The Path to Climate Sustainability

A Joint Statement by the Global Roundtable on Climate Change

Executive Summary

Climate change is an urgent problem requiring global action to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs). Energy use is vital for a modern economy. Burning fossil fuels produces CO_2. Thus, confronting climate change depends, in many ways, on adopting new and sustainable energy strategies that can meet growing global energy needs while allowing the stabilization of atmospheric CO_2 concentrations at safe levels.

Energy efficiency must play an important role in these strategies, but long-term success will require a concerted effort to de-carbonize the global energy system. This means significantly increasing the use of non-fossil-fuel energy sources, significantly raising the energy efficiency of fossil-fuel power plants through advanced technologies, and developing and deploying technologies that trap and store the CO_2 produced by the fossil fuels that will remain in use.

Cost-efficient technologies exist today, and others could be developed and deployed, to improve energy efficiency and to help reduce emissions of CO_2 and other GHGs in major sectors of the global economy. Research indicates that heading off the very dangerous risks associated with doubling pre-industrial atmospheric concentrations of CO_2, while an immense challenge, can be achieved at a reasonable cost. Failing to act now would lead to far higher economic and environmental costs and greater risk of irreversible impacts. To meet this challenge and take advantage of these opportunities:

- The world's governments should set scientifically informed targets, including an ambitious but achievable mid-century target for global CO_2 concentrations, for "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system," in accordance with the stated object of the Framework Convention on Climate Change (UNFCCC).

- All countries should be party to this accord, which should include specific near- and long-term commitments for action in pursuit of the agreed targets. Commitments for actions by individual countries should reflect differences in levels of economic development and GHG emission patterns and the principles of equity and common but differentiated responsibilities.

- Clear, efficient mechanisms should be established to place a market price on carbon emissions that is reasonably consistent worldwide and across sectors in order to reward efficiency and emission avoidance, encourage innovation, and maintain a level playing field among possible technological options.

- Government policy initiatives should address energy efficiency and de-carbonization in all sectors, allow businesses to choose among a range of options as they strive to minimize GHG emissions and costs, encourage the development and rapid deployment of low-emitting and zero-emitting energy and transportation technologies, and provide incentives to reduce emissions from deforestation and harmful land management practices.

- Governments, the private sector, trade unions, and other sectors of civil society should undertake efforts to prepare for and adapt to the impacts of climate change, since climate change will occur even in the context of highly effective mitigation efforts.

- Signatories to this statement will support scientific processes including the Intergovernmental Panel on Climate Change (IPCC), work to increase public awareness of climate change risks and solutions, report information on their GHG emissions, engage in GHG emissions mitigation, which can include emissions trading schemes, champion demonstration projects, and support public policy efforts to mitigate climate change and its impacts.

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Climate and Energy

Climate change is an urgent problem that requires global action to reduce emissions of greenhouse gases in a time frame that minimizes the risk of serious human impact on the Earth's natural systems. While undeniably complex, confronting the issue of climate change depends, in many ways, on developing and deploying low-carbon energy technologies.

The modern age is powered largely by fossil fuels: coal, oil and gas. The fossil-fuel era has been a period of unprecedented economic advance, with the world's average life expectancy roughly doubling and its per capita income rising roughly ten-fold since the start of the Industrial Revolution. Yet we now understand that fossil fuels—as they are currently used—increase the amount of carbon dioxide (CO_2) in the atmosphere which, along with the release of other greenhouse gases (GHGs), warms the planet and leads to other impacts of global climate change.[1]

Human-caused, or anthropogenic, climate change is now underway. If it continues on the current trajectory, it will become increasingly dangerous and costly for current and future generations through myriad impacts on the environment and human society and lead to the extinction of many species.[2] To avoid such risks, termed "dangerous anthropogenic interference with the climate system" in the 1992 UN Framework Convention on Climate Change (UNFCCC), which has been ratified by more than 180 countries, the world must adopt a new and sustainable energy strategy for the 21st century.[3]

Improving energy efficiency will be an important part of this strategy, especially initially because available and cost-effective strategies can be deployed quickly. Energy can be produced and used far more economically, contributing the same level of output with a lower input of energy.[4] Available options include increasing the efficiency of both power plants and the transmission of electricity to end users; expanding the use of combined heat and power generation technologies (co-generation); increasing the fuel-efficiency of cars, trucks, planes and ships; and improving and expanding the use of more efficient buildings, furnaces, lights, and appliances. Energy efficiency presents win-win scenarios for the economy and the environment, helping to moderate both energy demand and GHG emissions and complementing other technologies needed to meet rising global energy demands.

Yet improving energy efficiency will not be enough. Because energy use is vital for a modern economy, the worldwide demand for energy is bound to increase as economic development continues around the world.[5] As a result, societies must not only use energy more efficiently, but also must emit much less CO_2 per unit of energy produced. The reduction of CO_2 emissions per unit of energy, an essential requirement of addressing climate change, is known as de-carbonization.

De-carbonization can be achieved in two ways. The first is to increase the use of non-fossil-fuel-based energy sources. Potential options here include wind, solar, geothermal, hydro, tidal, wave, nuclear, waste-to-energy, and/or biomass.[6] The choices among these technologies will depend on costs, safety, public acceptance, and other considerations. Effective and relatively cost-efficient technologies exist for some of these options today and others could be developed and deployed. Significantly increasing the use of such energy sources, both when building new infrastructure and when replacing fossil fuel facilities, is essential if we are to meet the climate change challenge while meeting global energy needs.

The second is to adopt technologies that permit the use of fossil fuels while preventing the build-up of CO_2 in the atmosphere. One of the main options here is carbon capture and sequestration (CCS)—gathering and storing the CO_2 produced by burning or gasifying fossil fuels. CCS technologies that capture CO_2 emissions at the source (from a power plant, for example) and then sequester them beneath the Earth's surface have been proven technically but need to be demonstrated commercially and at the scale required to make a significant impact on efforts to de-carbonize the global energy system.[7]

Pursuing CCS should not be seen as an alternative to achieving significantly greater energy efficiency or greatly expanding the use of non-fossil-fuel-based energy sources but rather as an additional and important component to a comprehensive 21st century energy strategy. For example, realistic analysis suggests that, given the global distribution of immense coal reserves, coal is likely to remain an important fuel source for electricity production, and perhaps other energy needs, in many countries for an extended period.[8] CCS represents a potential method for significantly limiting the release of CO_2 from the use of these coal reserves, as well as the use of other fossil fuel reserves. Other currently available options that can reduce, although not eliminate, GHG emissions from coal-fired electric generation include distributed generation with combined heat and power (co-generation) and a variety of advanced coal technologies with improved energy efficiency and lower carbon emissions.

The impacts of climate change are already being observed, and each new power plant or factory constructed using standard fossil-fuel technology (especially without provision for CCS) locks in place a path of high CO_2 emissions during the life of the facility, which can be 50 years or more. Every year that passes without significant global efforts to reduce emissions means a higher concentration of atmospheric CO_2 and an increased risk that the world will surpass levels of atmospheric CO_2 that make "dangerous anthropogenic interference" unavoidable.[9]

The arithmetic behind the threat is compelling. The atmospheric concentration of CO_2 is now more than 380 parts per million (ppm), about 30 percent higher than it stood in 1900.[10] Nearly half of this increase has occurred since 1980. The world currently uses around 7 billion tons of carbon-based fuels per year, and emits roughly 2 billion tons from deforestation and land-use change, and carbon concentrations are now rising by around 2 ppm per year—a rate that is increasing.

As the CO_2 concentration rises, the impacts on the planet also mount. Some leading scientists put the threshold for "dangerous anthropogenic interference" as low as 450 ppm because of serious risks of major sea level rises, changes in weather patterns, and the extinction of many species.[11] Broad scientific consensus exists about the risks of reaching 560 ppm, which is sometimes called 2X CO_2 because 560 ppm is twice the pre-industrial concentration of 280 ppm.[12] However, even this higher threshold will be very hard to avoid unless strong actions are adopted in the near future. A "business-as-usual" path, meanwhile, could put the planet well above 750 ppm and perhaps at triple pre-industrial CO_2 levels (that is, 840 ppm) by the end of the century.[13]

The challenge is clear. Society must move reliably and swiftly toward a de-carbonized energy system and must do so in a manner that minimizes the transition costs, avoids economic dislocations, and does not jeopardize the economic development of poorer countries. Transition strategies should aim to reduce and/or compensate adjustment costs on workers affected by the move to de-carbonized energy systems.

There will be no single solution—many changes in energy efficiency and energy technology will play a role. Moreover, no single economic sector or group of countries can solve the problem alone. De-carbonization of the energy system will require global action in all key sectors of each economy. The changeover will require decades to complete, but the climate arithmetic dictates that we start now in order to avoid more dangerous risks in the coming decades.

Why We Can Succeed

The main source for optimism on heading off dangerous anthropogenic climate change is the potential to greatly reduce carbon emissions at reasonable adjustment costs to the economy. The world economy can achieve much lower carbon emissions per unit of output by achieving lower energy input per unit of economic output (energy efficiency) combined with much lower CO_2 emissions per unit of energy (de-carbonization):

$$\text{Lower } CO_2/\text{Output} = \underset{\text{(efficiency)}}{\text{Lower Energy/Output}} \times \underset{\text{(de-carbonization)}}{\text{Lower } CO_2/\text{Energy}}$$

The largest carbon-emitting sector is power generation, which the International Energy Agency identifies as responsible for more than 40 percent of global, energy-related CO_2 emissions, with that share likely to rise in the future. Industry accounts for more than 18 percent of energy-related CO_2 emissions. Transport (cars, trucks and planes) contributes another 20 percent. The residential and services sector (which includes most commercial and residential buildings and agricultural energy inputs) accounts for nearly 13 percent[14], although it can be considered to account for significantly more when electricity use is included.

Although completing the entire path to climate stability represents a very significant challenge, opportunities exist in each of these sectors for both increased energy efficiency (reduced energy per unit of output) and de-carbonization (lower CO_2 emissions per unit of energy). Here are some highlights:

Power Generation. Power plants can become more efficient in converting energy into available end-use electricity, as can the transmission of that electricity to the end-user.[15] Combined heat- and power-generation technologies (co-generation) can be deployed more widely for use in district systems, industrial parks, and commercial malls at more than twice the energy efficiency as centralized power systems. The power sector can be gradually de-carbonized by shifting increasing proportions of electricity production to non-carbon fuels (this includes options such as wind, solar, hydropower, geothermal, tidal, nuclear, waste-to-energy and/or biomass), utilizing lower carbon fuels where appropriate, developing and deploying advanced fossil-fuel technologies with high energy efficiency and low carbon emissions, and developing and deploying CCS technologies. Improvements in each of these technologies as well as a potential mix of new energy sources (e.g. solar thermal power, wave energy, and possibly nuclear fusion) will also play a role in further reductions. Increasing the use of low- and zero-CO_2-emitting distributed generation could also yield important ancillary benefits, particularly but not exclusively in developing countries.[16]

Industry. Important, large, energy-intensive, high CO_2-emitting business sectors such as cement, steel, petrochemicals, and refining have a variety of options to improve energy efficiency and increasingly de-carbonize their operations. These include utilizing new production processes, installing highly efficient on-site generation technologies, converting to non-fossil-fuel energy sources, developing and deploying CCS technologies, and other options. Although global economic activity will likely increase energy demand in this sector, energy efficiency measures, co-generation, CCS, and GHG mitigation policies that favor low-carbon energy sources mean that the increased output can be combined with lower overall carbon emissions.

Transportation. All forms of transport (cars, buses and trucks in particular, but also trains, planes, and ships), can become substantially more efficient (requiring less energy input per mile), in some cases through measures such as design and operational improvements, hybrid power systems, and lightweight design. Increasing levels of de-carbonization in the transport sector can be pursued by adopting bio-fuels, hydrogen, and/or electricity produced by low- or zero-carbon emission technologies and/or more efficient conversion technologies such as fuel cells. Mass-transit, traffic management, and commuting strategies can also help to decrease aggregate emissions from transport sector.

Residential and Services. Commercial and residential buildings account for a significant percentage of electricity consumption and CO_2 emissions.[17] Green building can play an important role in efforts to increase the efficient use of energy. Greater use of proven, scientifically based methods and standards for improved building design, sustainable site development, energy, and water efficiency, enhanced insulation, materials selection and indoor environmental quality would yield significant reductions in GHG emissions and produce other benefits.[18] De-carbonization can be pursued by converting heating and cooling systems reliant on fossil fuels to electricity and piped heat produced by low- or zero-carbon emission technologies.

In some cases, energy efficiency and de-carbonization will add little to the overall costs of energy to end users in these sectors. Significant, cost-efficient opportunities exist for efficiency gains using existing technology and proven practices. New technologies are on the horizon that might also save money and reduce GHGs at the same time. Pure win-win possibilities exist, but in some cases these technologies are impeded by government policies, lack of consumer information, or regulatory impediments. Such barriers to reduced GHG emissions should be removed as soon as possible.[19] Developing and deploying new technologies can also provide new business and employment opportunities for companies that take the initiative. In such efforts, “life-cycle thinking” on product and process design will be relevant.[20]

More often, however, the changeover to low-carbon and de-carbonized energy systems will require additional investments which will raise the costs to energy end-users. However, the costs of avoiding dangerous anthropogenic interference while achieving a more efficient, and de-carbonized global energy system still appear reasonable, particularly compared to the costs of inaction and the consequential impacts of significant climate change. Again, while the precise figures are uncertain and we have not sought agreement on specific quantitative claims, it is reasonable to believe that heading off a doubling of CO_2 concentrations can be achieved at a cost of about 1 percent of global GDP and perhaps less as new technologies become established.[21]

Put in different terms, this equals an average cost of about 2 cents per kilowatt-hour and 25 cents per gallon of gasoline.[22] The cost-per-ton of avoided CO_2 emissions can probably be kept to an approximate average of $25 to $30.[23] The exact cost will of course vary by economic sector and region, as well as over time. Many of the least expensive and potentially profitable options will be available in the initial phase (e.g. in situations where energy efficiency savings cover investment costs or where locally cost-effective energy alternatives are available). Costs will likely increase as the need to develop and deploy new technologies and infrastructures increases. Costs will also vary to the extent that there is effective use of existing technologies (including timely government action to facilitate deployment of existing low- or zero-carbon intensive technologies), timely government and private sector support for research, development and demonstration of new technologies, and public acceptance of those technologies. Nevertheless, and most importantly, if we delay too long in beginning the changeover to increasingly de-carbonized energy systems the eventual costs will only rise and the impacts of climate change will only become more severe.

How We Can Succeed: Towards A Global Plan

Participants in the Global Roundtable on Climate Change (GROCC) aim to support a greater global consensus on core aspects of a realistic policy on climate change; one that seeks the simultaneous objectives of effectively mitigating anthropogenic climate change while also creating the sustainable energy systems necessary to achieve long-term economic development and growth for all nations. In that spirit, we put forward the following as important principles for creating an effective climate policy.

- The world's governments should work expeditiously to agree on a target for stabilizing CO_2 levels in the atmosphere. The target should aim explicitly at "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" in accordance with the stated object of the Framework Convention on Climate Change (UNFCCC).[24] Deliberations on this target should be informed by the best and most current scientific information available, in particular the comprehensive 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).[25] As part of this agreement, governments should agree on an ambitious but achievable interim, mid-century target for global CO_2 concentrations and on a series of specific measures to ensure that effective and meaningful action is undertaken immediately.[26] As with all effective policies, targets should be adaptable to new evidence in a reasonable and precautionary manner.

- All countries should be party to this accord and it should include specific national and international commitments for action in pursuit of the agreed-upon target. Commitments for actions by individual countries should reflect differences in levels of economic development and GHG emissions patterns, and the principles of equity and common but differentiated responsibilities. The need for all regions of the world, including developing countries, to participate reflects the basic arithmetic of carbon emissions. The developing countries, as a group, will soon be the largest emitters of GHGs, though on a per capita basis the developed regions will still be far larger emitters. There is no prospect for stabilization of GHGs unless all countries with major emissions are actively committed to that goal.[27]

- In accordance with the principles of equity and common but differentiated responsibilities, the global agreement should include specific mechanisms for industrialized countries to take leadership roles related to emission reductions, such as developing, demonstrating, and deploying low- and zero-carbon emission energy technologies and CCS systems and/or providing appropriate assistance to developing countries to help them adopt low-carbon energy systems (for example, by creating a new sustainable energy fund to support the introduction of low- and zero-carbon emitting energy technologies in low-income countries). Continued and effective support should also be provided to the Clean Development Mechanism (CDM) and related initiatives.[28] Deeper and wider mutual understanding between developed and developing countries should be promoted in order to realize these mechanisms. Developed countries should appreciate the special challenges faced by poorer countries in combining economic development with GHG mitigation, and the historical patterns of GHG emissions.[29]

- Clear and efficient mechanisms are needed to place an appropriate market price on carbon emissions at the national and international level.[30] The price on carbon emissions should be reasonably consistent across sectors and worldwide. Establishing such a market price (via tradable emission credits, permits, incentives, taxes, and/or other measures) is needed to reward efficiency and emission avoidance, encourage innovation, help induce energy producers and consumers to choose low- and zero-emission technologies, create a level playing field across technology options, and, thereby, reduce the overall (system-wide) cost of de-carbonization.[31] The most successful policies will give a clear price signal for many years into the future.

- Energy efficiency and timely de-carbonization should be pursued in all major economic sectors and include sector-appropriate mixtures of performance standards, market mechanisms, and incentives to discourage the creation of additional high-carbon emission energy production and encourage low- and zero-carbon emission energy technologies. Businesses should be allowed to choose among a wide range of options, locally and globally, as they strive to minimize both GHG emissions and costs. Subsidies and other policies that encourage the use of high-carbon emission technologies, especially without provisions for CCS, or that discourage non-carbon, renewable energy sources, should be carefully reviewed and generally eliminated.

- Incentive schemes and policy mechanisms should not inadvertently work against early actions by companies, for example by inappropriately “raising the bar” on companies that have taken mitigation actions ahead of policy changes. Indeed, policy makers should make efforts to encourage rather than discourage such early actions.

- Carbon emissions from deforestation, which represent a significant portion of total global emissions, should be addressed. Incentives to protect forests should be included in relevant international and national policy mechanisms. These efforts should include providing appropriate financial incentives and emissions credits to developing countries that reduce CO_2 emissions by protecting tropical forests.[32]

- Land management patterns can have an important impact on net emissions of CO_2, methane, and nitrous-oxide. Public policies should provide incentives to implement land management practices that reduce net greenhouse gas emissions or augment the carbon content of soils.

- Governments should support, through direct funding or incentives for the private sector, major increases in research, development, and deployment (RD&D) of advanced non-carbon energy technologies. Targets for increased RD&D could include (but are not limited to): solar photovoltaic, solar thermal power, geo-thermal, tidal, wave, and/or nuclear energy (including safety, waste storage and proliferation issues); CCS; improved land management; and sustainable transportation (e.g. bio-fuels, hybrid technologies, fuel-cell technology, and/or lightweight design).[33] Special demonstration programs and other kinds of public policies (e.g. supportive regulations) should be adopted to enable promising new technologies and practices to reach the market expeditiously. Such programs will be of special importance in the rapidly industrializing developing countries.[34]

- Green building standards and incentives should be expanded and efforts to reduce energy use through green building initiatives should be supported at the public and private level. Efforts to reduce global emissions of methane from landfills should be expanded, including increased use of waste-to-energy facilities where appropriate and cost-effective. Policies that encourage or include provisions for GHG offsets (projects funded by industries, businesses, institutions or individuals in order to compensate for their GHG emissions in other areas), should ensure that all GHG offsets are real, verifiable, additional and quantifiable.

- Public-private councils should be formed in key sectors (for example, electricity production, cement, steel, petrochemicals, commercial building, and others) to assist the formulation, promotion, and adoption of standards for safety, efficiency, and consumer acceptability of key sustainable energy technologies. Such councils should include key stakeholders, such as policy-makers, business leaders, trade unions, consumer groups, and civil society.[35]

- Efforts should be undertaken to prepare for and adapt to the impacts of climate change. Many of these impacts will fall most heavily on the poorest and most vulnerable communities and in developing countries with the least ability to adapt. Technical and financial assistance will be needed by particularly vulnerable, low-income developing countries to meet their mounting adaptation needs. Mitigation and adaptation efforts need to be part of a coherent dual strategy. Effective climate adaptation will require stronger efforts within international climate agreements as well among development agencies, the private sector, and non-governmental organizations.

Our Climate Responsibility

Each company and institution, as well as each government, has the opportunity and responsibility to address climate change. This responsibility can be fulfilled in a variety of ways, which will differ depending on the nature of the business or organization. In this spirit, and in recognition of the importance and immediacy of this issue, we commit ourselves to pursuing the following measures and invite others to do likewise:

- Publicly supporting the global scientific processes that underpin international decision making with regard to climate change, including the IPCC.

- Advocating responsible climate and energy policies, including globally agreed-upon targets for stabilizing GHG levels in the atmosphere; policies designed to achieve these targets; increased research, development, and deployment of new technologies; and enactment of supportive market mechanisms and other policies.

- Helping to communicate information on climate change solutions, including energy efficiency, life-cycle thinking, and other options, to customers, suppliers, employees, and the public.

- Monitoring and reporting information on our annual emissions of greenhouse gases.

- Adopting clear goals and policies on our GHG emissions and engaging in appropriate GHG emissions mitigation efforts and programs, which could include participation in emissions trading schemes, offsets, CDM, or other mechanisms.

- Incorporating climate change and GHG emissions into relevant business management decision making, and communicating such actions to key stakeholders, such as investors, employees, suppliers, and customers.

- Examining the potential for advanced commercial and residential building designs and new energy technologies that result in lower greenhouse gas emissions when constructing new facilities or retrofitting existing facilities.

- Providing leadership in industry associations, trade unions, and other organizations appropriate to our company or institution to promote the adoption of climate change standards in each sector.

- Supporting demonstration projects and other activities that test, scale, or promote technologies, policies, or other programs that seek to mitigate climate change and its impacts.[36]

Affirmation

This statement seeks to help build consensus on the urgency and interconnected importance of adopting realistic government and corporate policies to address climate change and to build sustainable energy systems. It is neither a contract nor a formal policy proposal, but rather a brief, plain-language contribution to what we believe needs to be a serious global conversation and commitment for action. In this spirit, we endorse this statement and welcome others to join us.[*]

Participants in the Global Roundtable on Climate Change[37]

[To be completed upon publication]

Additional Endorsements[38]

[To be completed upon publication]

[*] Titles and affiliations for individuals listed for identification purposes only. Affirmation is not considered legally binding to a particular policy position or course of action but an indication of support for the general consensus expressed in the document.

Notes and References

Although not a technical document, we have chosen to provide references or additional details for particular statements details contained in this document in order to demonstrate their mainstream status among experts in relevant fields.

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[1] Broad scientific consensus exists concerning the fact that human activities, particularly loading the atmosphere with carbon dioxide (CO_2) from the burning of fossil fuels and deforestation, as well as emissions of other greenhouse gases (GHGs), such as methane and nitrous oxide, are ultimately responsible for much of the increase in global temperatures observed over the last century as well as the associated and increasingly visible and troubling impacts of climate change. The 2007 Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) provides the most authoritative review of this issue.

Existing public expression of this consensus includes statements by the national science academies of Australia, Belgium, Brazil, Canada, China, France, Germany, India, Indonesia, Ireland, Italy, Japan, Malaysia, Netherlands, New Zealand, Russia, Sweden, Turkey, the United Kingdom and the United States, reports by IPCC, the Arctic Climate Impact Assessment, the International Climate Change Taskforce (ICCT), and statements and findings by other international, national and regional scientific and political bodies.

For examples of the views of the national science academies see: National Science Academies of the G8 plus the National Science Academies of Brazil, China and India. (2005) *Joint Science Academies' Statement: Global Response to Climate Change*. Accessed 22 May 2006 at http://www.fco.gov.uk/Files/kfile/PostG8ClimChaAcademies.pdf; National Academy of Sciences (U.S.) Committee on the Science of Climate Change. (2001) Climate Change Science: An Analysis of Some Key Questions. (Washington, D.C.: National Academy Press.) p. 1 (also available online at available at: http://newton.nap.edu/html/climatechange/summary.html); The science of climate change. (2001) Editorial, signed by 17 national science academies. Science 292 (5520): 1261.

For the IPCC, see: Intergovernmental Panel on Climate Change (IPCC). (2001) *Climate Change 2001: Synthesis Report, Summary for Policymakers.* (Wembley, United Kingdom.) p. 5; Giles, J. (2006) U.S. posts sensitive climate report for public comment. *Nature* 4 May 2006: 6-7; IPCC. *1995 Assessment*. (Cambridge: Cambridge University Press.) For the Arctic Climate Impact Assessment, which was sponsored by the governments of Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the U.S., see: Impacts of a Warming Arctic: Arctic Climate Impact Assessment. (2004) Executive Summary, p. 8-9. (Cambridge: Cambridge University Press.) The report and additional information is available via the website of the Arctic Climate Impact Assessment at www.acia.uaf.edu. For the International Climate Change Taskforce, see: International Climate Change Taskforce. (2005) Meeting the Climate Challenge.

Available online at http://snowe.senate.gov/icctreport.pdf and http://www.whrc.org/resources/published_literature/pdf/ByersetalInstPubPolRes.1.05.pdf

For statements by other prominent scientific bodies and government groups that review scientific reports, see: Development and Environment Ministers of OECD Member Countries. (2006) *Declaration on Integrating Climate Change Adaptation into Development Cooperation*. (Paris, OECD Headquarters.) 4 April 2006, preamble and para. 1; U.S. Climate Change Science Program, Synthesis and Assessment Product 1.1. (2006) *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences*; United Kingdom, Parliamentary Office of Science and Technology. (2005) *Rapid Climate Change*. (London) p.1-4; American Geophysical Union Position Statement on Human Impacts on Climate. (2003) Reprinted in *Eos* 84 (51): 574; Showstack, R. (2003) Climate Change Statements Highlight Human Influence. *Eos* 84 (51): 574; American Meteorological Society. (2003) *Bulletin of the American Meteorological Society*. Vol. 84: 508; Oreskes, N. (2004) The Scientific Consensus on Climate Change. *Science* 306: 1686.

A number of business, civil society and religious groups have also issued statements on the serious threat posed by climate change, and the need to take action. Representative examples include: Evangelical Climate Initiative. (2006) *Climate Change: An* Evangelical Call to Action. Accessed 17 October 2006 at http://christiansandclimate.org/pub/statement-booklet.pdf; World Council of Churches. (2005) Statement to the high-level segment of the UN Climate Change conference. See also: A statement from the World Council of Churches (WCC) to the High-Level Ministerial Segment of the UN Climate Conference in Nairobi. Statements available at http://www.oikoumene.org/en/home.html; United States Conference of Bishops. (2001) Global climate change: A plea for dialogue, prudence, and the common good. Accessed 17 October 2006 at www.usccb.org/sdwp/international/globalclimate.htm; Corporate Leaders Group on Climate Change. (2006) 2006 Letter to the Prime Minister. Accessed 17 October 2006 at http://www.cpi.cam.ac.uk/bep/clgcc/letter_2006.htm; Institutional Investors Group on Climate Change. (2006) Investor Statement on Climate Change. Accessed 17 October 2006 at www.iigcc.org; Claussen, E., and Davis, G., Chairs. (2005) International Climate Efforts Beyond 2012: Report of the Climate Dialogue at Pocantico. (Washington, D.C.: Pew Center on Global Climate Change); Clinton Global Initiative First Year Report. Accessed 17 October 2006 at http://www.clintonglobalinitiative.org/pdf/annual_report/CGIReportFeb-01-2006.pdf; World Business Council on Sustainable Development. (2004) Facts & trends to 2050: Energy and climate change. Accessed 17 October 2006 at www.wbcsd.org; and the International Climate Change Taskforce. (2005).

Anthropogenic emissions of CO_2 – from fossil fuels use, cement production, land use change and forestry – are the most important anthropogenic GHG due to the relative size of the emissions (nearly 75 %) and the expected future growth of these emissions in the absence of effective action. Other notable GHGs include methane (CH_4, about 4% from land-filling of municipal solid wastes and about 11% from other sources) nitrous oxide

(N_2O, about 9%) and a variety of fluorinated gases including perfluorocarbons (PFCs), chlorofluorocarbons (CFCs and their related replacement halocarbons, HCFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF_6). Methane and the other gases have far higher Global Warming Potentials (GWPs) than does CO_2. GWP is a measure of how much a given mass of gas is estimated to contribute to global warming.

It is well known that, historically, the vast majority of anthropogenic GHG emissions have come from the wealthier nations although rapidly industrializing developing countries now emit very substantial amounts as well and may surpass the emissions of developed countries by 2015. The United States emits the most CO_2 on an aggregate and per-capita basis. China is expected to pass the United States in national CO_2 emissions sometime this decade but, like developing nations in general, it is well behind in per-capita emissions.

For detailed information, compare data and sources in: US EPA (2000), Global Greenhouse Gas Data available at http://www.epa.gov/climatechange/emissions/globalghg.html; United Nations Framework Convention on Climate Change (2003), Greenhouse Gas Inventory Data available at http://ghg.unfccc.int/index.html; World Resources Institute, Earth Trends: Climate and Atmosphere Searchable Database available at http://earthtrends.wri.org/searchable_db/index.php?theme=3; and for a directory to other Earth science data and services see NASA Goddard Space Flight Center, Global Change Master Directory: Atmosphere at http://gcmd.gsfc.nasa.gov/index.html.

[2] Ibid. See also, as indicative examples: Schellnhumber et al. (2006) Avoiding Dangerous Climate Change. (Cambridge: Cambridge University Press); Epstein, P., and Mills, E. (2005) Climate Change Futures: Health, Ecological and Economic Dimensions. *The Center for Health and the Global Environment*, Harvard Medical School; Patz, J.A., et al. (2005) Impact of regional climate change on human health. *Nature* 4387066: 310-317.

[3] 1992 United Nations Framework Convention on Climate Change, Article 2, Objective. For the text of the Convention and a list of the 189 countries which have ratified it into international law, see the website of the Convention Secretariat at http://unfccc.int/.

[4] This is widely acknowledged. For a recent analysis, see McKinsey Global Institute (2006). Productivity of growing global energy demand: A microeconomic perspective. (San Francisco: McKinsey and Company) p. 14-23.

[5] For discussion of how energy production and demand, the key drivers of CO_2 emissions under current conditions, are expected to continue growing at significant rates, see also International Energy Agency (2006), *World Energy Outlook 2006*. Cedex, France: OECD/IEA. Schmalensee, R., Stoker, T.M., and Judson, R.A. (1998). World carbon dioxide emissions: 1950-2050. *The Review of Economics and Statistics*, 80(1), 15-27.

[6] This is an indicative list of non-fossil-fuel-based energy sources, as are similar lists in this document. This statement endorses a significant increase in the use of non-fossil-fuel technologies but does not take a position on which technologies should or should not be used.

[7] Although still in the early stages, ongoing work suggests that it might prove feasible to extract CO_2 directly from the air for sequestration. This would make CCS possible wherever conditions are most favorable, where the CCS facilities would not pose environmental risks, and where the permitting, construction and operational costs would be relatively low. For a preliminary discussion, see Abanades, et al. *IPCC Special Report: Carbon Capture and Storage – Summary for Policymakers*. IPCC, 2005. pp 12-13.)

[8] It is well known that coal is the most abundant fossil fuel, with known global reserves that could last for at least another two centuries at current rates of production. Coal reserves are also widely distributed, and vary significantly from those of oil and gas, with very significant reserves found in the United States, Russia, China, India, Australia, Germany and South Africa. For a concise overview, see Energy Information Agency, US Department of Energy (2006), *The International Energy Outlook 2006* (IEO2006). Report # :DOE/EIA-0484(2006). Also available online. Accessed 17 October 2006 at http://www.eia.doe.gov/oiaf/ieo/index.html. See also International Energy Agency (2006), International Energy Agency (2006), World Energy Outlook 2006. Chapter 5. Paris: OECD/IEA. p. 80.

[9] As noted, avoiding “dangerous anthropogenic interference” is a stated objective of the 1992 United Nations Framework Convention on Climate Change.

[10] See, for example: IPCC. (2001) p. 5; National Science Academies’ of the G8 plus the National Science Academies of Brazil, China and India. (2005); Keeling, C.D. and Whorf, T.P. (2005) Atmospheric carbon dioxide records from sites in the SIO air sampling network. In: *U.S. Department of Energy*, Trends: A compendium of data on global change. (Oak Ridge: U.S. Department of Energy.)

[11] Representative examples include: Gregory, J.M., Huybrechts, P., and Raper, S. (2004) Climatology: Threatened loss of the Greenland ice-sheet. *Nature* 428: 616; Hansen, J. (2004) Defusing the global warming time bomb. *Scientific American* 290 (3): 68-77; O’Neill, B.C., and Oppenheimer, M. (2002) Dangerous Climate Impacts and the Kyoto Protocol. *Science* 296: 1972; Parry, M., Arnell, N., et al. (2001) Millions at risk: defining critical climate change threats and targets. *Global Environmental Change- Human and Policy Dimensions* 11 (3): 181-183; Azar, C., and Rodhe, H. (1997) Targets for stabilization of atmospheric CO_2. *Science* 276: 1818-1819.

[12] Many scientist now accept that $2XCO_2$ will lead to about a 3˚C temperature increase as the best available working estimate (for information on this regard, see Giles (2006)). The 2007 IPCC Assessment Report discusses this point directly. Currently, many experts

indicate that the potential for dangerous anthropogenic interference with the climate system increases rapidly as warming moves significantly above 2 degrees Celsius from pre-industrial levels (see, for example, IPCC (2001), p. 9). Maintaining a low probability of the largest and most destabilizing disruptions would therefore indicate setting a prudent, science-based CO_2 stabilization target at levels below those associated with warming greater than 2 degrees Celsius or well below $2XCO_2$. For similar conclusions or supporting analysis, see: International Climate Change Taskforce (2005), p.3 (available at http://snowe.senate.gov/icctreport.pdf). Stern, N. (2006) Stern Review: The Economics of Climate Change. Executive Summary, p. xvii. Accessed 30 October 2006 at http://www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf; Den Elzen, M.G.J., and Meinshausen, M. (2005) Meeting the EU 2oC climate target: Global and regional emission implications. Environmental Assessment Agency, p. 6. (Bilthoven, Netherlands: Netherlands); Meinshausen, M. (2006) What does a 2oC target mean for greenhouse gas concentrations? In: Schellnhumber et al. (2006) Avoiding Dangerous Climate Change. (Cambridge: Cambridge University Press). Baer, P. (2004) Probabilistic analysis of climate stabilization targets and the implications for precautionary policy. Paper presented at the American Geophysical Union Annual Meeting, 17 December 2004, San Francisco, available online through the Smithsonian/NASA ADS Physics Abstract Service. Accessed 21 November 2006 at http://adsabs.harvard.edu/abs/2004AGUFMPA52A..03B. For an accessible explanation of climate sensitivity, the relationship between atmospheric CO2 concentrations and global average temperature, see: UK Met Office, Exeter. (2005) Stabilizing climate to avoid dangerous climate change: A summary of relevant research by the Hadley Center. p. 14-15.

[13] See, for example, Stern, N. (2006) Executive Summary, p. iv and xiv. For information on the full range of future emission scenarios see: Intergovernmental Panel on Climate Change (2001) Third Assessment Report. *Climate Change 2001: Synthesis Report*, Summary for Policymakers. p. 10-11. Accessed 30 October 2006 at http://www.ipcc.ch/pub/un/syreng/spm.pdf; IPCC Working Group 1. (2001) Climate Change 2001: The Scientific Basis, Summary for Policymakers. p. 14. Accessed 30 October 2006 at http://www.ipcc.ch/pub/spm22-01.pdf.

[14] See also International Energy Agency (2006), *World Energy Outlook 2006*. p. 80. These are global figures and terms are those used by the International Energy Agency. For the United States, the US Department of Energy estimates that in 2004, the electric power sector accounted for 39 percent of total U.S. energy-related carbon dioxide emissions, the transportation sector, 33 percent, and the industrial sector 29 percent. US Department of Energy (20056) *Emissions of Greenhouse Gases in the United States 2005*, Report number: DOE/EIA-0573(20062004). Accessed 27 October 2006 at http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html. For additional on the availability of emission reductions in these sectors see International Energy Agency (2006), *Energy Technology Perspectives 2006*. Available at http://www.iea.org/textbase/nppdf/stud/06/enertech2006.pdf

[15] For discussion, see: Davidson, O., Metz, B., et al. (2001) Climate Change 2001: Mitigation- The Contribution of Working Group III to the Third Assessment Report of the IPCC. *IPCC* Chapter 3. Accessed 17 October 2006 at http://www.grida.no/climate/ipcc_tar/wg3/089.htm; Morgan, G., Apt, J., et al. (2005) The US Electric Power Sector and Climate Change Mitigation. *Pew Center on Global Climate Change*).

[16] Such benefits include increasing the market for renewable energy and other mitigation technologies and providing power in non-electrified or under-served rural areas to pump water, increase lighting, enhance schools, and power radios, phones, computers and small businesses.

[17] For example, commercial and residential buildings account for 38% of CO2 emissions, in the United States, when the impact from energy consumption is included (U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *2006 Buildings Energy Data Book.* The U.S. Green Building Council (USGBC), estimates that in the United States, buildings account for: 36% of total energy use; 65% of electricity consumption; 30% of greenhouse gas emissions; 30% of raw materials use; 30% of waste output (approximately 136 million tons annually); and 12% of potable water consumption. This information and links to a large number of detailed research reports are available via the USGBC website at www.usgbc.org.

[18] An increasing referenced example of such standards is the "Leadership in Energy & Environmental Design" Green Building Rating System (LEED).

[19] International Energy Agency (2006), *World Energy Outlook 2006*; p 43 and 193-314.

[20] The relevance of life-cycle thinking in this regard is increasingly recognized. Indicative examples from intergovernmental contexts include: Point 11 in the in the Malmö Ministerial Declaration agreed by governments during the First Global Ministerial Environment Forum in Malmö, Sweden, May 2000 (available at http://www.unep.org/malmo/malmo_ministerial.htm) and relevant elements of the 10-year program framework of programmes to promote sustainable consumption and production patterns agreed to at 2002 World Summit on Sustainable Development (see Report of the World Summit on Sustainable Development: Johannesburg, South Africa, 26 August-4 September 2002. Section III: Changing unsustainable patterns of consumption and production, point 15(a). Report available at http://daccessdds.un.org/doc/UNDOC/GEN/N02/636/93/PDF/N0263693.pdf?OpenElement). Additional information on life cycle thinking can be found via the UNEP's Production and Consumption Branch: Sustainable Consumption website at http://www.uneptie.org/pc/sustain/lcinitiative/background.htm.

[21] Examples of supporting analyses include: Hourcade, J., and Shukla, P., et al. (2006) Climate Change 2001: Third Assessment Report: Mitigation. *Intergovernmental Panel on Climate Change* Chapter 8, p. 1; Stern, N. (2006) Stern Review: The Economics of

Climate Change. Executive Summary, p. xii, xiii, and xiv. International Energy Agency (2006), *World Energy Outlook 2006*; p 43 and 193-314.

[22] For example, see: Rubin, E.S. et al. (1992). Realistic Mitigation Options for Global Warming. *Science*. 257: 264. Again, please note that these figures, as well as those in the next sentence, are offered only as indicative examples of the probable reasonableness of costs of addressing climate change, particularly in comparison to the probable costs of inaction, not as firm conclusions or policy recommendations.

[23] For example, see: Stern, N. (2006) Stern Review: The Economics of Climate Change. Executive Summary, p. xvii. Accessed 30 October 2006 at http://www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf; Wiser, R., and Bolinger, M. (2004) An Overview of Alternative Fossil Fuel Price and Carbon Regulation Scenarios. *Lawrence Berkeley National Laboratory*. Accessed 26 October 2006 at http://eetd.lbl.gov/EA/EMP; Springer, U. (2003) The Market for Tradable GHG Permits Under the Kyoto Protocol: A Survey of Model Studies. *Energy Economics* 25: 527-551. As noted above, these figures are offered only as indicative examples not as firm conclusions or policy recommendations.

[24] 1992 United Nations Framework Convention on Climate Change, Article 2, Objective. For the text of the Convention, see the website of the Convention Secretariat at, http://unfccc.int/.

[25] The IPCC was established in part to provide authoritative information on climate change, independent of any one government, to inform policy makers devising individual and collective policy. Governments participating in negotiations under the Framework Convention on Climate Change agreed that their deliberations on targets and commitments beyond the time-frame of the Kyoto Protocol should be informed by the work of the IPCC and other scientific studies of the causes and impacts of climate change and potential mitigation and adaptation strategies, including economic and social factors.

[26] Please note that signatories to this statement have not agreed, nor do we seek to propose, particular final or interim targets for atmospheric GHG concentrations. We do agree that such targets need to be set, that they should be based on the best scientific information available, that they should be linked to serious, ambitious national and international policies designed to achieve them, and that they should be adjusted in a precautionary manner as we learn more about both climate change and the costs and benefits of various mitigation strategies.

[27] Article 3 of the UNFCCC delineates a series of principles, agreed to by more than 180 governments, that underlie the Convention and, by extension, any related policy protocol. These include the principles of equity and common but differentiated responsibilities, taking into account the respective capabilities of Parties, recognizing the specific needs and special circumstances of developing country Parties, noting that developed country Parties should take the lead in combating climate change, the right and responsibility of

Parties to promote sustainable development, and other issues. Realistic political analysis suggests that these principles must be taken into account when considering global policy options or achieving climate stability. At the same time, GHG emissions in many rapidly-industrializing developing countries are increasing rapidly. The developing countries, as a group, will soon be the largest emitters of GHGs, though on a per capita basis the developed regions will still be far larger emitters and are responsible for the vast majority of historical emissions. Thus, realistic analysis of the climate change issue suggests that all major emitters of GHG must be part of a global climate policy or it will not succeed in stabilizing GHGs. This joint statement acknowledges both the reality of the carbon arithmetic and the principle of common but differentiated responsibilities and other principles agreed to under the UNFCCC.

[28] CDM is a flexibility mechanism under the Kyoto Protocol which allows industrialized countries with binding greenhouse gas reduction commitment (often called Annex 1 countries) to invest in GHG emission reduction projects in developing countries. Verified reductions from such projects can help an Annex 1 country meet its reduction commitments under the Protocol. When successful, CDM and similar mechanisms can help lead to more total GHG emission reductions at less overall cost while helping to increase the availability of low- and zero-carbon emission energy systems to developing countries.

[29] See Footnote 1 on the patterns of GHG emissions including historical emissions from today's developed countries.

[30] For extensive discussion of this point see: Stern, N. (2006) Chapters 14-17; Stern, N. (2006) Stern Review: The Economics of Climate Change. Executive Summary, p. xvii. Accessed 30 October 2006 at http://www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf..

[31] Please note that the statement does not necessarily endorse using any particular mechanism. Those endorsing this statement agree on the importance of establishing a price but hold different views regarding which of these mechanisms should be used.

[32] Reducing deforestation also yields important ancillary benefits, including but not limited to biodiversity protection.

[33] This list is indicative. Inclusion on the list does not imply that all participants necessarily support RD&D for each technology or that a given technology is not used today or requires RD&D to become more widely used. Absence from the list does represent an opinion on the propriety of providing incentives for further improvement, or the potential for expanded deployment, of proven technologies such as wind, IGCC, co-generation, waste-to-energy, and green-building.

[34] An international example of such an effort is the Asia-Pacific Partnership on Clean Development and Climate < http://www.asiapacificpartnership.org/> whose founding

partners, the governments of Australia, China, India, Japan, Republic of Korea, and the United States have agreed to work together and with private sector partners to accelerate the development and deployment of clean energy technologies.

[35] One example of analogous consultations involving trade unions and business experts is the OECD Labour/Management Programme, including the 1 March 2006, *Joint Meeting of Management and Trade Union Experts on Implementing the OECD Environmental Strategy*. See: www.oecd.org and http://www.oecd.org/document/36/0,2340,en_2649_201185_36256932_1_1_1_1,00.html#

[36] Indicative examples of demonstration projects involving Roundtable participants and that enjoy the general endorsement of the Roundtable will be listed at www.grocc.org.

[37] Titles and affiliations for individuals listed for identification purposes only. Endorsement of this statement by a Roundtable participant is not considered legally binding with regard to a particular policy position or course of action but an indication of support for the general consensus expressed in this document. Participation in the Global Roundtable on Climate Change on its own does not imply support for this statement.

[38] Titles and affiliations for individuals listed for identification purposes only. Endorsement of this statement by individuals not participating in the Roundtable is not considered legally binding with regard to a particular policy position or course of action but an indication of support for the general consensus expressed in this document.