

Headed toward the danger zone

Human activity is warming the planet. For the past millennium the Earth's average temperature varied within a range of less than 0.7°C (shown in green); however, man-made greenhouse gas emissions have resulted in a dramatic increase in the planet's temperature over the past century (shown in yellow). The projected future increase over the next 100 years (shown in red) due to growing emissions could possibly warm the planet by 5°C relative to the preindustrial period. Such warming has never been experienced by mankind and the resulting physical impacts would severely limit development. Only through immediate and ambitious actions to curb greenhouse gas emissions may dangerous warming be avoided.

The evolution of the planet's temperature for the past 1,000 years is based on a range of proxy estimates (such as tree ring analysis or ice core sampling) that define the envelope of long-term temperature variation. With modern weather observations starting in the nineteenth century, global temperature could be estimated more precisely; thermometer

data for the past 150 years or so document a global temperature increase of nearly 1°C since the preindustrial period. Global climate models that estimate the effect of different future emission scenarios on Earth's climate predict a range of possible global temperatures for this century. These estimates show that even the most aggressive mitigation efforts may lead to warming of 2°C or more (a level already considered dangerous), and most models project that less mitigation would lead to warming of 3°C or even up to 5°C and beyond (though with less certainty around these higher amounts of warming).

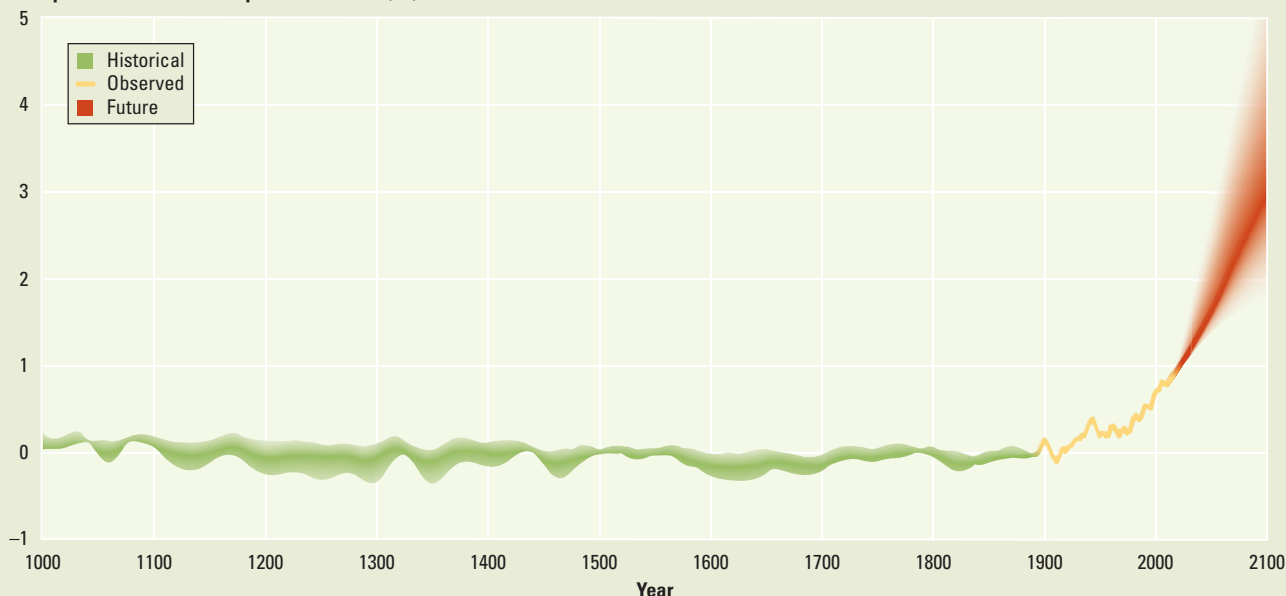
The three globes on the cover are composites of data collected by satellites during the summer months of 1998 through 2007. The colors of the ocean represent chlorophyll concentration, which is a measure of the global distribution of oceanic plant life (phytoplankton). Deep blue colors are areas of low chlorophyll concentration while green, yellow, and red indicate ever higher concentration. The colors on land show vegetation, with whites, browns, and tans representing

minimal vegetative cover and light greens through dark greens indicating ever more dense vegetation. Biological processes on land and in the oceans play a key role in regulating Earth's temperature and carbon cycle, and information such as presented in these global maps is essential to manage limited natural resources in an increasingly populous world.

Sources:

- Jones, P. D., and M. E. Mann. 2004. "Climate Over Past Millennia." *Reviews of Geophysics* 42(2): doi:10.1029/2003RG000143.
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Temperature relative to the preindustrial era (°C)



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Foreword

Climate change is one of the most complex challenges of our young century. No country is immune. No country alone can take on the interconnected challenges posed by climate change, including controversial political decisions, daunting technological change, and far-reaching global consequences.

As the planet warms, rainfall patterns shift and extreme events such as droughts, floods, and forest fires become more frequent. Millions in densely populated coastal areas and in island nations will lose their homes as the sea level rises. Poor people in Africa, Asia, and elsewhere face prospects of tragic crop failures; reduced agricultural productivity; and increased hunger, malnutrition, and disease.

As a multilateral institution whose mission is inclusive and sustainable development, the World Bank Group has a responsibility to try to explain some of those interconnections across disciplines—development economics, science, energy, ecology, technology, finance, and effective international regimes and governance. With 186 members, the World Bank Group faces the challenge, every day, of building cooperation among vastly different states, the private sector, and civil society to achieve common goods. This 32nd *World Development Report* seeks to apply that experience, combined with research, to advance knowledge about *Development and Climate Change*.

Developing countries will bear the brunt of the effects of climate change, even as they strive to overcome poverty and advance economic growth. For these countries, climate change threatens to deepen vulnerabilities, erode hard-won gains, and seriously undermine prospects for development. It becomes even harder to attain the Millennium Development Goals—and ensure a safe and sustainable future beyond 2015. At the same time, many developing countries fear limits on their critical call to develop energy or new rules that might stifle their many needs—from infrastructure to entrepreneurship.

Tackling the immense and multidimensional challenge of climate change demands extraordinary ingenuity and cooperation. A “climate-smart” world is possible in our time—yet, as this Report argues, effecting such a transformation requires us to act now, act together, and act differently.

We must act now, because what we do today determines both the climate of tomorrow and the choices that shape our future. Today, we are emitting greenhouse gases that trap heat in the atmosphere for decades or even centuries. We are building power plants, reservoirs, houses, transport systems, and cities that are likely to last 50 years or more. The innovative technologies and crop varieties that we pilot today can shape energy and food sources to meet the needs of 3 billion more people by 2050.

We must act together, because climate change is a crisis of the commons. Climate change cannot be solved without countries cooperating on a global scale to improve energy efficiencies, develop and deploy clean technologies, and expand natural “sinks” to grow green by absorbing gases. We need to protect human life and ecological resources. We must act together in a differentiated and equitable way. Developed countries have produced most of the emissions of the past and have high per capita emissions. These countries should lead the way by significantly reducing their carbon footprints and stimulating research into

green alternatives. Yet most of the world's future emissions will be generated in the developing world. These countries will need adequate funds and technology transfer so they can pursue lower carbon paths—without jeopardizing their development prospects. And they need assistance to adapt to inevitable changes in climate.

We must act differently, because we cannot plan for the future based on the climate of the past. Tomorrow's climate needs will require us to build infrastructure that can withstand new conditions and support greater numbers of people; use limited land and water resources to supply sufficient food and biomass for fuel while preserving ecosystems; and reconfigure the world's energy systems. This will require adaptation measures that are based on new information about changing patterns of temperature, precipitation, and species. Changes of this magnitude will require substantial additional finance for adaptation and mitigation, and for strategically intensified research to scale up promising approaches and explore bold new ideas.

We need a new momentum. It is crucial that countries reach a climate agreement in December in Copenhagen that integrates development needs with climate actions.

The World Bank Group has developed several financing initiatives to help countries cope with climate change, as outlined in our Strategic Framework for Development and Climate Change. These include our carbon funds and facilities, which continue to grow as financing for energy efficiency and new renewable energy increases substantially. We are trying to develop practical experience about how developing countries can benefit from and support a climate change regime—ranging from workable mechanisms to provide incentives for avoided deforestation, to lower carbon growth models and initiatives that combine adaptation and mitigation. In these ways, we can support the UNFCCC process and the countries devising new international incentives and disincentives.

Much more is needed. Looking forward, the Bank Group is reshaping our energy and environment strategies for the future, and helping countries to strengthen their risk management practices and expand their safety nets to cope with risks that cannot be fully mitigated.

The *2010 World Development Report* calls for action on climate issues: If we act now, act together, and act differently, there are real opportunities to shape our climate future for an inclusive and sustainable globalization.



Robert B. Zoellick
President
The World Bank Group

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Rebecca Sugui served as senior executive assistant to the team—her 17th year with the *WDR*—Sonia Joseph and Jason Victor as program assistants, and Bertha Medina as team assistant. Evangeline Santo Domingo served as resource management assistant.

Abbreviations and Data Notes

Abbreviations

AAU	assigned amount unit
ARPP	Annual Report on Portfolio Performance
BRIICS	Brazil, the Russian Federation, India, Indonesia, China, and South Africa
Bt	<i>Bacillus thuringiensis</i>
CCS	carbon capture and storage
CDM	Clean Development Mechanism
CER	certified emission reduction
CGIAR	Consultative Group on International Agricultural Research
CIPAV	Centro para Investigación en Sistemas Sostenibles de Producción Agropecuaria
CH ₄	methane
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
CPIA	Country Policy and Institutional Assessment
CTF	Clean Technology Fund
EE	energy efficiency
EIT	economies in transition
ENSO	El Niño–Southern Oscillation
ESCO	energy service company
ETF–IW	Environmental Transformation Fund–International Window
EU	European Union
FCPF	Forest Carbon Partnership Facility
FDI	foreign direct investment
FIP	Forest Investment Program
GCCA	Global Climate Change Alliance
GCS	global climate services enterprise
GDP	gross domestic product
GEO	Group on Earth Observation
GEOS	Global Earth Observation System of Systems
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	greenhouse gas
GM	genetically modified
Gt	gigaton
GWP	global warming potential
IAASTD	International Assessment of Agricultural Science and Technology for Development
IATAL	international air travel adaptation levy

IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IFCI	International Forest Carbon Initiative
IIASA	International Institute for Applied Systems Analysis
IMERS	International Maritime Emission Reduction Scheme
IPCC	Intergovernmental Panel on Climate Change
IPR	intellectual property rights
kWh	kilowatt-hour
JI	Joint Implementation
LDCF	Least Developed Country Fund
LECZ	low-elevation coastal zones
LPG	liquefied petroleum gas
MEA	multilateral environmental agreement
MRGRA	Midwestern Regional GHG Reduction Accord
MRV	measurable, reportable, and verifiable
NAPA	National Adaptation Program of Action
N ₂ O	nitrous oxide
NGO	nongovernmental organization
O ₃	ozone
O&M	operation and maintenance
OECD	Organisation for Economic Co-operation and Development
PaCIS	Pacific Climate Information System
ppb	parts per billion
PPCR	Pilot Program for Climate Resistance
ppm	parts per million
PPP	purchasing power parity
R&D	research and development
RD&D	research, development, and deployment
RDD&D	research, development, demonstration, and deployment
REDD	reduced emissions from deforestation and forest degradation
RGGI	Regional Greenhouse Gas Initiative
SCCF	Strategic Climate Change Fund
SDII	simple daily intensity index
SD-PAMs	sustainable development policies and measures
SO ₂	sulfur dioxide
SUV	sports utility vehicle
toe	tons of oil equivalent
TRIPS	Trade-Related Aspects of Intellectual Property Rights
Tt	trillion tons
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Collaborative Program on Reduced Emissions from Deforestation and forest Degradation
WCI	Western Climate Initiative
WGI	World Governance Indicator
WMO	World Meteorological Organization
WTO	World Trade Organization

Data notes

The countries included in regional and income groupings in this Report are listed in the Classification of Economies table at the end of the Selected World Development Indicators. Income classifications are based on gross national product (GNP) per capita; thresholds for income classifications in this edition may be found in the Introduction to Selected World Development Indicators. Figures, maps, and tables (including selected indicators) showing income groupings are based on the World Bank's income classification in 2009. The data shown in the Selected World Development Indicators are based on the classification in 2010. Group averages reported in the figures and tables are unweighted averages of the countries in the group, unless noted to the contrary.

The use of the word *countries* to refer to economies implies no judgment by the World Bank about the legal or other status of a territory. The term *developing countries* includes low- and middle-income economies and thus may include economies in transition from central planning, as a matter of convenience. The terms *industrialized countries* or *developed countries* may be used as a matter of convenience to denote high-income economies.

Dollar figures are current U.S. dollars, unless otherwise specified. *Billion* means 1,000 million; *trillion* means 1,000 billion.

Main Messages of the World Development Report 2010

Poverty reduction and sustainable development remain core global priorities.

A quarter of the population of developing countries still lives on less than \$1.25 a day. One billion people lack clean drinking water; 1.6 billion, electricity; and 3 billion, adequate sanitation. A quarter of all developing-country children are malnourished. Addressing these needs must remain the priorities both of developing countries and of development aid—recognizing that development will get harder, not easier, with climate change.

Yet climate change must urgently be addressed. Climate change threatens all countries, with developing countries the most vulnerable. Estimates are that they would bear some 75 to 80 percent of the costs of damages caused by the changing climate. Even 2°C warming above preindustrial temperatures—the minimum the world is likely to experience—could result in permanent reductions in GDP of 4 to 5 percent for Africa and South Asia. Most developing countries lack sufficient financial and technical capacities to manage increasing climate risk. They also depend more directly on climate-sensitive natural resources for income and well-being. And most are in tropical and subtropical regions already subject to highly variable climate.

Economic growth alone is unlikely to be fast or equitable enough to counter threats from climate change, particularly if it remains carbon intensive and accelerates global warming. So climate policy cannot be framed as a choice between growth and climate change. In fact, climate-smart policies are those that enhance development, reduce vulnerability, and finance the transition to low-carbon growth paths.

A climate-smart world is within our reach if we act now, act together, and act differently than we have in the past:

- **Acting now** is essential, or else options disappear and costs increase as the world commits itself to high-carbon pathways and largely irreversible warming trajectories. Climate change is already compromising efforts to improve standards of living and to achieve the Millennium Development Goals. Staying close to 2°C above preindustrial levels—likely the best that can be done—requires a veritable energy revolution with the immediate deployment of energy efficiency and available low-carbon technologies, accompanied by massive investments in the next generation of technologies without which low-carbon growth cannot be achieved. Immediate actions are also needed to cope with the changing climate and to minimize the costs to people, infrastructure and ecosystems today as well as to prepare for the greater changes in store.

- **Acting together** is key to keeping the costs down and effectively tackling both adaptation and mitigation. It has to start with high-income countries taking aggressive action to reduce their own emissions. That would free some “pollution space” for developing countries, but more importantly, it would stimulate innovation and the demand for new technologies so they can be rapidly scaled up. It would also help create a sufficiently large and stable carbon market. Both these effects are critical to enable developing countries to move to a lower carbon trajectory while rapidly gaining access to the energy services needed for development, although they will need to be supplemented with financial support. But acting together is also critical to advance development in a harsher environment—increasing climate risks will exceed communities’ capacity to adapt. National and international support will be essential to protect the most vulnerable through social assistance programs, to develop international risk-sharing arrangements, and to promote the exchange of knowledge, technology, and information.
- **Acting differently** is required to enable a sustainable future in a changing world. In the next few decades, the world’s energy systems must be transformed so that global emissions drop 50 to 80 percent. Infrastructure must be built to withstand new extremes. To feed 3 billion more people without further threatening already stressed ecosystems, agricultural productivity and efficiency of water use must improve. Only long-term, large-scale integrated management and flexible planning can satisfy increased demands on natural resources for food, bioenergy, hydropower, and ecosystem services while conserving biodiversity and maintaining carbon stocks in land and forests. Robust economic and social strategies will be those that take into account increased uncertainty and that enhance adaptation to a variety of climate futures—not just “optimally” cope with the climate of the past. Effective policy will entail jointly evaluating development, adaptation, and mitigation actions, all of which draw on the same finite resources (human, financial, and natural).

An equitable and effective global climate deal is needed. Such a deal would recognize the varying needs and constraints of developing countries, assist them with the finance and technology to meet the increased challenges to development, ensure they are not locked into a permanently low share of the global commons, and establish mechanisms that decouple where mitigation happens from who pays for it. Most emissions growth will occur in developing nations, whose current carbon footprint is disproportionately low and whose economies must grow rapidly to reduce poverty. High-income countries must provide financial and technical assistance for both adaptation and low-carbon growth in developing countries. Current financing for adaptation and mitigation is less than 5 percent of what may be needed annually by 2030, but the shortfalls can be met through innovative financing mechanisms.

Success hinges on changing behavior and shifting public opinion. Individuals, as citizens and consumers, will determine the planet’s future. Although an increasing number of people know about climate change and believe action is needed, too few make it a priority, and too many fail to act when they have the opportunity. So the greatest challenge lies with changing behaviors and institutions, particularly in high-income countries. Public policy changes—local, regional, national, and international—are necessary to make private and civic action easier and more attractive.