GLOBAL WARMING: A PUBLIC HEALTH CRISIS DEMANDING IMMEDIATE ACTION

This article reviews the causes and environmental and health consequences of global warming. Corporations have employed unsound science and legislative influence to refute the existence of and to impede the progress towards curtailing, global warming. The media have also obfuscated the issue of global warming. The roles of individuals, governments and health professionals in confronting this major environmental and public health crisis are then analysed.

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CAUSES OF GLOBAL WARMING

Climate Change and the Greenhouse Effect

hile cooling and heating shifts in the Earth's climate occur with somewhat predicable frequency on geological time scales, it is now accepted that we are in the midst of a dramatic and rapid warming of the planet, consequent to the combustion of fossil fuels (Report of the Intergovernmental Panel on Climate Change, 2007, available at, http://www.ipcc.ch; Gore, A, *An Inconvenient Truth*, New York: Rodale/Melcher Media, 2006; Donohoe, M T, "Causes and Health Consequences of Environmental Degradation and Social Injustice", *Social Science and Medicine*, Vol 56(3), 2003; and Donohoe, M T, "Roles and Responsibilities of Health Professionals in Confronting the Health Consequences of Environmental Degradation and Social Injustice", submitted to *Medscape*, April 2007). This warming, which began with the advent of industrialisation in the late nineteenth and early twentieth century, has accelerated over the last few decades and bodes ill for the Earth's ecosystems and for human health.

The planetary temperature has increased one degree Celsius over the last century, a number that might seem small yet has dramatic consequences (Report of the Stern Commission on Climate Change, United Kingdom, available at, http://www.hm-

treasury.gov.uk). The last 24 years have been the hottest in the last century and a half and 2006 was the hottest year since record keeping began in 1856. If no action is taken to reduce carbon emissions, the concentration of atmospheric greenhouse gasses could reach double its pre-industrial level within the next 30 years, leading to a

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temperature rise of at least 2°C (*ibid*). Estimates from the International Panel on Climate Change place the rise as high as 10°C over the next century (Intergovernmental Panel Report, *ibid*).

The greenhouse effect refers to the tendency of carbon dioxide, methane, nitrous oxide, sulphur compounds and chlorofluorocarbons to trap that portion of the sun's heat energy, which is reflected off the Earth (Staff–Union of Concerned Scientists (UCS), "Frequently Asked Questions (FAQs) about Global Warming", available at, http://www.ucsusa.org). Without the greenhouse effect, the Earth's average surface temperature would be -18°C instead of 15°C and our frozen planet could not sustain human life (Staff–UCS, FAQs, ibid). The presence of the major greenhouse gasses is a consequence of both natural processes like cellular respiration and manmade technologies like the burning of fossil fuels and methane production from agricultural activities like growing rice and raising cattle (Staff–UCS, FAQs, ibid).

Industrialisation and Automobiles

Since pre-industrial times, the atmospheric concentration of carbon dioxide has increased 31 per cent (Gore, *ibid*). The major cause of increased greenhouse gas production is the burning of fossil fuels such as coal, oil and natural gas.

Transportation, electricity generation and heating and cooling for industrial processes contribute almost equally (Staff–UCS, FAQs, *ibid*).

Industrialisation and the accelerating worldwide demand for fuel-inefficient automobiles have polluted our air and hastened global warming and the destruction of the protective ozone layer. Large industrialised countries are the greatest contributors to global warming. The top one-fifth of the world's nations account for over 60 per cent of global CO₂ emissions, while the lowest one-fifth, just 2 per cent (Staff–UCS, FAQs, *ibid*). While the United States contains just 5 per cent of

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the world's population, it is responsible for 25 per cent of the world's energy consumption, 33 per cent of its paper use and 72 per cent of all hazardous waste production (Donohoe, M T, "Causes and Health Consequences of

Environmental Degradation and Social Injustice", *ibid*). On the other hand, the countries likely to be most affected by global warming are those least responsible for the increases in global temperature, primarily the developing nations of the Southern Hemisphere.

To focus on automobiles—for every gallon of gasoline manufactured, distributed and then burned in a vehicle, 25 pounds of carbon dioxide are produced (Alexander, G J and Kanner, R E, "Air Pollution: From Irritating to Life-Threatening", *IM*—*Internal Medicine*, October 1995). In the US there is one car for every two people, in Mexico one for every eight and in China one for every 100. The global automobile population is expected to double in the next 25 to 50 years and the number of miles driven per person will grow as urban sprawl leads to longer commute distances (Mark, J and Morey, C, "Rolling Smokestacks", *Nucleus* (Union of Concerned Scientists), Summer 2000 and Staff, "Driving Ourselves Crazy", *Amicus Journal*, Summer 1999). US fuel economy standards have changed very little since the Model T, in large part due to lobbying by automobile manufacturers and the oil industry (Donohoe, M T, *ibid*).

The Military, Oil and Global Warming

The world's militaries are the planet's single largest polluter, responsible for eight percent of global air pollution and six percent of raw materials use (Sidel, V W and Shahi, G S, "The Impact of Military Activities on Development, Environment and Health", in Shahi, G S, Levy, B S, Binger, A, Kjeustrom, T and

Lawrence, R, (Eds), International Perspectives on Environment, Development and Health: Toward A Sustainable World, New York: Springer Publishing Company, 1997). Even prior to the current wars in Iraq and Afghanistan, the US Defense Department was the world's largest consumer of oil and the Pentagon generated half a billion tonnes of toxic

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waste per year, more than the five top chemical companies combined (Thomas, W, *Scorched Earth: The Military's Assault on the Environment*, Philadelphia: New Society Publishers, 1995). Ironically, the Pentagon has deemed global warming a "vastly greater threat than terrorism" with enormous consequences for US national security and the potential to cause global anarchy (Townsend, M and Harris, P, "Now the Pentagon Tells Bush: Climate Change Will Destroy Us", *The Guardian*, February 22, 2004, available at, http://observer.guardian.co.uk). Oil production, fuels civil and international armed conflicts and is associated with human rights abuses in Nigeria, Myanmar and elsewhere. Such violence in turn exacerbates world hunger and increases infant mortality, as financial and scientific resources are diverted toward militarism and away from the amelioration of poverty.

Deforestation

Deforestation, spurred by overpopulation, poverty, unsustainable farming practices and rapacious logging to satisfy an increasing demand for paper products, has in turn augmented global warming, degraded soil quality and contributed heavily to species loss (Intergovernmental Panel Report, *ibid*; Gore,

ibid; and Donohoe, M T, *ibid*). Deforestation destroys the plant life, which serves as the planet's carbon dioxide sink. Half of all tropical forests have been destroyed; by 2010, three-quarters may be lost (Donohoe, M T, *ibid*). In addition, 20 to 50 per cent of global wetlands have been destroyed (Donohoe, M T, *ibid*). The areas most affected by deforestation are the Amazon, Sub-Saharan Africa, the Philippines and most recently the Pacific Northwest and

Half of all tropical forests have been destroyed; by 2010, threequarters may be lost. In addition, 20 to 50 per cent of global wetlands have been destroyed. British Columbia (the "Amazon of the North"). The factors that lead to deforestation are the need for new agricultural settlements, spurred by overpopulation, poverty and unsustainable farming practices; urban sprawl; logging for building

materials and paper; cattle ranching and drug cultivation in countries like Peru, Bolivia and Columbia (Donohoe, M T, *ibid*). With deforestation and global warming come shifts in the ranges and behaviours of plant and animal species. One example is the increase in the range of mosquitoes, which carry malaria to higher elevations, contributing to a rise in the prevalence of this deadly killer disease.

Combustion for Cooking and Heating

Another important contributor to global warming and pollution is the combustion, by almost three billion people worldwide, of coal and biomass (wood, charcoal, crop residues and animal dung) for cooking, heating and food preservation (Ezzati, M and Kammen, D, "The Health Impacts of Exposure to Indoor Air Pollution from Solid Fuels in Developing Countries: Knowledge, Gaps and Data Needs", *Environmental Health Perspectives*, Vol 110 (11), 2002). Health consequences of released pollutants are magnified when such combustion is carried out in enclosed spaces, which is common.

CONSEQUENCES OF GLOBAL WARMING

Melting and Flooding

There are many actual and potential adverse effects of global warming. Its consequences include the melting of polar icecaps and glaciers and the rise of global sea levels (Intergovernmental Panel Report, *ibid*; Gore, *ibid*; Stern

Commission Report, *ibid*; and Staff– UCS, FAQs, *ibid*). Over the next 100 years, sea levels are predicted to rise between 9 and 88 cms, which is likely to result in greater coastal erosion, flooding during storms and may inundate Male (the capital of the Maldives) and South Pacific islands like Tuvalu and Vanuatu. Low-lying countries like Bangladesh will be threatened and aquifers in New

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Orleans and San Francisco may be destroyed. Large portions of the Antarctic ice shelf have caved into the sea and the Greenland ice sheet is rapidly receding. With less ice to reflect sunlight, the Earth absorbs more heat, which accelerates melting. If the layer of permafrost covering the Siberian tundra continues to melt, huge amounts of carbon dioxide could be released, further accelerating global warming.

Extreme Weather Events

Global warming augments the effects of extreme weather patterns, including El Niño and La Niña and may have contributed to the recent dramatic increase in severe hurricanes and costly flood damage in the US (Intergovernmental Panel Report, *ibid*; Gore, *ibid*; Stern Commission Report, *ibid*; and Staff–UCS, FAQs, *ibid*). Due to the added effects of global warming, overpopulation and water pollution, we are running out of fresh water, a resource over which future wars will likely be fought (Leslie, J, "Running Dry—What Happens When the World No Longer has Enough Freshwater?", *Harper's* Magazine, July 2000).

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Air Pollution and Ramifications for Human Health

Numerous studies have documented the links between global warming, greenhouse gasses, air pollution, ozone depletion and acute and chronic health problems. Greenhouse gasses are major contributors to air pollution, whose levels have been strongly linked to morbidity and mortality from cardiopulmonary and cerebrovascular diseases, lung cancer and infant mortality in the US (Samet, J M, Dominici, F, Curriero, F C, et al, "Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987–1994", New England Journal of Medicine, Vol 343(24), 2000; Dockery, DW, Pope, CA, Xu, X, et al, "An Association between Air Pollution and Mortality in Six U.S. Cities", New England Journal of Medicine, Vol 329(24), 1993; Ponka, A and Virtanen, M, "Low-Level Air Pollution and Hospital Admissions for Cardiac and Cerebrovascular Diseases in Helsinki", American Journal of Public Health, Vol 86(9), 1996; and Bobak, M and Leon D A, "Air Pollution and Infant Mortality in the Czech Republic, 1986-88", The Lancet, Vol 340, 1992). Rising temperatures increase smog and ground level ozone, increasing symptoms in those suffering from asthma and chronic obstructive pulmonary disease. Higher levels of carbon dioxide favour the growth of ragweed and other pollen-producing plants, which exacerbates allergies. Furthermore, due to the

Scientists at the World Health Organisation have estimated that about 160,000 people die each year from the side effects of global warming and that this number could double by 2020. pollution-induced destruction of the ozone in the upper atmosphere (as well as cooling of the upper atmosphere, a consequence of more heat being trapped in the lower atmosphere), the ozone layer, which protects us from the sun's harmful ultraviolet radiation, is being depleted. This has led to an

increase in cataracts, a consequence of ultraviolet-light induced damage to the eye's lens and a predicted increase in the lifetime risk of malignant melanoma, the most virulent form of skin cancer (Whited, J D and Grichnik, J M, "Does This Patient Have Melanoma?", *Journal of the American Medical Association*, Vol 279(9), 1998). Finally, with higher temperatures come more heat waves, resulting in more deaths from hyperthermia, although deaths from hypothermia should drop. Scientists at

the World Health Organisation have estimated that about 160,000 people die each year from the side effects of global warming and that this number could double by 2020 (Staff, "Global Warming Deaths on the Rise", available at, http:/ /www.wired.com).

CORPORATIONS, THE MEDIA AND UNSOUND SCIENCE

Corporate Attacks on Global Warming Science

Through lobbying, campaign contributions, control of a media which limits public debate on topics of environmental importance and in some cases human

rights abuses, corporations, in their pursuit of greater profits, have fought to weaken environmental legislation designed to protect the public's health, such as industrial emissions and fuel economy standards (Donohoe, M T, *ibid*). The early twenty-first century has seen a tremendous increase in the influence of corporations on national

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policy, with a revolving door between industry, lobbying groups and governmental agencies responsible for safeguarding the environment and protecting public health (Donohoe, M T, *ibid*). Pre-eminent scientists have protested the current US administration's misuse of science, including classification of data and rewriting of important policy statements to minimise health concerns (Union of Concerned Scientists, Scientific Integrity Project, available at, http://www.ucsusa.org).

Media Misinformation

Many corporations whose activities contribute to global warming and which stand to gain financially from the perpetuation of the *status quo*, hide behind "greenwash" public relations and advertising campaigns designed to present themselves as eco-friendly (Beder, S, *Global Spin: The Corporate Assault on Environmentalism*, White River Junction, Vermont: Green Books and Chelsea Green Publishing Company, 1997). They grant large amounts of money to the few

"scientists" who dispute global warming. These "scientists" at the behest of their corporate benefactors, often communicate through front groups, such as the American Council on Science and Health (ACSH) and the Foundation for Clean Air Progress. Companies also lobby legislators through the creation of artificial "grassroots coalitions", which may only contain a few members, a phenomenon known as "astroturfing" (Donohoe, M T, *ibid*).

In 2005, the American Association of Petroleum Geologists gave its journalism award to author Michael Crichton, a physician whose book *State of Fear* (HarperCollins, 2004) questions the existence of human-caused global warming (American Association of Petroleum Geologists Explorer Awardees, available at, http://www.aapg.org). Crichton also received the 2005 "Sound Science Medal"

There is a dearth of environmental coverage in the media, in part a consequence of major news outlets being owned by corporations with extensive histories of environmental destruction. from the ACSH. The ACSH, which grants this inappropriately named award, is one of the most visible, well-funded purveyors of pseudoscience and misinformation regarding the health risks of environmental degradation. The group has a history of strong ties to corporate polluters. Its physician in

charge of publications is a convicted felon whose medical license has been revoked. Its president, Dr. Elizabeth Whelan praised Crichton for confronting "the threat of pseudoscience... in this case, the belief that careless human activity (the burning of fossil fuels) has made the world too dangerously warm, causing death-dealing weather changes and human misery" (Whelan, E M, "Novel Debunks Environ-Dogma", available at, http://www.acsh.org). ACSH has referred to those who describe the serious health and environmental consequences of global warming and who call for fossil fuel restrictions as "doomsayers" and "fearmongers" ("Public Health Panel Rips Draconian Measures Pushed by Global Warming Doomsayers", American Council on Science and Health Press Release, December 14, 1997). This year, Senator James Inhofe (R, Oklahoma) called "the threat of catastrophic global warming ... the greatest hoax ever perpetrated on the American people" (Mann, M, Rahmstorf, S, Schmidt, G, Steig, E and Connolley, W, "Senator Inhofe on Climate Change", available at, http://www.realclimate.org). Such anti-science declarations are an affront to respected climate scientists worldwide.

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Whenever the mainstream media have covered global warming, until very recently, they have portrayed it as a scientific uncertainty. Of a sample of over 900 articles dealing with climate change and published in peer-reviewed, scientific journals between 1993 and 2003, none expressed doubt as to the existence or major cause of global warming (Oreskes, N, "The Scientific Consensus on Climate Change", *Science*, Vol 306, 2004). On the other hand, an analysis of articles in the most influential American dailies (the *New York Times*, the *Washington Post*, the *LA Times* and the *Wall Street Journal*) over a similar period found that 53 per cent expressed doubt as to the cause of global warming and many gave the impression that

mainstream scientists still doubted the existence of global warming (Michaels, D and Monforton, C, "Manufacturing Uncertainty: Contested Science and the Protection of the Public's Health and Environment", *American Journal of*

A majority of Americans believe that electricity in the US is produced in non-polluting ways; only 25 per cent are aware that the majority (70 per cent) comes from oil, coal and wood.

Public Health, Vol 95, 2005). The manufacture of controversy, the repositioning of global warming as theory rather than fact by the public relations campaigns of a small but well-funded cadre of special interests in the fossil fuels industry, is reminiscent of the tobacco companies' campaign to create doubt about the role of cigarettes in causing diseases (Michaels and Monforton, *ibid*).

Sponsored Environmental Curricula

Many polluting companies capitalise on Americans' environmental ignorance, which is in part a by-product of a public education system in disarray, particularly in poor and minority neighbourhoods, which suffer disproportionately due to under-funded school systems (Donohoe, M T, *ibid*). For example, a majority of Americans believe that electricity in the US is produced in non-polluting ways; only 25 per cent are aware that the majority (70 per cent) comes from oil, coal and wood (McManus, R, "Myth Buster: Popular Fiction", *Sierra* Magazine, May–June 1999, available at, http://www.sierraclub.org).

To fill the void left by the absence of environmental education programmes, corporations have distributed free, sponsored environmental educational materials

To reduce their contribution to global warming, private citizens can properly insulate their homes, use energy-efficient lighting, take public transportation and stop receiving catalogues and junk mail. to public schools. These materials are produced and supported by a loose coalition of corporate polluters, lapdog "scientists", anti-regulatory zealots and misguided parents (Selcraig, B, "Reading, 'Riting and Ravaging", *Sierra* Magazine, May– June 1998). Examples include Exxon's "Energy Cube", which states, "gasoline

is simply solar power hidden in decayed matter" and "offshore drilling creates reefs for fish". International papers' proclaim, "Clear cutting promotes the growth of trees that require full sunlight and allows efficient site preparation for the next crop" (Donohoe, M T, *ibid*).

CONFRONTING GLOBAL WARMING

A multi-faceted approach to the problems of environmental degradation includes shifting from a throwaway economy to a re-use/recycle economy and reevaluating economic inputs and outputs by including the contributions of natural phenomena and processes to human health (Donohoe, M T, *ibid*). To reduce their contribution to global warming, private citizens can properly insulate their homes, use energy-efficient lighting, take public transportation and stop receiving catalogues and junk mail (Direct Marketing Association's Consumer Assistance, available at, http://www.dmaconsumers.org) and purchase locally-produced goods, including foodstuffs, to minimise the pollution associated with the transportation of such products from distant locations.

Governments and corporations can reduce global emissions by increasing energy efficiency standards, sharing technologies, encouraging the use of renewable energy sources, eliminating coal and oil subsidies and protecting forests. Some have advocated emissions trading, in which polluting companies "purchase" pollution credits from less polluting companies, with the goal of decreasing overall industry-

wide emissions. However, such trading offers less incentive to polluters to develop and adopt technological innovations to curb their individual contributions to global warming. Stronger clean air and water standards and the elimination of fossil fuel industry tax breaks and subsidies could

Stronger clean air and water standards and the elimination of fossil fuel industry tax breaks and subsidies could save billions of dollars and thousands of lives each year.

save billions of dollars and thousands of lives each year. Tax breaks and subsidies for research and development of renewable energy should be increased and the tax system restructured to decrease levies on work and savings and increase levies on destructive activities, such as carbon emissions and toxic waste generation. Alternatives to electrical-coal-oil-nuclear and natural gas-based power include solar energy, wind turbines, geothermal power, tidal/wave power, hydropower and co-generation (harnessing waste heat), all of which would decrease air pollution and the risk of accidental or deliberate catastrophes (Donohoe, M T, *ibid*).

Alternatives to automobiles include electric cars and electric trolley systems; natural gas and/or gasohol (which generates less carbon dioxide than regular gasoline); solar cars; and hydrogen-powered cars, whose by-product is water. Electric cars were marginalised and electric trolley systems dismantled, as was much of the existing public transportation and network, by a triumvirate of oil, chemical and tire companies in the early twentieth century. Their actions led to their convictions under the Sherman Anti-Trust Act (Donohoe, M T, *ibid*). Trains, which are fifteen times more energy-efficient per passenger than automobiles, should be utilised more. Unfortunately, federal funding for Amtrak, the American national rail system,

has declined dramatically. Some individuals car-pool or car share, while millions of Americans telecommute, that is work from home. Telecommuting leads to decreased absenteeism, job turnover and need for office space, improved worker productivity and saves between six and twelve thousand dollars per worker per year (Erickson, K, "Home Work: The Green Routine of Telecommuting", *Sierra* Magazine, September–October 1998). Still others ride bicycles or walk to work.

Improvements in the status of women, including the strengthening of family planning programmes and improved/equal access to educational opportunities and legal and political representation will produce a more equitable world and are likely to decrease the demand for large families which spurs overpopulation (Donohoe, M T, "Individual and Societal Forms of Violence Against Women in the United States and the Developing World: An Overview", *Current Women's Health Reports*, Vol 2(5), 2002 and Donohoe, M T, "Violence and Human Rights Abuses Against Women in the Developing World", *Medscape Ob/Gyn and Women's Health*, Vol

To help developing nations become self-sufficient, the World Bank and the International Monetary Fund need to alter their policies and promote the production of local food crops, rather than crops destined for export to developed nations. 8(2), 2003, available at, http:// www.medscape.com). To help developing nations become selfsufficient, the World Bank and the International Monetary Fund need to alter their policies and promote the production of local food crops, rather than crops destined for export to developed nations (Donohoe, M T, "Genetically-Modified Foods:

Health and Environmental Risks and the Corporate Agribusiness Agenda", *Z Magazine*, December 2006, available at, http://zmagsite.zmag.org). Debt forgiveness will also help lift many nations out of poverty, with limited impact on the financial status of the world's richest nations (Donohoe, M T, *ibid*).

Global cooperation through international treaties is critical for decreasing global warming. The Montreal Protocol has been fairly successful in phasing out chlorofluorocarbon use (Gore, *ibid*). This treaty and the international "Earth Summits" in Rio de Janeiro and Kyoto represent the beginnings of global cooperation. The US, however, has resisted international efforts to reverse global

warming. On February 16, 2005, the Kyoto Protocol, an international treaty, which legally binds developed nations to limit their output of fossil fuel emissions and other harmful gases in the upcoming century, took effect in the 141 countries that ratified it. The US has refused to ratify the Kyoto Protocol and has not formulated

a workable plan to achieve the goals of the Protocol. Even so, many US cities have taken the lead and passed legislation to meet Kyoto standards (Staff, "Cool Cities: Solving Global Warming One City at a Time", available at, http://www.coolcities.us) and Sweden has pledged to become the world's first oil-free economy by 2020.

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20 per cent of the world's gross domestic product (GDP) each year, an investment of just one percent of the annual world GDP by 2050 could reduce emissions significantly and head-off the worst projected impacts of global warming (Stern Commission Report, *ibid*). Given the enormous economic and social consequences of global warming, it is essential that we act now to ameliorate and reverse climate change.

The Role of Health Professionals

As a result of their training, health professionals are in a unique position to recognise the causes and consequences of the global warming crisis. Because of their privileged position in society, since they themselves are in part responsible for these problems and because their *raison d'être* is to promote health and fight injustice, health professionals share a responsibility to oppose, individually and collectively, those forces which contribute to the spread of global warming.

CONCLUSIONS

The rapid, human-caused warming of the Earth over the last century carries serious consequences for our environment and health. Urgent action on the part of individuals, health professionals, public interest groups, governments and corporations is required to confront this serious threat to global health. We must constantly remind others, through our words and deeds, of the Native American saying, "We have not inherited the Earth from our ancestors, but have borrowed it from our children".

This article is based on the papers by Donohoe, M T, "Global Warming: A Public Health Crisis Demanding Immediate Action", (Parts I and II), Medscape Public Health and Prevention, 2007, available at, http://www.medscape.com.