another excellent model for change is the Newberry Place cohousing community on the near northeast side of Grand Rapids, Michigan. This urban community of Christians consists of twenty homes clustered together in a neighborhood suitable for walking, biking, and public transportation. According to the community's web site, the development's dense design "fosters strong relationships among neighbors, and creates shared and private green spaces. Neighbors also share ownership of a large 'common house' where they can enjoy group meals several times a week or participate in social events and other activities." The people living at Newberry Place are committed to developing a community-based model of living that places lower demands on the creation. (For more about Newberry Place, visit the community's web site at http://newberryplace.org.)

Many environmentally-sensitive Christians, especially young people, are undertaking these kinds of actions, which are all signs of hope. The challenges are great, but Spirit-led living can produce lifestyles that are

healthful for the planet, fulfilling for ourselves, affirming of community, and pleasing to God.

Energy

Energy is critical for sustaining life and, along with population growth and climate change, is another area of concern related to environmental sustainability. Without energy, nothing can change or grow. The rise of industrial civilization could not have occurred without access to affordable, dependable energy resources and modern civilization cannot be sustained without access to energy.

A resource provided by nature is known as a *primary energy source*. Until around 1750, civilization's primary energy sources were the sun, wind, and water. The latter two energy forms are also essentially forms of solar energy, since the sun drives both the hydrological cycle and the wind. All of these forms of energy are renewable, meaning they will not be depleted over time, no matter how much they are used.

Today, our primary energy sources are the fossil fuels: coal, oil, and natural gas. Coal use began around 1750, oil use began in earnest around 1900, and natural gas use became common after 1950. Nearly 85% of the world's energy is currently obtained form these three fuel sources. We turn all three of these fossil fuels into energy by burning them, releasing heat energy that can be used to accomplish work, like moving a car, or boil water to make electricity, as in a steam-driven power plant. Burning fossil fuels (combustion) converts the carbon in the fuel into carbon dioxide, which is released into the air. This process is the major source—about 70%—of the growing levels of atmospheric carbon dioxide that impact the earth's climate.

Fossil fuels are not renewable resources. A time will come when their supply will be diminished. In fact, many professional oil geologists believe that the world's capacity to extract oil from the ground will soon begin to decline. Because oil provides the energy resources for nearly all of the world's mechanized transportation systems and for our modern system of agriculture, declining availability of oil will represent a grave challenge for modern civilization.

In 2006, global energy consumption was increasing by a factor of 2% per year. At this rate, energy consumption will double by 2041. Of the total energy used by people all over the world, we here in the U.S. use roughly 25%, even though we have less than 5% of the world's population. U.S. energy consumption per person is the highest in the world, closely followed by Australia and Canada. On average, each of us uses about one million kiloJoules of energy per day. To put this figure in perspective, consider that one person's physical activity (fueled by the food we eat) is about ten thousand kiloJoules of energy per day. That means that our total consumption is the same amount of energy that one hundred adults working for us would provide. Some have said that it is as though each of us has about one hundred "energy slaves" tending to us twenty-four hours a day. In contrast, the average Chinese adult has fewer than ten such "energy slaves."

Our Energy Future

Modern civilization must be judged unsustainable from the standpoint of energy use. The supply of fossil fuels is limited, meaning they can't be replenished once they are consumed, and yet we depend on fossil fuels for 85% of our primary energy supply. Additionally, the heavy use of fossil fuels has substantial negative impacts for the biosphere. Without a sustainable energy supply, modern civilization will ultimately collapse. So what are the options?

A strategy of drilling and digging for more oil is a twentieth century answer to a twenty-first century problem. It will only lead to further depletion of fossil fuels, greater security risks for the U.S. and western Europe, and greater threats to a livable future from the standpoint of ecosystem health. Fossil fuels have been alluring, convenient, and, if we neglect climate change and other bio-impacts, seemingly economical, but we must begin the transition away from their use sooner rather than later. The twenty-first century challenge is to develop a civilization that relies on clean, abundant, renewable, and inexhaustible supplies for its energy.

Given these constraints, the available options are few, although the

resources are in ready supply for nearly everyone on the planet. The options include:

- Direct solar energy, including passive, photovoltaic, and thermal systems
- Indirect solar energy from wind, biomass, and hydropower.
- Non-solar options like geothermal and tidal energy.

Technologies for harnessing and managing all of these renewable sources are already known and available. Currently, all of these renewable technologies combined provide only 8% of the world's energy. Water (via hydropower) provides about 5-6% of our primary energy supply; the burning of biomass (typically wood) provides 1-2%; and wind, direct solar, and geothermal provide less than 1% each. (Another 7-8% of our primary energy is supplied by nuclear fuels, like uranium, but I do not list nuclear power as one of the main alternative options for two reasons. First, nuclear power is not renewable since it relies on non-renewable resources. Second, we have not yet agreed on how to solve the issue managing spent fuel once it has come out of the nuclear reactor. However, I do not preclude the expanded use of nuclear power generation in the future, at least as a way to help reduce greenhouse gas emissions without jeopardizing essential electrical services to society.) Making the transition away from a fossil fuel-based energy system will require vast investments in renewable energy systems, as well as continuing research and development.

Energy Resources and the Church

Let there be light! These words accompany God's original act of creation (Gen. 1:3). How should we understand this simple sentence? In our everyday lives, we understand light as something that enables us to see, like the sun or a light bulb. But light itself is a form of energy. Thus, we might say, "In the beginning, God created energy." In fact, we can trace all forms of energy back to that original creative act. Solar and wind power are continually renewed by the sun. Fossil fuels originated from decaying

marine organisms and plant matter which gained their energy from the sun. Geothermal power comes from heat deep within the earth. Thus, when God made the earth and sun, he provided for all our energy needs. Because energy is conserved, the amount of energy present at the moment of creation is the same as the amount of energy present in the universe today.

Thus, the fossil fuels that we so heavily use today should ultimately be understood as a one-time energy inheritance of the original creative act. It was not until the eighteenth century that humans learned how to use this inheritance for the purposes of constructing modern civilization. But this endowment of energy must truly be understood as a perishable gift; once we use it up, it will be gone and no human population will ever be able to make use of it again. When considering the myriad of ways in which we use fossil fuels in the developed world, I am often reminded of the story of the prodigal son. We in America have received our inheritance from our father and have engaged in a period of riotous and profligate living, squandering much of our inheritance. While modern civilization has achieved much, we have also wasted much, and without continuing access to suitable and sustainable primary energy resources, this civilization cannot continue. Unfortunately, there's virtually no sign of any kind of national repentance from this style of life. In the case of our energy excesses, lament and repentance might be one of the most important gifts the Church has to offer.

A New Era

I have identified human population growth, climate change, and energy resources as three aspects of our present way of being in the world that portend an unsustainable future. We could have used several other lenses to perceive the same outcome: the availability of fresh water, the ability to produce food for expanding populations, the modern system of industrial agriculture, the loss of ecosystem habitats, and species extinction. Underlying all of these issues is the belief that continuous, exponential economic growth is the way to lead humanity into a better future. All of these issues are on the near horizon of modern civilization, proclaiming

that the twenty-first century will be different from the twentieth century. We are entering an era of global challenges that will require radical and courageous behavior from all of our leaders and from human society as a whole.

While a transition to a more sustainable civilization will be turbulent and uncertain with no assurance of success, we have an obligation to each other, to future generations, to the other creatures with whom we share this planet, and, above all, to the Creator, to make the effort. The church has a crucial role to play in this drama as it proclaims the good news of the Word who was present at the very creation of the earth and all that is in it.

Further Reading

- Bouma-Prediger, Steven. *For the Beauty of the Earth: A Christian Vision for Creation Care*. Grand Rapids, MI: Baker Academic, 2001.
- Dewitt, Calvin B. *Earthwise: A Guide to Hopeful Creation Care* (3rd edition), Grand Rapids, MI: Faith Alive Christian Resources, 2011. A 160 page introduction to creation care, with suggestions for group sessions and additional self-study.
- Hayhoe, Katherine and Farley, Robert. *A Climate for Change: Global Warming Facts for Faith-Based Decisions*, New York, NY: FaithWords, 2009. A climate scientist and a pastor write for Christians.
- Koetje, David, ed. *Living the Good Life on God's Good Earth*, Grand Rapids, MI: Faith Alive Christian Resources, 2006. Ten short essays in 83 pages, with questions for group discussion.
- Wilkinson, Loren. *Earthkeeping: Christian Stewardship of Natural Resources*. Grand Rapids, MI: Wm. B. Erdmanns Publishing, 1980.