Center for a New American Security

Clout & Climate Change War Game
Participant Briefing Book

NEWSEUM
555 PENNSYLVANIA AVE NW
WASHINGTON, DC

July 27-30, 2008

Clout and Climate Change War Game
Participant Briefing Book

About the Briefing Book

In July 2008, the Center for a New American Security (CNAS), with a consortium of ten partner organizations, hosted "Clout and Climate Change," an international climate change "war game" to explore the national security implications of global climate change. CNAS provided this briefing book to participants in advance of the game, set in the year 2015, to prepare them for the event. Its contents, future scenarios based partially on open-source material and partially on climate modeling conducted by consortium partners, were intended to shape the game by providing a vision of the world in 2015 and key events that occur in the years leading up to that time.

You can also find a report of key findings from the event and materials generated from the game at www.cnas.org. The briefing book and game-derived materials should not be considered as facts or predictions, but rather plausible projections designed and tailored for the specific purpose of optimal game play.

We encourage researchers and educational institutions to use these materials. Please cite this briefing book as:

Sharon Burke and Christine Parthemore, eds., *Clout and Climate Change War Game: Participant Briefing Book* (Washington, D.C.: Center for a New American Security, 2008).

CNAS Game Material

Acknowledgements

Game materials, edited by Sharon Burke and Christine Parthemore of CNAS, include research, projections, and writing contributions from: Stefanie Garcia, Michael Horowitz, Alice Hunt, Jon-Claud Nix, Nirav Patel, Kevin Sullivan, and Michael Zubrow of CNAS; Jay Gulledge of the Pew Center on Global Climate Change; Andrew Jones, Tom Fiddaman, and Dr. Lori Siegel of the Sustainability Institute; Sebastian Graefe and Katherine Stainken of the Heinrich Böll Foundation North America; and the Oak Ridge National Laboratory team.

Table of Contents

Event and Contact Information

Table of Contents

NEWSEUM'S FREEDOM FORUM FIRST AMENDMENT CENTER
SIXTH STREET ENTRANCE
555 PENNSYLVANIA AVENUE, NW
WASHINGTON, D.C.

Clout and Climate Change Game Agenda

Sunday, July 27

6:00 – 6:30 p.m. COCKTAIL RECEPTION
Welcoming remarks by Dr. Kurt Campbell, CEO, CNAS
Honorable Sherri Goodman, General Counsel, CNA

6:30 – 9:00 p.m. EXCLUSIVE OPENING DINNER
A conversation with Honorable Carol Browner, Principal of the Albright Group, and General Chuck Wald (USAF ret)
Moderated by Sharon Burke, Senior Fellow, CNAS

Keynote address by Peter Schwartz
Co-Founder and Chairman, Global Business Network
Introduced by Dr. Kurt Campbell, CEO, CNAS

Monday, July 28

8:00 – 8:30 a.m. REGISTRATION & CONTINENTAL BREAKFAST

8:30 – 8:45 a.m. WELCOMING REMARKS
Dr. Kurt Campbell
CEO and Co-Founder, Center for a New American Security

8:45 – 9:00 a.m. INTRODUCTION OF KEYNOTE SPEAKER
Honorable John Podesta
CEO, Center for American Progress

9:00 – 9:45 a.m. KEYNOTE SPEAKER & Q&A
Dr. R.K. Pachauri, Director General
The Energy and Resource Institute and Chairman
United Nations Intergovernmental Panel on Climate Change

9:45 – 10:00 a.m.	EXPLANATION OF THE GAME *Dr. James Miller, Game Director* *Senior Vice President and Director of Studies, CNAS*

GAME PLAY BEGINS

10:00 – 10:15 a.m.	SCENARIO OVERVIEW – 2015 ABC NEWS SEGMENT
10:15 – 10:25 a.m.	OPENING BY THE UNITED NATIONS SECRETARY GENERAL
10:25 – 10:45 a.m.	ASSISTANT SECRETARY GENERAL FOR PEACEKEEPING: THREAT ASSESSMENT *Assessment of potential threats posed by climate change from 2015-2050*
10:45 – 11:00 a.m.	UNITED NATIONS SECRETARY GENERAL REMARKS TO COUNTRY TEAMS
11:00 – 11:15 a.m.	BREAK
11:15 a.m. – 4:00 p.m.	MOVE 1 – COUNTRY TEAM DELIBERATIONS *A working lunch will be served from 11:45 a.m. to 1:00 p.m.*
4:00 – 4:15 p.m.	BREAK
4:15 – 5:30 p.m.	CLOSING PLENARY FOR MOVE 1
5:30 p.m.	ADJOURN FOR THE DAY
5:30 – 8:00 p.m.	RECEPTION HOSTED BY THE BROOKINGS INSTITUTION *Newseum, 7th Floor Terrace*

Tuesday, July 29

8:00 – 8:30 a.m.	CONTINENTAL BREAKFAST

8:30 – 8:45 a.m.	DAY 2 WELCOME *Sharon Burke* *Senior Fellow, CNAS*
8:45 – 9:25 a.m.	KEYNOTE ADDRESS *Diana Farrell* *Director, McKinsey Global Institute*
9:25 – 9:40 a.m.	EXPLANATION OF MOVE 2 *Dr. James Miller, Game Director*

GAME PLAY BEGINS

9:40 – 10:00 a.m.	UN SECRETARY GENERAL and STAFF BRIEFING
10:00 – 10:15 a.m.	BREAK
10:15 a.m. – 1:00 p.m.	MOVE 2 – COUNTRY TEAM LEADER and ISSUE TEAM DELIBERATIONS *A working lunch will be served from 11:45 a.m. to 1:00 p.m.*
1:00 – 1:15 p.m.	BREAK
1:15 – 3:00 p.m.	PLENARY SESSION *Country Team Leaders and ad hoc Issue Teams give presentations*
3:00 – 3:15 p.m.	BREAK
3:15 – 5:00 p.m.	FINAL COUNTRY TEAM DELIBERATIONS *At the end of Move 2, Country Teams submit final positions*
5:00 p.m.	ADJOURN FOR THE DAY
6:00 – 8:00 p.m.	RECEPTION HOSTED BY THE HEINRICH BÖLL FOUNDATION *Co Co. Sala, 929 F Street, NW, Washington, D.C. 20004*

Wednesday, July 30

8:00 – 8:30 a.m.	CONTINENTAL BREAKFAST

GAME PLAY BEGINS

8:30 – 9:00 a.m.	SECRETARY GENERAL and STAFF BRIEFING
9:00 – 10:00 a.m.	COUNTRY TEAMS COMMENT ON MOVE 2 RESULTS AND OVERALL STRATEGY INSIGHTS

GAME PLAY ENDS

10:00 – 11:15 a.m.	CLOSING REMARKS AND DISCUSSION *Honorable Eileen Claussen* *President, The Pew Center on Global Climate Change* *Honorable Sherri Goodman* *General Counsel, CNA* *Moderator, Sharon Burke, CNAS*
11:15 – 11:30 a.m.	CLOSING THANKS AND ADJOURNMENT *Dr. Kurt Campbell*

The Newseum's Freedom Forum First Amendment Center
Sixth Street Entrance
555 Pennsylvania Avenue, NW
Washington, D.C.

GAME PARTICIPANTS

Michael Allegretti
Head of Government Relations
North America
The Climate Group

Vicki Arroyo
Director of Policy Analysis
Pew Center on Global Climate Change

Ambassador Hattie Babbitt
Vice Chair, World Resources Institute
Former Deputy Administrator, USAID

Kenneth H. Bacon
President
Refugees International

Jessica Bailey
Program Officer, Sustainable Development
Rockefeller Brothers Fund

Markus Baumanns
Chief Executive Officer
Zeit Foundation

The Honorable Reinhard Buetikofer
Leader
The German Green Party

Kent Butts
Director, National Security Issues Group
Center for Strategic Leadership
U.S. Army War College

Dr. Brahma Chellaney
Professor of Strategic Studies
Center for Policy Research

Pramit Pal Chaudhuri
Senior Editor – Global Trends
The Hindustan Times

The Honorable Eileen Claussen
President
Pew Center on Global Climate Change

The Honorable Tom Daschle
Former Majority Leader
United States Senate

Michael Deich
Director, Policy and Government Affairs
Bill and Melinda Gates Foundation

The Honorable Rudy deLeon
Senior Vice President
Center for American Progress

Reid Detchon
Executive Director for Energy and Climate
United Nations Foundation

Dr. Kristie Ebi
President
ESS, LLC

Diana Farrell
Director
McKinsey Global Institute

Helga Flores Trejo
Executive Director
Heinrich Böll Foundation North America

The Honorable Leon Fuerth
Research Professor of International Affairs
Elliott School of International Affairs
George Washington University

Dr. Yoichi Funabashi
Editor-in-Chief
The Asahi Shimbun

Auroop Ganguly
Research Scientist
Oak Ridge National Laboratory

David Goldston
Visiting Lecturer
Harvard University
Center for the Environment

Sherri Goodman
General Counsel, CNA
Former Deputy Under Secretary of Defense
for Environmental Security

Lianhong Gu
Research Scientist
Oak Ridge National Laboratory

Barry Ives
Senior Engineering Manager & Researcher
Advanced Technology Laboratories
Lockheed Martin

Dr. Murari Lal
Director and Chairman
Climate, Energy and Sustainable
Development Analysis Centre

Flynt Leverett
Senior Fellow and Director
Geopolitics of Energy Initiative
New America Foundation

Dr. Michael Levi
Senior Fellow and Director, Program on
Energy Security and Climate Change
Council on Foreign Relations

Dr. Preeti Malhotra
Director for India
The Climate Group

Dr. Adele Morris
Fellow and Deputy Director for
Climate and Energy Economics
Brookings Institution

Dr. Moisés Naím
Editor-in-Chief
Foreign Policy Magazine

Karen O'Reilly
Director of Product Development
Lexington Insurance Company

Debo Oladosu
Economist
Oak Ridge National Laboratory

Dr. Jiahua Pan
Executive Director, Research Centre for
Sustainable Development
Chinese Academy of Social Sciences

Dr. Paty Romero-Lankao
Deputy Director and Scientist
Institute for the Study of Society
and the Environment

Blair Ross
Senior Program Manager
National Security Directorate
Oak Ridge National Labs

David Sandalow
Senior Fellow, Foreign Policy
Brookings Institution

Randy Schriver
Partner, Armitage International and
CEO, Project 2049

Dr. Harinder Sekhon
Senior Fellow
Observer Research Foundation

Dr. Howard-Yana Shapiro
Global Director
Plant Science and External Research
Mars, Incorporated

RDML John Sigler (USN, Ret.)
Deputy Director
Near East-South Asia Center for
Strategic Studies
National Defense University

Chris Smith
Head of Sustainable Business
Standard Chartered Bank

Mario-Ingo Soos
Political Counselor
Environment and Energy
German Embassy

Todd Stern
Vice Chair
Public Policy and Strategy Group
WilmerHale

Professor Hitoshi Tanaka
Senior Fellow
Japan Center for International Exchange

Dr. Sara Ulrich
Simulation Director
Visiting Lecturer & Senior Research Fellow
King's College London

Dr. Tapani Vaahtoranta
Program Director
Finnish Institute of International Affairs

Dr. Michael Werz
Fellow, Georgetown Center for
International Migration

Lt Col Bill Young, USAF
Donella Meadows Leadership Fellow
Sustainability Institute

Dr. Junhua Zhang
Professor in the Political Science
Zhejiang University

Dr. Wei Zonglei
Deputy Director, Institute of Global Strategy
China Institutes of Contemporary
International Relations (CICIR)

GAME MANAGEMENT

Dr. Kurt Campbell
Event Host
Chief Executive Officer & Co-Founder
Center for a New American Security

Dr. James Miller
Game Director
Senior Vice President & Director of Studies
Center for a New American Security

Christine Parthemore
Assistant Game Director
Research Associate
Center for a New American Security

SECRETARY GENERAL'S TEAM

The Honorable John Podesta
as the game's Secretary General
Chief Executive Officer
Center for American Progress

Michèle Flournoy
as the game's Assistant Secretary General
President & Co-Founder
Center for a New American Security

Sharon Burke
as the game's Assistant Secretary General
Senior Fellow
Center for a New American Security

Dr. Jay Gulledge
as the game's Science Advisor to the Secretary General
Senior Scientist and Program Manager for Science & Impacts
Pew Center on Global Climate Change

CONSORTIUM GAME ADVISORS

Dr. William Curry
Senior Scientist
Geology & Geophysics
Woods Hole Oceanographic Institution

Tom Fiddaman
Simulation Modeler
Ventana Systems

Sebastian Graefe
Program Director for Foreign & Security Policy and Transatlantic Issues
Heinrich Böll Foundation North America

Dr. Gary Jacobs
Division Director
Environmental Sciences Division
Oak Ridge National Labs

Andrew Jones
Simulation Modeler
Sustainability Institute

Dr. Anthony King
Research Staff Member
Oak Ridge National Labs

Peter Ogden
Chief of Staff
Center for American Progress

Nirav Patel
Bacevich Fellow
Center for a New American Security

Cheryl Rosenblum
Deputy Director for Energy Research
CNA

Blair Ross
Senior Program Manager
National Security Directorate
Oak Ridge National Labs

Dr. Lori Siegel
Simulation Modeler
Sustainability Institute

Katherine Stainken
Environment and Global Dialogue Program
Heinrich Böll Foundation North America

FACILITATORS

Derek Chollet
Senior Fellow
Center for a New American Security

Craig Corl
Senior Fellow
CNA

Eric Pierce
Fellow
Center for a New American Security

Nate Tibbits
Chief Operating Officer
Center for a New American Security

RAPPORTEURS

Dave Capezza
Research Intern
Center for a New American Security

Dr. David Catarious
Research Analyst
CNA

Nicole DeMarco
Research Intern
Center for a New American Security

Eleanore Douglas
Fellow
Center for Strategic & International Studies

Zachary Hosford
Executive Assistant
Center for a New American Security

Alice Hunt
Research Associate
Center for a New American Security

Theo Milonopoulos
Research Intern
Center for a New American Security

Tiffany Sirc
Research Assistant
Center for a New American Security

Team Designations

China Team
Facilitator: Nate Tibbits
Rapporteurs: Zachary Hosford, Tiffany Sirc
Senior Mentor: Blair Ross
Amb. Hattie Babbitt
Diana Farrell
Dr. Yoichi Funabashi
Lianhong Gu
Karen O'Reilly
Dr. Jiahua Pan
David Sandalow
Randy Schriver
Rear Admiral John Sigler
Mario-Ingo Soos
Todd Stern
Dr. Junhua Zhang
Dr. Wei Zonglei

European Union Team
Facilitator: Derek Chollet
Rapporteurs: Alice Hunt, Nicole DeMarco
Senior Mentor: Helga Flores Trejo
Michael Allegretti
Markus Baumanns
Hon. Reinhard Buetikofer
Hon. Rudy deLeon
Dr. Kristie Ebi
Hon. Leon Fuerth
Flynt Leverett
Dr. Adele Morris
Debo Oladosu
Dr. Tapani Vaahtoranta
Lt Col Bill Young

India Team
Facilitator: Craig Corl
Rapporteurs: Eleanore Douglas, Theo Milonopolous
Senior Mentor: Sherri Goodman
Dr. Brahma Chellaney
Pramit Pal Chaudhuri
Michael Deich
Auroop Ganguly
Dr. Murari Lal
Dr. Moises Naim
Dr. Harinder Sekhon
Dr. Howard-Yana Shapiro
Professor Hitoshi Tanaka
Dr. Michael Werz

United States Team
Facilitator: Eric Pierce
Rapporteurs: Dave Catarious, Dave Capezza
Senior Mentor: Jessica Bailey
Ken Bacon
Kent Butts
Hon. Eileen Claussen
Hon. Tom Daschle
Reid Detchon
David Goldston
Barry Ives
Dr. Michael Levi
Preeti Malhotra
Dr. Paty Romero-Lankao
Dr. Sara Ulrich

Game Overview

Table of Contents

Introduction

On behalf of The Center for a New American Security (CNAS) and its consortium partners, welcome to *Clout & Climate Change*, a climate change "war game," or scenario planning exercise. This event brings together scientists, national security strategists, political leaders, and members of the business communities from Asia, Europe, South Asia, and the United States to look at plausible future scenarios and consider the national security and foreign policy implications of global climate change.

The consortium of ten partners agreed that the timing was right to hold a climate change scenario game. Last year, the United Nations Intergovernmental Panel on Climate Change (IPCC), reflecting the consensus opinion of the world's top physical and social scientists, found with near certainty that human activities are changing the world's climate. It is difficult to know exactly how these changes will affect human societies, but recent observations ranging from melting glaciers and Arctic sea ice to worsening drought and flood conditions have raised public and political concerns around the world. Furthermore, in 2009, the international community will gather in Copenhagen, Denmark, to negotiate a new agreement for dealing with global climate change, and the outcome of those negotiations is by no means clear.

This growing global alarm, high degree of uncertainty, and upcoming negotiations are the backdrop behind the *Clout & Climate Change* game, which will be played over the course of two and a half days.

The game is set in the year 2015. Participants in the game will organize into four teams representing China, the European Union, India, and the United States, which are gathering in a special summit to examine climate change challenges that entail a high risk of conflict and to explore the possibilities for international cooperation. The rationale for bringing together only these four players (China, the EU, India, and the United States) is that these nations will be instrumental to future progress in cutting greenhouse gas emissions and adapting to the effects of global climate change. Other nations will play important roles, of course, but the game's designers made a judgment that the dynamics among these four players will be particularly important to explore and understand. The four players in the game may consult or negotiate with other nations, however, through the International Team on the control team.

In the context of the game, the years preceding the summit have continued to be marked by volatile and unexpected climate events, ranging from droughts to heavy rains and other extreme weather events, including several in the months leading up to the summit. There is a global feeling of crisis and growing international tension over climate change.

CNAS Game Material

The 2015 summit is hosted by the UN Secretary General. In order to avoid future conflict and minimize human suffering related to global climate change, the UN Secretary General proposes that international cooperation needs to be strengthened in four areas: resource scarcity, disaster relief, migration, and reduction of greenhouse gas emissions.

Over the two and a half days of the summit, negotiating teams representing China, the European Union, India, and the United States will discuss the Secretary General's four challenges and develop their own proposals for international cooperation. Each team will be given background information and general negotiating guidance for reaching an agreement on how to build international capacity in these areas, while protecting their country's interests. The background information and guidance are intended to establish the game "reality" and define the world of 2015.

The game players' collective goal is to reach a Framework Agreement on Managing Long-Term Climate Change that would be acceptable to China, the European Union, India, and the United States. This non-binding agreement, meant to be the first step to a more comprehensive international agreement, may propose strategies for dealing with all four issues addressed in the game (resource scarcity, migration, disasters, and reduction of greenhouse gas emissions), or it may be more limited. The players will dictate the content of the agreement.

As with all other war games and simulations, *Clout & Climate Change* will not be able to address all of the complexities of the real world. However, it will be anchored in real-world dynamics, perhaps more than most simulations. The 2015 climate future that forms the basis for this game has been reviewed by a team of scientists; futures for 2050 and beyond have been drawn from United Nations Intergovernmental Panel on Climate Change (IPCC) data, and are unique to this game.

This climate change game was developed by the Center for a New American Security in cooperation with a consortium of partners. The consortium includes: the Brookings Global Economy and Development Program; the Center for American Progress; the CNA Corporation; the Heinrich Böll Foundation; the McKinsey Global Institute; the Pew Center on Global Climate Change; the Rockefeller Brothers Fund; the Sustainability Institute; and Woods Hole Oceanographic Institution. Additionally, Oak Ridge National Laboratory provided scientific and technical expertise, and ABC News will be following the game as part of a forthcoming documentary on climate change futures.

This exercise was inspired by the *Age of Consequences: The National Security and Foreign Policy Implications of Global Climate Change*, published by CNAS and the Center for Strategic and International Studies in 2007. This report can be found at www.cnas.org.

CNAS Game Material

Why Conduct a "War Game?"

For hundreds of years, military strategists have used role-playing games as a way to develop and test war plans and broader political-military strategies. More recently, many successful businesses have adopted similar techniques to help identify long-term threats and opportunities and to create more robust corporate strategies. These games are a particularly useful way to anticipate future challenges and understand complex situations and uncertain environments. Global climate change lends itself to just such an exploration, given the long lead times, the complexity of the effects, and the wide range of uncertainties involved.

Games and simulations also can allow participants with different expertise and from different countries to explore possibilities and ideas in a way that may be difficult to do in official, inter-governmental dialogues. In the case of climate change, an international game may be particularly helpful, given the centrality of international cooperation both to mitigating the human contribution to global climate change and adapting to its effects.

War games can help advance understanding of both the problem being considered and potential solutions. At the same time, they typically also raise a host of new questions. We hope participants gain new insights – and are confident they will provide many – but at the same time, the game sponsors understand that this one simulation will not provide all the answers as to how the world can better deal with the challenge of global climate change. We intend to conduct additional games in the future that build on the insights learned in *Clout & Climate Change*.

Game Objectives

The *Clout & Climate Change* game has three interrelated objectives:

1. Improve understanding of the possibility of increased international cooperation on climate change, particularly among China, India, the EU, and the United States.
2. Provide a venue for essential interdisciplinary, intergenerational, and international discussion and debate on the national security and foreign policy implications of climate change, and improve understanding of key differences and commonalities among the perspectives and potential positions of China, India, the EU, and the United States.
3. Offer insights regarding areas requiring additional study, and serve as a proof-of-concept for future climate change games.

Key findings and recommendations from the game will be incorporated into a report on U.S. climate change strategy to the next U.S. administration.

CNAS Game Material

The Premise

Every war game is based on a premise around which the game scenario is built. In military games, the premise is typically that a specific conflict may occur in the future; the scenario then spells out details such as the objectives and capabilities of the belligerents. In the private sector, the premise may be a significant economic or social change; for example Royal Dutch Shell's pioneering work in the 1970s considering the possibility of a marked increase in the price of oil helped prepare the company for the events that actually occurred. Any given premise may be likely or unlikely, but it is essential that it is plausible, or else the game and the specific scenario on which it is based will not be interesting or credible.

The premise of the *Clout & Climate Change* game is that in the near future it becomes compellingly clear that urgent global action is needed to deal with human-induced climate change, and that a failure to act swiftly will make the problem increasingly intractable and potentially lead to international conflict. In our view, this premise is highly likely to be borne out by actual future events, but one only has to believe that this premise is plausible to make the game worthwhile.

Game Players and Teams

Approximately 40 players will participate in the game as members of one of four Country Teams representing the world's largest developed and developing economies and top greenhouse gas emitters by 2015: the United States, the European Union, China, and India. Each team will have about 10 players, with a mix of national security/foreign policy experts, retired senior military officers, climate/environment experts, and business/economic experts. Each team will include a designated leader. A facilitator and two rapporteurs will be embedded within each team to help guide discussions and record key elements of discussion.

Running the Game

A Control Cell will oversee and monitor game play. It may insert new information, redirect the teams' activities, and if appropriate adjust the schedule of game play. Supporting the Control Cell will be a group of senior subject matter experts who will serve as a resource to the Country Teams by providing additional information and assessments. If teams need additional information about the game, climate change, energy resources, or other topics, the Control Cell will assist.

CNAS Game Material

Two additional groups are essential to game play. First, an International Team will represent stakeholders (e.g., Japan, Russia, Brazil) that would be key to any international agreement on climate change. Although the International Team will not be a proactive player in the game, Country Teams may consult or negotiate with this team. Second, over the course of the game, *ad hoc* Issue Teams comprised of members from some or all Country Teams will be established to focus on issues expected to include resource scarcity, migration, disasters, and reduction of greenhouse gas emissions.

Note on Scenarios and Game Materials

Please note that game materials, including the UN Secretary General's proposal and the events and trends in the game through 2015, are for the purpose of building credible scenarios that players can believe and understand. These game materials are intended to provide a plausible start to game play, and do not necessarily represent views advocated by CNAS or any of the consortium members.

Throughout the game materials, references to "today" and any time periods not specified are to be taken as the world in 2015 in which the game is played. Information pertaining to pre-2015 time or projecting into the future beyond 2015 are noted as such.

Media Protocol and Attribution

Several members of the press will observe the game. Additionally, ABC News will be filming portions of the game and they may request a quote or interview from specific participants. All game discussion will be considered on the record. If any participant has concerns regarding the media protocol and does not wish to be filmed, he/she should raise this issue with the game management.

Two rapporteurs will be in each room to record deliberations to provide insights for the CNAS report that will summarize findings and recommendations from the game. However, comments and quotations will not be attributed to specific players in the final report without their express permission.

CNAS Game Material

The 2015 World

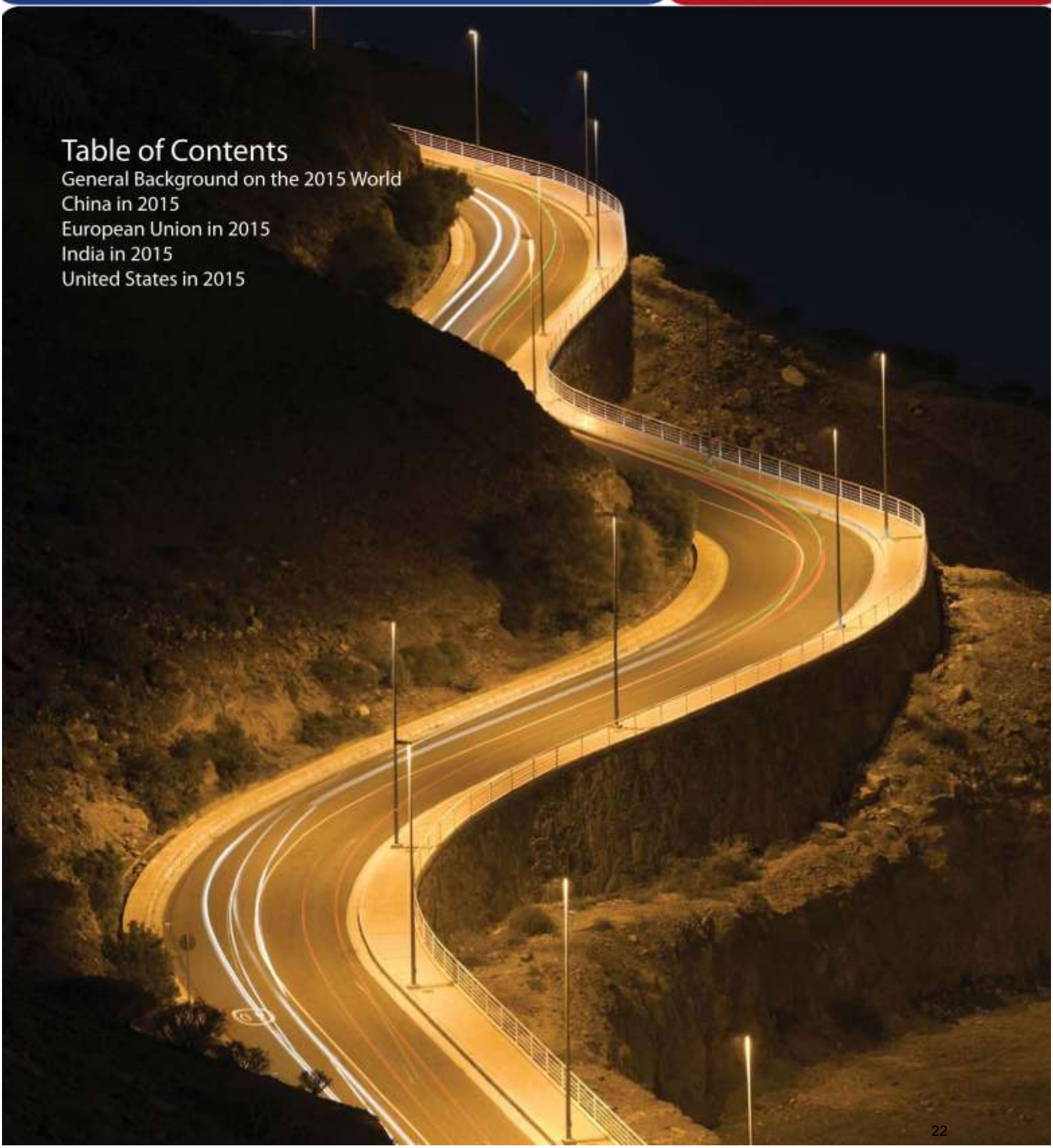


Table of Contents

General Background on the 2015 World

2008 was a watershed year for climate change: the Northwest Passage thawed for the first time in human memory; China experienced record snowstorms; a devastating cyclone hit Myanmar; rising energy prices combined with drought and other climate conditions and governance problems to raise food prices around the world, sparking unrest on three continents; and the American Midwest had a 500-year flood for the second time in 15 years.

The intervening years, 2008 to 2015, have seen more – in some cases much more – of the same. Changing weather patterns and increased numbers of severe weather events, along with small but perceptible increases in sea level rise, have had major impacts on agricultural productivity, availability of water, and migration away from affected areas.

Regional effects for China, Europe, India, and the United States have varied, but all are facing difficult challenges. India is experiencing flooding in some places and droughts in other places, with marked declines in agricultural productivity. A terrible cyclone that tore through Bangladesh in 2013 has also challenged the region, with some 250,000 refugees still camped on the Indian border by 2015. Southern Europe has seen severe heat, with wildfires, droughts, and brownouts as a result. Famine and drought conditions in the Maghreb and Sahelian African have pushed large numbers of migrants north, adding millions of new migrants into Europe. The United States has experienced drought in some places and flooding in others, affecting crop yields. In addition, hurricanes on the Gulf Coast have all but shut down New Orleans and affected oil and gas production, while a Category 5 hurricane made direct landfall in Miami in July of 2015. Migrants from severe weather and poor agricultural productivity in Mexico, Central America, and the Caribbean have dramatically increased the number of economic migrants seeking to enter the United States.

Against this backdrop of climate turmoil, the way nations deal with the challenge of global climate change has shifted. A major international agreement on climate change went into effect in 2012. The treaty included an aspirational target of an 80 percent cut in global greenhouse gas emissions by 2050 relative to 2005, with interim national targets. It also included increased funding for adaptation assistance, global meteorological monitoring, and the clean development mechanism.

Today, most nations have adopted national adaptation plans, though implementation varies widely from country to country. Many major cities, such as New York City, London, Shanghai, and Mumbai are in the process of improving their flood control measures and storm protections, for example; a number of major infrastructure projects are stalling in the face of persistent high energy prices.

CNAS Game Material

A carbon cap and trade system passed into law in the United States in 2010 and started going into effect in 2014. There are signs it will help spur the nascent global carbon trading market that the EU cap and trade system and Kyoto Protocol initiated.

Also in 2014, the 5th Assessment of the Intergovernmental Panel on Climate Change was released, with findings that climate change is happening much faster and more dramatically than any model predicted (see full text in the Appendix). The situation is labeled urgent and in crisis. The release of the report prompts a global "political tipping point," with broad acceptance of the urgency of stepping up adaptive capabilities and emissions cutting schemes.

Against this backdrop, an international conference is hosted in 2015 by the UN Secretary General, who proposes four areas for improved international cooperation: resource scarcity, migration, disasters, and reduction of greenhouse gas emissions. Over the next two and a half days, negotiating teams representing China, the European Union, India, the United States, and other nations will debate the Secretary General's proposal and develop their own proposals for international cooperation. Their collective goal is to reach a Framework Agreement on Managing Long-Term Climate Change that meets the interests of all four parties and can form the basis for subsequent international negotiations involving all UN members.

CNAS Game Material

Timeline of Major Climate Change-Related Events: 2008 to 2015

In **2009** the Copenhagen Agreement, the successor to the Kyoto Protocol, was agreed to, and ratification took place over the following years. It included an aspirational target of an 80 percent cut in global greenhouse gas emissions below 2005 levels by 2050, with interim national targets. It also included increased funding for helping at-risk nations adapt to climate change effects, global meteorological monitoring, and clean development mechanisms.

In the meantime, climate-related events continued to worsen around the world, with effects on agricultural productivity, availability of water, migration away from affected areas, and severe weather events complicated by sea level rise.

By **2010**, oil prices reached US$165 a barrel, a 150 percent increase from only 5 years earlier.[1] The United States also passed cap and trade legislation to go into effect beginning in 2012. It has helped spur a nascent global carbon trading market.

In **2012** the Copenhagen Agreement went into effect, replacing the Kyoto Protocol as the international climate change regime.

During the **2011 and 2012** hurricane seasons, a Category 4 hurricane hit Houston and Louisiana. New Orleans has never recovered.

By **2011** southern and central Europe are experiencing persistent heat waves and drought, especially along the Mediterranean region, igniting a competition for the allocation of water among agriculture, industry, and households.

In **2013** the Bhola cyclone hit Bangladesh, killing 200,000 people. Mass migration ensued, causing border tensions. The government of India deployed the Army to help stem the influx of refugees.

In **2013** renewed disputes over water rights of the Rio Grande increased tensions between the United States and Mexico.

In **2014** late monsoon rains ruined India's wheat and rice harvests. Once rain arrived, extreme flooding overwhelmed many Indian cities. The Indian Army was deployed to assist in relief efforts.

[1] In August 2005, a barrel of oil cost US $66. See David Ellis, "Experts see relief from high oil and gas prices coming around the corner, is it soon enough?" *CNN/Money* (11 August 2005).

CNAS Game Material

In **2014**, the 5th Assessment of the Intergovernmental Panel on Climate Change was released, with findings that climate change is happening much faster and more dramatically than previous models projected. The situation was labeled urgent and in crisis. The release of the report prompted a global "political tipping point," with broad acceptance of the urgency of stepping up adaptive capabilities and emissions cutting schemes.

In **2014** drought, food shortages, and political instability, especially in North Africa and the Sahel, triggered an influx of refugees to Europe.

In **2015** tensions flared between Egypt and Ethiopia over water supplies and distribution along the Nile.

After a temporary decline, global commodity prices increased 15 percent in **early 2015** in the first six months of the year, and the high prices have fueled a lucrative black market for grain commodities.

In **July 2015**, a Category 5 hurricane hit Miami, flooding a majority of the city and damaging much of its infrastructure. The National Guard was called to lead the disaster response. Before the hurricane hit Miami, a series of tropical storms affected the Caribbean, and Florida has been receiving an influx of refugees from Haiti and the Dominican Republic.

Today, in **October 2015,** the United Nations Secretary General presides over a meeting to help advance international cooperation in mitigating and adapting to climate change.

CNAS Game Material

Technology: Key Developments to 2015[2]

2008 to 2015:

- Technology to improve energy production efficiency has been developed and adopted in many regions but there is clearly additional room for improvement.
- More efficient and hybrid vehicles are in high demand
- Efficient lighting, appliances, and energy-saving building practices have been widely adopted.
- New efforts began by 2009 to improve battery technologies.
- The U.S. conducted the first commercial demonstration of cellulosic ethanol in 2012.
- Some nations are beginning fuel switching to nuclear, natural gas, and first-generation biofuels.
- Renewables increase as percentage of energy supply, at a relatively small but growing scale.
- Carbon capture and storage (CCS) is in use at a small scale.

Future Trends Knowable in 2015:

- Higher efficiency aircraft will begin coming to the global market.
- Smart energy and other design efficiency technologies will be increasingly common in new buildings around the world.
- Advanced industrial energy practices and technologies will come into regular practice, particularly in developed countries but also in developing countries to a lesser degree.
- Battery technologies will increasingly benefit the cost scales of efficient vehicles around the world.
- Generation III nuclear power plants could come online in some places by 2020 and work on Generation IV reactors will begin after 2030.
- Solar, tidal, and other renewable power sources will continue to experience improvements of scale; in solar, this will be part due to thin-film and nanotech developments.
- Hydrogen fuel cell demonstrations will increase.
- Tree species improvement will be underway to increase biomass productivity and carbon sequestration.
- The International Thermonuclear Experimental Reactor (ITER) will be moderately successful, but will not yet have led to any breakthroughs despite its original timeline for major progress by 2016.

[2] Unless otherwise noted, technology projections are from the IPCC, "Summary for Policymakers," Climate Change 2007: Synthesis Report (2007).

CNAS Game Material

- Improved remote sensing technologies will be deployed for analysis of vegetation/soil carbon sequestration potential and mapping land use change.
- Application of CCS will grow (Australia demonstrated first commercially viable "clean coal" plant in 2012 with CCS technology) but large-scale additional development will be necessary to increase capture capability to 100% of CO2.[3]
- Depending upon R&D, carbon capture and storage technology could contribute to a 20-28% reduction in global emissions by 2050.[4]

CNAS Game Material

[3] Keith Orchison, "ZeroGen aims to be first with clean coal power," *Weekend Australian* (17 May 2008); also see http://www.iea.org/textbase/work/2007/oslo/summary_report.pdf.
[4] IEA, "Energy Technology Essentials: CO2 Capture and Storage," (January 2007): 3.

Emissions Trends to 2015 (and projected to 2030): Not on Track to Meet Copenhagen

Annual CO2 Emissions by Country (million tons).[5]

	1990	2005	2015	2030
United States	4,832	5,789	6,392	6,891
European Union	4,084	3,944	4,011	4,176
India	587	1,147	1,804	3,314
China	2,244	5,101	8,632	11,448
Russia	2,189	1,528	1,802	1,973
Japan	1,057	1,210	1,291	1,182
World Total	20,688	26,620	34,071	41,905

Annual CO2 Emissions Growth Per Year, 2005 to 2030.

	United States	European Union	India	China	Russia	Japan	World Total
Average Annual Growth 2005-2030	.7%	.2%	4.3%	3.3%	1%	-0.1%	1.8%

CNAS Game Material

[5] Emissions of CO2 from the combustion of fossil fuels; total anthropogenic emissions are that value plus emissions from land-use change, assumed to be constant at 1.5 Gt C/yr from 2005 to 2100; data from the Reference Scenarios from the International Energy Agency, *World Energy Outlook* (2007), Annex A.

Assessment of Impact of Meeting Copenhagen Goals

The following chart compares fossil fuel (FF) emissions (CO2) in a business as usual (BAU) scenario, where nations do nothing additional to reduce emissions, to a scenario in which nations collectively meet the commitment to reduce emissions by 80 percent by 2050.

Business as Usual vs 80% Reduction

	BAU based on A1FI			80% Reduction of 2005 Levels by 2050		
	FF CO2 Emissions (tonsC/year)	CO2 in Atmosphere (ppm)	Temperature Change Relative to 1990	FF CO2 Emissions (tonsC/year)	CO2 in Atmosphere (ppm)	Temperature Change Relative to 1990
2015	9.586	407	0.43	10.24	407	0.43
2050	22.76	566	1.42	1.639	431	1.10
2075	27.74	743	2.40	1.639	437	1.45
2100	29.91	949	3.46	1.639	447	1.79

- FF and land use emissions 1900-2005: Regional and global historical data, Carbon Dioxide Information Analysis Center
- FF emissions A1FI 2005-2100: MiniCAM pSRES A1FI projections
  80% Red 2005-2015: Proteus model projections with WEO projected growth rates
  2015-2100: Proteus model projections with 80% reduction of 2005 emissions by 2050

QuickTime™ and a decompressor are needed to see this picture.

- Land use emissions 2005-2100: constant at 1.5 GtC/year

Sustainability Institute

China in 2015

Background

- Chinese military capabilities for disaster relief and humanitarian assistance are under strain as a result of flooding and civil unrest in several parts of the country.
- Popular anger about pollution and climate effects has reached a boiling point, including anger towards the United States for its disproportionate contribution to the problem.
- Rural to urban migration has contributed to falling agricultural productivity, supply imbalances, and rising food prices; popular unrest in rural and urban centers over food is not uncommon.
- The energy intensity of the Chinese economy has declined as more efficient power and industrial facilities have been constructed, but per capita consumption of energy has risen. China has seen a steady rise in total emissions.
- Although there have been major breakthroughs in energy efficiency, composite materials, battery storage, nanotechnologies, carbon capture, and renewable technologies in China, these breakthroughs have not yet translated into commercial advances that have significantly displaced fossil fuels.

Political and Climate Change Policy Profile

The political situation in the People's Republic of China has been relatively consistent between 1976 and 2015. The nomination of Li Keqiang as President and Xi Jinping as Premier in the 18th National Congress of the Chinese Communist Party (CCP) has not impelled any significant policy changes.[1] Former President Hu Jintao remains a formidable political force and remains committed to ensuring that his "scientific development" platform – which stresses environmentally responsible economic development – guides internal Chinese development.

In 2015, the Chinese Communist Party is still the only political party. Calls for elections at the provincial level within the party following the successful Shenzhen experiment are increasing.[2] At the District level, there are more competitive elections within the party. Environmental issues

[1] Simon Elegant, "Advantage: Hu Jintao," *Time* (25 October 2007). Both individuals are considered the chosen successors of President Hu Jintao. Their positions as President and Premier are debatable but their views are seemingly aligned with President Hu.

[2] See Michael Leonard, *What Does China Think* (New York: PublicAffairs, 2008); and Edward Cody, "Pioneering Chinese City Offers a Peek at Political Ferment," *The Washington Post* (30 June 2008).

CNAS Game Material

are gaining more salience for voters who are demanding change; however, voters continue to have little say in the direction of the nation's policies.

Dominant views within the Standing Committee that seek to ensure that China is viewed as a "responsible stakeholder" continue to ensure open and receptive conditions for negotiations to international climate change agreements.

The Standing Committee of the Politburo still makes environmental and energy-related decisions. It is both aware of and concerned about growing environmental degradation caused by rapid industrialization. Growing health problems and lack of clean water are viewed as potential challenges to the Standing Committee's rule; it therefore passes extensive regulations meant to curb greenhouse gas emissions. Implementation challenges remain a major problem as the Standing Committee seeks to balance internal economic development with economically burdensome environmental regulations. In recognition of perceived shortcomings, the CCP remains rather conciliatory toward nongovernmental organizations committed to environmental cleanup and sustainability. Greenhouse gas emissions nonetheless continue to grow at a rate of approximately 3.3% per year.

The growing number of natural disasters in China and throughout Asia over recent years has placed greater emphasis on the need for the People's Liberation Army to augment disaster relief capabilities.

President Li has publically committed Chinese support to regional and international efforts to curb greenhouse gas emissions. Bilateral joint agreements with developing nations from Southeast Asia to Africa to promote environmentally sustainable development policies are increasing. However, a lack of agreement with the major global emitters (America, European Union, and India) continues to handicap efforts to mitigate carbon emissions.

China continues to experiment with new seed varieties and resistant crops, to improve irrigation infrastructure, and to adapt its agricultural sector in other ways as well. Its work through 2015 on improving plant breeds to withstand greater climate variations has led to current programs to increase the forestation of strong, resilient tree species. While China has carried out many plans to increase water usage efficiency and reduce pollution, it still endures major challenges in this area. In its strongest current efforts for adapting to the effects of climate change, China has a robust program for securing infrastructure and reinforcing susceptible coastal areas.[3]

[3] Adapted from the People's Republic of China, "China's National Climate Change Programme," National Development and Reform Commission (June 2007): 47-52.

CNAS Game Material

Economic and Demographic Profile

Gross domestic product in China today is $14.3 trillion (on a purchasing power parity [PPP] basis, in 2007 US dollars), up from $7.0 trillion in 2007. Growth since 2007 has been rapid, at 9.3%, but almost a percentage point slower than was registered from 2001 to 2007. China's population rose from 1.32 billion in 2007 to 1.42 billion today, and as population momentum takes effect its growth has been rising, from 0.6% annually from 2001 to 2007 to 0.9% annually from 2007 to 2015. The coastal/non-coastal split is remaining mostly consistent. Real per capita income has almost doubled since 2007, rising from $5,300 per capita to $10,100 per capita. As a result, China's share of the world economy has darted from 10.8% to 16.0%.[4] Services have increased as a portion of China's economy.

Table 1: Long-term Population Trends (in millions of people)

	2000	2050	2050 versus 2000
China	1,300	1,500	+200
India	1,350	2,100	+750
Eastern Europe	150	150	0
Western Europe	350	400	+50
USA	300	500	+200
World Population	6,110	9,015	+2,905

Source: Oak Ridge National Laboratory; data results from ORNL population projections consistent with the IPCC scenarios, based on A1FI assumptions.

Energy Profile[5]

Energy demand increase is mainly driven by economic growth (as opposed to population expansion), which makes energy growth projections highly sensitive to changes in economic growth patterns. Total energy demand experienced 5.1% growth annually from 2008 to 2015,

[4] Projections care of the Brookings Institution, based on personal analysis and the International Monetary Fund, *World Economic Outlook* (2008).
[5] Energy projections are derived from the International Energy Agency, *World Energy Outlook* (2007) unless otherwise noted.

CNAS Material

and is projected to slow a bit in subsequent years. Market reforms continue in China, increasingly allowing world energy prices to influence China's domestic energy prices. Some efficiency improvements in both power generation and certain segments of industry will continue as well.

The percentage of coal in total energy consumption continued to increase beyond 2008 but is starting to level off. It is mostly used for power generation, but businesses are beginning to consider creating a larger coal-to-liquids industry. China continues to rely on its own significant supplies of coal, but any future growth of domestic supplies will in part depend on increased mining and production efficiency and modernization.

Natural gas has been and continues to be the fastest growing fuel source, but it still comprises a small portion of total energy consumption. China produces 102.7 billion cubic metres (bcm) of natural gas in 2015, and imports 28 bcm. LNG imports have increased and will continue to increase dramatically, with up to a dozen terminals active as of 2015; by 2030 China will import to meet about half of its natural gas demand.

Just over half of increased energy consumption between 2008 and 2030 is expected to be in power generation. The industrial sector comprises the largest single element in growth and the biggest overall demand sector, as industrial energy demand grew 5.7% per year by 2015. Energy consumption by China's transportation sector grew 7% per year from 2005 to 2015. This rate of increase is predicted to slow somewhat in the future. Eighty percent of the transportation sector increase since 2008 was in road vehicles, with an increase from 35 million in 2005 to 115 million in 2015, and that number is set to increase to 270 million by 2030. Oil makes up 96% of China's transport fuel in 2015, with biofuels accounting for only 1%.

CNAS Game Material

Table 2: China's Energy Mix, 1990 to 2050.

	1990	% of total[6]	2005	% of total	2015	% of total	2030	% of total	2050	% of total
Total Energy (Mtoe)	874	100	1,741	100	2,852	100	3,819	100	5,796	100
Coal	534	61	1,094	63	1,869	66	2,399	63	3,346	58
Biomass (including fuel wood and waste)	200	23	227	13	225	8	227	6	230	4
Oil	116	13	327	19	543	19	808	21	1,373	24
Natural Gas	13	1	42	2	109	4	199	5	444	8
Nuclear	0	0	14	1	32	1	67	2	179	3
Other renewables (including hydro, wind and solar)	11	1	37	2	74	3	119	3	224	4

Source: International Energy Agency, *World Energy Outlook* (2007). The 2050 calculations are derived as follows: the average yearly rate of growth for the period 2015 to 2030 was extended to continue at the same rate each year for the period 2030 to 2050.

In 2006, 44% of China's oil came from the Middle East and 32% from Africa, with a total of 3.7 million barrels per day (bpd) imported. In 2015, China is importing 7.1 million bpd, with declining domestic production. By 2030 China expects to be 80% dependent on imports to meet its oil demand. Pollution in China has been unrelenting under these energy growth circumstances, and without changes is expected to cost the nation up to 13% of its potential annual GDP by 2020, compared to 3-7% of GDP in 2008. China is the world's largest energy-related CO2 emitter, and its emissions growth is expected to slow to 3.3% annually through 2030.

Military Posture and Capabilities[7]

Through 2015, China continued to build and modernize its military forces, geared to address traditional and non-traditional challenges. Motivation in the Politburo to train soldiers to deal

[6] Totals and percentages rounded; total of all columns may therefore be +/- 100%.

[7] Many of the concepts in this section expand on previous work in Kurt Campbell and Michael O'Hanlon, *Hard Power: The New Politics of National Security* (Washington, D.C.: Basic Books, 2006).

CNAS Game Materials

with disaster relief and other humanitarian operations has increased, but not dramatically. In 2010, China and the United States Pacific Command conducted humanitarian relief drills together for the first time, a sign the China may look more toward improving those capabilities.[8] Many of the capabilities that Beijing has and is acquiring are dual-use in nature—a littoral navy cruiser can help deliver goods and rations in the wake of a natural disaster, such as a cyclone. The People's Armed Police (PAP), which consists of 660,000 personnel, supports disaster relief operations and has proven critical in responding to disease outbreaks and earthquake relief efforts.[9] China is also deploying more satellites which could presumably help Beijing pinpoint environmental conditions that merit relief operations. However, despite the potential non-military use of these capabilities, China still devotes more defense-related expenditures and resources to ensure security against traditional threats by procuring and developing advanced weapons systems and enhancing existing platforms.

Anxiety in the region has grown as China continues to invest billions advancing its force projection capabilities. In 2007 China announced a 17.8 percent increase in its military budget, after an average annual increase of 15 percent in the preceding five years in China's military spending – one of the few sectors that outpaces the country's overall economic growth – and the spending pattern has held mostly consistent since that time. The Chinese government has accelerated efforts to modernize and upgrade the People's Liberation Army (PLA), a trend it began in the 1990s. The lack of transparency regarding Chinese defense expenditures obscures matters, but most foreign analysts estimate that because the official figure excludes spending on military research and development, nuclear weapons, and major foreign-weapons imports, that its spending is actually far higher.[10] Despite China's significant military modernization, they have yet to publically articulate a "grand strategy" and remain relatively attracted to pursuing non-confrontational policies as laid out in Deng's "24 Character Strategy."[11]

Table 3: China's 2008 Manpower

Branch	Manpower
Army	1,600,000
Navy	255,000
Air Force	250,000
Paramilitary	1,500,000[1]
Reserves	~ 800,000

Source: *The Military Balance* (2008). Military tables depict manpower in 2008, but game players should use these figures as a baseline of minimum capabilities for 2015.

Whatever the actual numbers on defense spending, U.S.-led military operations in Iraq and the former Yugoslavia influenced the Chinese government to pursue improved capacities for power projection, precision strike, and the other capabilities associated with the latest so-called

[8] See "U.S. Eyes Humanitarian Drills with Chinese Military," *Reuters* (16 July 2008).
[9] U.S. Department of Defense, "Military Power of the People's Republic of China," Annual Report to Congress (2008): 18.
[10] Ibid.: 31-2.
[11] Ibid.: 8.

CNAS Game Material

revolution in military affairs (RMA).[12] For example, the PLA has emphasized developing rapid reaction forces capable of deploying beyond China's borders, and the PLA navy (PLA-N) has been acquiring longer-range offensive and defensive missile systems and more effective submarine forces (i.e., more operationally efficient and stealthy).[13]

Besides allowing the PRC to improve its traditionally weak indigenous defense industry, rapid economic growth has made China a prolific arms importer, and Russia has been an especially eager seller.[14] China has also been developing a three-carrier battle group posture,[15] and PLA-N has advanced its "over the horizon" targeting capabilities with new radars.[16] Many of China's naval advancements could be used – if approved by the PLA – to aid in disaster relief efforts, particularly floods and rising sea level-based challenges. However, the development of a trans-oceanic navy will likely include having Chinese naval assets far from the mainland. This may prove particularly costly as responding to natural disasters requires rapid, effective, and mass reaction.

Even though China has advanced its airlift capabilities, the platforms the PLA has invested in (such as the J-12) may offer little utility in responding to natural disasters that require heavy-lift air capability and transport, such as the Y-8 cargo plane. China's space program has resulted in its acquiring new surveillance, communication, and navigation capabilities.[17] This capability could prove important in providing environmental monitoring technology for both preventative and disaster relief operations.

The Chinese presence in Gwadar, Pakistan, located opposite the vital energy corridor of the Strait of Hormuz, also has a strategic dimension. For several years, China has been pursuing a "string of pearls" strategy to gain access to major ports from the Persian Gulf to Bangladesh, Cambodia, and the South China Sea.[18] China's neighbors are wary.

CNAS Game Material

[12] Michael Pillsbury, "China Debates the Future Security Environment," (Washington D.C.: National Defense University Press, 2000): 278-304.
[13] Lyle Goldstein and William Murray, "Undersea Dragons: China's Maturing Submarine Force," *International Security* (Spring 2004): 161-196.
[14] "China's navy: Drive for modernization," *IISS Strategic Commentary* 14:1 (January 2008): 2.
[15] See, for example, Russell Hsiao, "China navy floats three-carrier plan," *The Asia Times* (8 January 2008); and U.S. Department of Defense, "Military Power of the People's Republic of China," Annual Report to Congress (2008): 4.
[16] U.S. Department of Defense, "Military Power of the People's Republic of China," Annual Report to Congress (2008): 4.
[17] Ibid.: 2-3.
[18] Ibid.: 33.

Table 4: Chinese Capabilities Relevant to Addressing the Effects of Climate Change

Capability	Service	Quantity	Applicability		
			Humanitarian Assistance	Basic Services Restoration	Security
Selected Air Capabilities					
Search and Rescue Helicopters	Army	7 SA-321 *Super Falcon;* 61 AS-350 *Dauphin 2;* 8 SA-316 *Alouette III*	X	X	
Utility Helicopters	Air Force	20 Z-9 (AS-365N) *Dauphin* 2; 4 Bell 214; 6 AS-332 *Super Puma*	X	X	X
Search and Rescue Helicopters	Navy	15 SA-321; 20 Z-8, Z-8A (SA-321Ja) *Super Frelon*	X	X	
Selected Sea Capabilities					
Aircraft Carriers	Navy	1 Possibly under construction	X		X
Amphibious Assault	Navy	84 Amphibious Assault Ships	X		X
Small Amphibious	Navy	140 Amphibious Craft	X	X	
Strategic Sea Lift	Navy	204 Logistics and Support Ships	X	X	
Search and Rescue	Air Force	3 Squadrons	X		
Selected Manpower Capabilities					
Infantry	Army	18 Divisions	X		X
Engineers	Army	About 130,000 individuals	X	X	
Reserve Infantry	Army National Guard	30 divisions	X		X
Reserve Support	Army National Guard	7 Support Brigades	X	X	

CNAS Game Material

Reserve Infantry	Army Reserve	30 Divisions	X		X
Reserve Support	Army Reserve	7 Support Brigades	X	X	
Infantry	Marines	2 Brigades	X		X

Source: *The Military Balance*, International Institute for Strategic Studies, (London, UK: Routledge, 2008).
Note: Military tables depict manpower and capabilities in 2008, but game players should use these figures as a baseline of existing capabilities in 2015.

Resources

China is both the world's largest food producer and consumer. China is a net food exporter, despite its large population. State-planned agricultural policies have emphasized self-sufficiency in grain production, both at a national level and at a regional level (although regional policy changes from time to time).[19]

China's continued agricultural growth is projected to be constrained in the future by scarcity of land and water resources. Already, Chinese farmers use land that is less than ideal, including arid desert-like land, steep hillsides, and land without significant water resources.[20] Government investment in agricultural research and infrastructure has been a major factor in growth to this point; for example, farming of sub-optimal land as described above is often made possible by massive irrigation projects. However, increased development and urbanization in China means that both land and water resources face non-farm competition. There is also the possibility of labor scarcity in part due to China's rural-to-urban migration.[21]

In 2015, eastern areas of Asia are experiencing increased crop yields, but South and Central Asia have even more pronounced declines, particularly in wheat production. Agricultural regions are shifting northward.[22] It is projected that rice crop yield potential could decline by 5 to 12 percent between 2050 and 2075 through Asia.[23]

[19] Bryan Lohmar and Fred Gale, "Who Will China Feed," *Amber Waves* (June 2008).
[20] Food and Agriculture Organization, "China: Agricultural Sector," at http://www.fao.org/countryProfiles/index.asp?lang=en&iso3=CHN&subj=4
[21] Ibid.
[22] Unless otherwise noted, China information from: R.V. Cruz, H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, "Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., (Cambridge, UK: Cambridge University Press, 2007): 469-506.
[23] Effects from M.L. Parry, O.F. Canziani, J.P. Palutikof and Co-authors, "Technical Summary. Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., (Cambridge, UK: Cambridge University Press, 2007): 66-67; paired with Jones and Siegel date projections for temperature rise.

CNAS Game Material

Some water supplies in Asia, such as the Yellow River in China, face serious flood problems related to sedimentation and pollution, especially in densely populated areas.[24] China's water usage has quintupled since 1949, and leaders will increasingly face tough political choices as cities, industry, and farming compete for a finite and unbalanced water supply.[25] The Chinese people are already experiencing increased water stress, in part from the exertion of demographic changes.[26] This is affecting China directly and through migration and instability in neighboring nations, but going forward climate change will also have different effects on water supplies in different areas. In northern China, surface and groundwater will fall short of meeting agricultural demand needs. Some river areas may experience flooding in high-flow times and insufficient water supplies in times of lower flows. Many water sources in China will be susceptible to increased salinization, particularly in coastal areas. Glacial melting from the Himalayas could affect a quarter of a billion Chinese residents dependent that water source.[27]

Migration

China is a party to the 1951 Refugee Convention with reservations for Article 14 (on artistic rights and industrial property), and is also a party to the 1967 Protocol with reservations for Article IV (on settlement of disputes). China is also on the UNHCR Executive Committee. China had a population of 323,600 refugees and asylum-seekers at the end of 2007. The majority (310,900) was from Vietnam, and most of the rest (11,000) were from North Korea.

Today, in 2015, environmental factors (e.g. desertification, flooding, decreasing arable land) have spurred an increase in internal migration. Migratory trends from countryside to city are putting added pressure on already overpopulated urban centers, especially along the eastern coast (e.g., Shanghai, Tianjin).[28] At the turn of the 21st century, China's "floating population" – those not permanently registered in a place of residence – had reached 140 million,[29] and this number has grown consistently. The general migratory patterns of this floating population tend to run from the countryside to cities and eastern coastal areas.[30] Rural migrants outnumber local urban labors in many major cities, flooding the market and depressing wages. The situation is likely to

[24] See UNESCO International Hydrological Program at http://typo38.unesco.org/en/worldwide/ihp-asia-and-pacific.html.
[25] Ibid.
[26] Parry, et al., (2007): 23-78.
[27] Cruz, et al.: 484.
[28] Huang Ping and Zhan Shaohua, "Internal Migration in China: Linking it to Development," People's Republic of China Ministry of Foreign Affairs, Department for International Development (14-16 March 2005): 3.
[29] Ibid.: 2.
[30] Ibid.: 2-3.

CNAS Game Material

deteriorate as agricultural workers continue leaving their rural communities that have been destroyed by environmental factors.[31]

Disasters

Natural disasters in China affect more than 200 million people every year.[32] The Ministry of Civil Affairs of China organizes and coordinates disaster relief and distributes relief funds and materials. In 2004 the central government also created a natural disaster emergency response system that is now operational.[33] Standing Committee, the highest executive body in the nation, has helped streamline disaster relief laws and emergency power provisions. Beyond the central government level, 31 provinces, autonomous regions, and municipalities have their own response plans.[34]

Higher temperatures have contributed to increased instances of cardiovascular and respiratory disease, as well as deaths due to heat stress. China, like India, is also experiencing increasing occurrences of dengue fever.[35] Recently, increasing desertification in the autonomous Uighur region of Xinjiang has sparked an open competition for scarce land resources and rekindled ethnic tensions. If the situation escalates, it could draw China into a regional conflict with bordering nations such as Kazakhstan, Kyrgyzstan, or Tajikistan.[36]

In western, eastern, and southern China there is an increasing frequency of extreme precipitation events leading to disruptive snowstorms in the winter, and more frequent floods in the summer months.[37] Flooding along the Yangtze River has destroyed staple crops and contributed to a rise in waterborne diseases in many urban areas. Last year, 2014, was a particularly extreme year. After more than 30 days of heavy downpours, many parts of the Yangtze and Huaihe rivers flooded, often overwhelming dykes and disrupting river traffic. In order to protect surrounding communities, Chinese officials have often allowed flooding of rice, cotton, and tobacco crops in order to absorb the excess water.[38]

CNAS Game Material

[31] Ibid.: 2.
[32] See UNDP report at http://www.undp.org/cpr/disred/documents/publications/corporatereport/asia/china.pdf
[33] See Asian Disaster Reduction Center at http://www.adrc.or.jp/publications/TDRM2005/TDRM_Good_Practices/PDF/PDF-2005e/Chapter3_3.3.3-2.pdf
[34] Zijun Li, "China Tackles Disasters with New Emergency Response System," Worldwatch Institute (6 January 2006).
[35] Cruz, et al., (2007): 487.
[36] Renate Schubert, et al., "Climate Change as a Security Risk," German Advisory Council on Global Change (2008): 143.
[37] Cruz, et al., (2007): 475-476.
[38] "Flooding Affects Rice and Cotton Crops in China," Foreign Agricultural Services, United States Department of Agriculture (19 July 2004).

Severe winter storms frequently disrupt major transportation grids, critical infrastructure and coal shipments, which have caused routine power outages in many cities. Additionally, blocked roadways and railroads have stranded tens of thousands of travelers and migrant workers on several occasions.[39] Despite improved emergency response laws to handle such instances, the snowstorms often overwhelm local governments and military troops are regularly deployed to help control and improve the situation.

CNAS Game Material

[39] Louie Huang, "Winter Chaos Tests China," *Caijing Magazine* (30 January 2008).

European Union in 2015

Background

- Europe is reeling under the impact of sharply increased immigration from North and Sahelian Africa; in addition, there are millions more people on the southern borders either attempting to enter Europe or impounded in camps. Popular discontent, both within immigrant and longstanding populations, is high and there is unrest in major cities.
- Popular support for assistance to other nations remains high; Europeans continue to believe strongly in the importance of development assistance.
- The energy intensity of the EU economy as a whole has declined, although there are regional differences.
- Public opposition to genetically modified organisms (GMOs) remains high, though there is an increasing shift of opinion on the necessity of GMOs in the face of a growing global food crisis.
- Although there have been major advances in wind turbines, concentrated solar, energy efficiency, biodiesel, and hydrogen in Europe, they have not yet translated into commercial advances that have significantly displaced fossil fuels.

Political and Climate Change Policy Profile

The EU has overcome its institutional crisis by 2015 and strengthened its role internationally, based on the former Lisbon Reform Treaty. Member states nevertheless remain important players on the international level, especially in the framework of international institutions. The Union consists of 28 member states - including Croatia - and is considering membership of the rest of the Western Balkan countries by 2016. Despite strong economic cooperation with Turkey, political relations between the EU and Turkey have worsened due to Europe's reluctance to grant EU membership to the country. The Mediterranean Union project has not made significant progress.

Despite high energy prices, the enlargement of the Euro zone and the increasing internal economic ties were able to maintain a low but steady economic growth so far, with some regional inconsistencies. However, restrictive immigration policy continues to mount pressure on Europe's aging workforce problem and high-cost social programs. This policy leads to increasing illegal immigration from the Middle East and North Africa to Europe and provokes riots in major European cities. For this reason, most of the European countries are ruled by conservative governments. A European-wide debate on structural economic and social reform has not yet resulted in any concrete steps.

CNAS Game Material

The EU's dependence on Russian gas has increased. Nevertheless, new infrastructures to import LNG (liquified natural gas) from countries like Qatar and Algiers are close to being finished. Relations with Iran have improved somewhat, and there are talks of expanding natural gas imports from Iran. More nuclear power plants are being built in France, Italy, and Bulgaria, but a region-wide nuclear renaissance does not appear to be happening.

The EU has started the third phase of its cap and trade system and has included aviation. Full auctioning of permits is applied to the power sector. Prices for one ton of CO2 are stable between 35-40 Euros in 2015. The steel industry and a few other industries have been excluded due to competitiveness concerns. Fuel efficiency standards of 50mpg have been in force for carmakers since 2012. The European energy markets have become more liberalized. This stronger competition has shown price-decreasing effects, but overall electricity prices have gone up due to the cost for CO2-allowances and the construction of new power plants.

European nations have adequate capabilities for most local disaster relief and the management of most resources at the national level. At the regional level, in 2009 the EU implemented an integrated adaptation plan, as many of the challenges brought on by the effects of climate change require transnational cooperation and were already subject to EU common policies.[1] A key aspect of the current EU adaptation program is to share information, technical knowledge, and resources (financial and non-monetary) with developing nations. Specifically, the EU has integrated climate change adaptation into its programming for poverty alleviation and broader development assistance.[2]

The EU Common Foreign and Security Policy covers migration issues, but individual European nations continue to struggle as systems are being strained by the burden of heavy increases in migration. As part of its broader migration strategy for 2007 to 2010, the EU set up several rounds of regional negotiations with and increased development assistance for Africa to tackle migration issues. Many analysts believed such efforts had positive results, however, the influx of illegal immigrants through northern Africa beginning in 2012 has continued and added great strain to relations and has once again become a hot political issue in most southern European nations.[3]

CNAS Game Material

[1] Commission of the European Communities, "Adapting to Climate Change in Europe – Options for EU Action," Green Paper from the Commission to the Council, The European Parliament, The European Economic and Social Committee and the Committee of the Regions (29 June 2007): 12.
[2] Ibid.: 22.
[3] See, for example, European Commission, "Strategy for the Thematic Programme of Cooperation with Third Countries in the Areas of Migration and Asylum: 2007-2010," (25 September 2007), available at http://ec.europa.eu/external_relations/migration/intro/index.htm.

Economic and Demographic Profile

Gross domestic product in Europe in 2015 is $17.3 trillion (on a purchasing power parity [PPP] basis, expressed in 2007 US dollars), up from $14.8 trillion in 2007. Real growth since 2007 has been reasonable, at just over 2%, down marginally from the growth registered from 2001 to 2007. Europe's population has continued its stagnation, with growth of only 0.3% and a population that now stands at 512 million (up from 498 million in 2007). Like with other OECD areas, the small net population increase was from immigration, as birth rates have declined. The population is projected to grow faster in OECD Europe as a whole than in just EU nations alone through 2030. The EU population will also experience average age increases, and from 2015 to 2030 it is projected that there will be zero net population growth. Per capita income has recently increased by about $4,300, from $29,600 in 2007 to $33,900 today in 2015.

Table 1: Long-term Population Trends (in millions of people)

	2000	2050	2050 versus 2000
China	1,300	1,500	+200
India	1,350	2,100	+750
Eastern Europe	150	150	0
Western Europe	350	400	+50
USA	300	500	+200
World Population	6,110	9,015	+2,905

Source: Oak Ridge National Laboratory; data results from ORNL population projections consistent with the IPCC scenarios, based on A1FI assumptions.

Energy Profile[4]

Oil demand in the EU was 13.8 million barrels per day (bpd) in 2006, and rose to 14 million bpd in 2015, and is expected to hold steady from 2015 to 2030. As of 2005, the EU consumed one-fifth of ethanol produced and is projected to consume two-thirds of ethanol produced by 2030. It produced 87% of the world's biodiesel, at 2.53 Mtoe in 2005, with Germany making up 62% of

[4] Energy projections are derived from the International Energy Agency, *World Energy Outlook* (2007) unless otherwise noted.

total EU production, and this proportion holds today. Biofuels are expected to constitute 4% of Europe's transport fuel by 2030, up from about 1% in 2005.[5]

Coal consumption is dropping, and is expected to fall to 10% below 2005 levels by 2030 in the European Union, having hit a high point around 2000, in part due to CO2 emissions capping programs. EU coal production has and continues to decline, and its reserves only account for about 4% of world total,[6] indicating that if consumption were to take a different trajectory, greater importation would be necessary. Electricity demand, however, continues to increase, from 2,755 terawatt-hours (TWh) in 2005 to 3,179 TWh today in 2015, and an even faster rate of increase is projected for the following 15 years.

Table 2: European Union Energy Mix, 1990 to 2050.

	1990	% of total[7]	2005	% of total	2015	% of total	2030	% of total	2050	% of total
Total Energy (Mtoe)	1,653	100	1,814	100	1,911	100	2,005	100	2,286	100
Coal	451	27	317	17	291	15	275	14	255	11
Biomass (including fuel wood and waste)	46	3	83	5	127	7	182	9	294	13
Oil	626	38	671	37	678	35	670	33	659	29
Natural Gas	295	18	444	25	509	27	610	30	777	34
Nuclear	207	13	260	14	239	13	159	8	92	4
Other renewables (including hydro, wind and solar)	28	2	39	2	67	4	109	5	209	9

Source: International Energy Agency, *World Energy Outlook* (2007). The 2050 calculations are derived as follows: the average yearly rate of growth for the period 2015 to 2030 was extended to continue at the same rate each year for the period 2030 to 2050.

[5] Ethanol/biodiesel information from the International Energy Agency, *World Energy Outlook* (2006).
[6] *World Energy Outlook* (2006).
[7] Totals and percentages rounded; total of all columns may therefore be +/- 100%.

Coal has declined by about 2% of total EU energy consumption by 2015, and that demand has been made up by an increase in natural gas. Natural gas demand increased through 2015, but production in OECD Europe is projected to decline slowly through 2030. This is forcing up demand for imports, which will be met by increases from the Middle East and Africa, and possibly from Russia and Venezuela if they can improve production capacity at the pace needed to do so in the future. In 2015, OECD Europe imports 54% of the natural gas it consumes, which is projected to increase to 67% by 2030.

Nuclear power generation capacity in the EU will decline by 2030 as a result of policy choices, especially in Germany, Sweden, and Belgium. Many nuclear and coal-fired power plants are planned to be decommissioned in the next few decades, and the EU is expected to invest the needed capital in replacing overall energy capacities to meet demand.

Military Posture and Capabilities

The Petersberg Declaration of 1992 stated that "Apart from contributing to the common defense in accordance with Article 5 of the Washington Treaty and Article V of the modified Brussels Treaty respectively, military units of WEU member States, acting under the authority of WEU, could be employed for: humanitarian and rescue tasks; peacekeeping tasks; tasks of combat forces in crisis management, including peacemaking."[8] The goal of this declaration, taken in part with other initiatives by the Western European Union members, was to increase the operational role of European forces out of Europe. Since this declaration, many other initiatives and agreements have continued to move European nations towards this goal, and it reflects a primary concern for European militaries today.

In 1999, at the Helsinki Summit, in recognition of the need for Europe to increase its efforts towards a common defense, member states decided on the Helsinki Headline Goals 2003. The Headline Goals were a statement of the military capabilities that the EU hoped to be able to generate by 2003; the stated goals were "being able, by 2003, to deploy within 60 days and sustain for at least one year forces up to corps level (60,000 persons). These forces should be militarily self-sustaining with the necessary command, control and intelligence capabilities, logistics, other combat support services and additionally, as appropriate, air and naval elements."[9]

It gradually became clear that the Helsinki Headline Goals lacked one major element: responsiveness. The 60,000-strong force was unwieldy and difficult to mobilize quickly. In light

[8] Western European Union Council of Ministers, "Petersberg Declaration," (12 June 1992), available at http://www.weu.int/documents/920619peten.pdf.

[9] Nice European Council, "Presidency Report on the European Security and Defence Policy," Annex I to Annex III (7, 8, and 9 December 2000), available at http://www.esdp-course.ethz.ch/content/ref/2000Nice_Excerpt.htm.

CNAS Game Material

of this problem, member states developed the Headline Goals 2010, which took into account the lack of responsiveness of the capabilities developed in line with the Helsinki Headline Goals. The new goals stated: "The ability for the EU to deploy force packages at *high readiness as a response to a crisis* either as a stand-alone force or as part of a larger operation enabling follow-on phases, is a key element of the 2010 Headline Goal. These minimum force packages must be militarily effective, credible and coherent and should be broadly based on the Battlegroups concept."[10] Through 2015, the EU has worked rather successfully toward this goal of high crisis response, but no nations have dramatically increased their capabilities.

The European Union will use one or more of several available options for military action in cases of natural disaster relief, heavy migration pressure, or humanitarian crisis response. The sections below detail some of the mechanisms for force that might be employed by the EU member states.

The EU Battlegroup Concept (BG 1500)

Following the success of Operation Artemis, in which European forces deployed rapidly to the Democratic Republic of the Congo to intervene in a crisis there, the French and the British unveiled the Battlegroup Concept in 2004. This concept solidified the notion of a rapid-response (compact but high-utility) European force that could be deployed within 10 days to a theater, in line with the Headline Goals 2010.

The EU now has two battlegroups on call, on half-year rotations, at all times. Its goal is to be able to carry out two simultaneous, unrelated missions at the same time. The standard size for a battlegroup is about 1,500 soldiers, and they are at a 10-day readiness during their entire 6-month rotation of duty, and the missions they carry out are based upon both the Petersberg Tasks and the tasks from the European Security Strategy:

Table 3: European Security and Defence Policy Tasks and Missions[11]

Petersberg Tasks	Tasks from the European Security Strategy
Humanitarian and rescue tasks	Joint disarmament operations
Peacekeeping	Support for 3rd countries in combating terrorism
Tasks of combat forces in crisis management, including peacekeeping	Security Sector Reform (SSR) operations as part of broader institution building

[10] Jean-Pierre Kucheida, "The EU battlegroups −reply to the annual report of the Council, submitted on behalf of the Defence Committee," Explanatory Memorandum (June 2007), available online at http://www.assembly-weu.org/en/documents/sessions_ordinaires/rpt/2007/1964.php?PHPSESSID=3cc86ba911085a8790f8373f8dbf2453#P140_15251.

[11] Recreated from Gustav Lindstrom, "Enter the EU Battlegroups," *Chaillot Paper No.* 97 (Paris: Institute for Security Studies, February 2007): 17.

CMANS Game Material

However, each battlegroup's actual capability depends on the assets and commitments of the member states comprising the group. Furthermore, it is important to understand that the operational and strategic enablers are not actually mandated as a part of each group, but rather must be provided outside the process by participating member states. That is, the EU battlegroups are primarily land-based task forces, and require additional strategic lift assets for large-scale cargo or personnel transport. Some EU countries have acquired new strategic lift assets, but this will not be a dramatic increase; furthermore, these types of asset are typically borrowed from NATO, the United States, or the Ukraine, under the Strategic Airlift Interim Solution agreement.[12]

Table 4: Sample airlift and sealift capabilities of the German, French, and Polish group in 2013.[1]

	Command Nation	Contributing Nations	
	Poland	France	Germany
Aircraft			
Fixed-wing transport, smaller	5 AN-26 2 AN-28		
Fixed-wing transport, large	8 C295 5 C130	14 C130; 42 C160	83 C160
Fixed-wing transport, largest		3 A310	7 A310
Transport helicopters, smaller		106 SA-330	
Transport or Search and Rescue helicopters, medium		7 AS-332 6 AS-355 29 SA 330 8 SA321 9 AS-365F	3 AS-532U2 80 UH-1D
Transport or Search and Rescue helicopters, larger size	32 Mi24D 22 Mi 24BP 24 mi8 13 mi17		
Sealift			
Amphibious Ships	5	8	3
Amphibious Landing Craft	3	19	
CVN/CVH Aircraft Carriers		2	

The battlegroups are designed around a principle of multinationality: they can be formed by any number and combination of nations, or by one nation alone if it has the capability. The groups can be deployed for 30 days, or up to 120 days if they are resupplied appropriately. The groups can deploy up to 6,000 kilometers away from Brussels. Because the battlegroups are relatively small, they are ideal for rapid deployment to hostile

[12] Gustav Lindstrom, "Enter the EU Battlegroups," *Chaillot Paper No. 97* (February 2007).

Training Material

environments, such as failed states, to prevent crises from developing, to provide humanitarian assistance, and, if the problem of strategic lift is resolved, to evacuate non-combatant personnel from hostile environments.[13]

There are some complications and difficulties involved with the deployment of the EU BGs. Multinational groups at times suffer from a lack of interoperability due to different languages, cultures, command and control systems, and equipment. However, each battlegroup must be certified to a minimum level of operability before it can be considered at full readiness to deploy within a two-week timeframe. There is a potential for political difficulty in deciding where the groups will deploy. However, since the group is designed to respond to UN requests for intervention in hostile environments (such as under a Chapter VII mandate), it is hoped that the combined forums of the UN and the EU can achieve consensus about when the battlgroups can be deployed.[14]

Table 5: 2008 Manpower, Select EU Nations

Branch	France	Germany	Italy	Portugal	Spain	Sweden	United Kingdom
Army	133,500	160,794	108,000	26,700	95,600	10,200	99,707
Navy	43,995	24,328	34,000	9,110	23,200	7,900	38,900
Air Force	63,600	60,580		7,100	20,900	5,900	41,920
Paramilitary	199,148		254,300	47,700	73,360	600	
Reserve and/or Civilian	69,815	161,548	41,867	210,900	319,000	262,000	199,280
Other	13,800					42,000	

Source: *The Military Balance*, International Institute for Strategic Studies (London, UK: Routledge, February 2008).
Note: Military tables depict manpower and capabilities in 2008, but game players should use these figures as a baseline of minimum capabilities for 2015.

CNAS Game Material

Other European Force Mechanisms

European Maritime Force (EUROMARFOR)

The European Maritime Force (EUROMARFOR) is comprised of naval forces from four contributing states: France, Italy, Portugal, and Spain. EUROMARFOR and EUROFOR – its sister multinational land force – are designed to work either in tandem or independently as rapid

[13] Ibid.
[14] Ibid.

reaction forces.[15] EUROMARFOR, while pre-structured, is non-permanent, and it can be activated with five days' notice.[16] (It should be noted that the base asset around which the unit is built – an aircraft carrier – can only be provided by the French navy.) The force is specifically designed to carry out Petersberg tasks, or humanitarian, peacekeeping, and "peace-making" missions.

The force is made available not only to the WEU but to NATO and the EU as a whole. The command structure and leadership are provided by the Interministerial Committee, as is the case for EUROFOR, and like that body, EUROMARFOR has largely become a part of the European Security and Defence Policy.[17] Command responsibility (COMEUROMARFOR) is assigned for a two-year period on a rotating basis among the four member states. The force is activated for training and real-world operations. For example, it was stood up in support of Operation Enduring Freedom (Afghanistan) from 2002 to 2004, operating in the Indian Ocean and the Red Sea, and again in support of general counterterrorism operations from August to December 2005 as part of the multinational Task Force 150.[18]

European Operational Rapid Force (EUROFOR)

The European Operational Rapid Force (EUROFOR) was formed in 1995 and declared operational in 1998. EUROFOR can be used in the service of either NATO or the EU. EUROFOR and EUROMARFOR are basically complementary, and have a similar political/military command structure. This force, like the battlegroups and EUROMARFOR, can carry out Petersberg missions. It is headquartered in Florence, and has a reserve of 5,000 troops which can be increased to 10,000 as needed. Like EUROMARFOR, this is not a standing force.[19]

EUROCORPS

The EUROCORPS is a European multinational force, made up of military units from five European countries (Germany, Belgium, Spain, France, and Luxembourg). The permanent headquarters of EUROCORPS is in Strasbourg and can be used for NATO or EU missions. EU

[15] French Embassy in the United Kingdom, "Reply by M. Hubert Védrine, Minister of Foreign Affairs, to a written question in the Senate, Paris," (2 May 2002), available at http://www.ambafrance-uk.org/Eurofor-Reply-by-M-Hubert-Vedrine.html.
[16] Assembly of the WEU, "Multinational European Forces," (3 December 2002), available at http://www.assemblee-ueo.org/en/documents/sessions_ordinaires/rpt/2002/1804.php?PHPSESSID=a7478ea14d2f137dc6a721296877c08a#P111_17253.
[17] Ibid.
[18] Ministry of Defense (France), "The French Navy and Europe," (2008), available at http://www.defense.gouv.fr/marine_uk/decouverte/organisation/autres_commandements/the_french_navy_and_europe__1.
[19] Assembly of WEU, "Multinational European Forces," (3 December 2002), available at http://www.assemblee-ueo.org/en/documents/sessions_ordinaires/rpt/2002/1804.php?PHPSESSID=a7478ea14d2f137dc6a721296877c08a#P127_20484.

CNAS Game Material

member states are in the process of reforming EUROCORPS to be a rapid reaction force. Thirteen European nations (including Greece, Poland, Turkey, Austria, Finland, the Netherlands, Italy, and Great Britain) are involved in EUROCORPS to some degree (such as having liaison officers to the force), but only those five framework nations assign units to the force even during peacetime.[20]

European Air Group (EAG)

The European Air Group was formed in 1995, as a result of efforts by the French and British. Initially, the group only included the French and British, but it was expanded in 1999 to also include Germany, Belgium, Spain, Italy, and the Netherlands. The Air Group is a coordination mechanism, rather than a force with its own assets, designed to help foster interoperability and joint operations between the countries.[21]

NATO Response Forces

The NATO Response Force (NRF) is another mechanism for rapid deployment of forces. The NRF is also designed to operate for 30 days initially, and longer if resupplied. Also like the battlegroups, the NRF is on a six-month rotation of readiness. It is also able to engage in humanitarian operations, respond to crises, etc. The main differences between NRF and BG 1500s are: their size (the NRF are approximately 9,500 troops as opposed to 1,500); their capabilities (the NRF contain sea- and air-based components as well as land-based capabilities); and the involvement of the U.S. in the NRF.[22]

Resources

The European Union implemented the Common Agricultural Policy (CAP) years ago, as a policy mechanism to protect domestic farms and buffer Europe's food security. The system proved so successful in conjunction with European farming efficiency that an excess supply of produce was created. Cereals, sugar, milk and other goods surpassed domestic demand and the surplus threatened to implode European farming.[23] During the 1980s, the EU attempted to rectify its policies by cutting back on export subsidies, limiting guaranteed prices, and dumping food surpluses. There was sharp opposition by farmers throughout the EU. Today, the EU subsidizes for meeting environmental standards with regard to arable land rather than for producing food.[24] The CAP is still undergoing changes to better attain its initial goals in a sustainable manner.

[20] Ibid.
[21] Ibid.
[22] Lindstrom (2007).
[23] See "The reform of the common agricultural policy (CAP)," at http://www.ena.lu/?lang=2&doc=10792.
[24] See the HGCA Knowledge Centre, "Background to the Common Agricultural Policy (CAP)," at http://www.hgca.com/minisite_manager.output/1583/1583/Knowledge%20Centre/Markets/Introduction%20to%20EU%20cereals%20policy.mspx?minisiteId=11; and CAP Health Check, at http://caphealthcheck.eu/.

CNAS Game Material

The EU has long recognized that it will be affected by climate change, and has shown it is willing to take the necessary policy steps. Agriculture is beginning to suffer in the south and southeast, but northern areas are seeing positive net effects. The CAP already has some building blocks in place which should make it easier to adapt to climate change, such as the decoupling of farm support and the rural development policy. The decoupling farm initiative no longer ties production of certain crops to payments received; instead, it ensures farmers can produce whatever profits them in a free market without removing production subsidies.[25] Producing what grows best in their climate, which they can sell for the most profit, is one coping mechanism for climate change that the EU is undertaking.

Overall, beyond 2015 climate change effects will increase agricultural productivity in much of the EU, but this varies widely by region. Some crops, such as wheat, are increasing dramatically in yield – from 2 to 10 percent in northern Europe and 3 to 4 percent in southern Europe by 2015, and 10 to 25 percent in northern Europe and 10 to 20 percent in southern Europe after 2050.[26] The viability of other crops will migrate north and to higher latitudes. Especially in southern Europe, increasing yield potential may be offset by extreme weather events, particularly drought and heatwaves. The harvest season has been pushed forward to the hottest summer months, and, consequently, has increased water demand for irrigation. Additionally, the persistent and intense heat waves and drought have made vineyards more vulnerable to pests and disease.[27] Together, higher production costs and production losses have increased the price of wine and decreased exports. Livestock production and grassland productivity have also suffered: higher temperatures and drought have killed many farm animals and productive grazing lands have decreased due to drought conditions.[28]

Although the agriculture industry only accounts for a small portion of GDP in southern Europe, it maintains a strong and vocal lobby. A Mediterranean agricultural coalition (France, Italy, Spain, Portugal, and Greece) has united and is demanding the EU updates CAP's water management policies to reflect the agricultural impacts of climate change. Specifically, this coalition is demanding an increase in subsides and an EU water transfer system from the "wet northern countries to the dry south."[29]

Water disputes involving EU states are rare as most of the continent generally has sufficient access to clean water even in times of strain. The Water Frame Directive (WFD) was created to

[25] See "Agriculture and Climate Change," European Commission, at http://ec.europa.eu/agriculture/climate_change/index_en.htm; and "The Common Agricultural Policy – a Glossary of Terms, at http://ec.europa.eu/agriculture/glossary/index_en.htm#decoupling.
[26] Effects from Parry, et al. (2007): 66-67, paired with Jones and Siegel date projections for temperature rise.
[27] "Climate Change in the Vineyards: The Taste of Global Warming," Press Release, The Geological Society of America (3 November 2003).
[28] Jason Anderson, ed., "Climate Change-Induced Water Stress and Its Impact on Natural and Managed Ecosystems," Policy Department, Economic and Scientific Policy, European Parliament (January 2008): 7-8.
[29] "When Rain Does Not Fall in Spain, the Farmers March to Protest," *The New York Times* (18 November 1999).

CNAS Game Material

sustainably manage water to unify European policy and set quantifiable standards.[30] The EU has enacted a Waste Water Directive which promotes primary/secondary water treatment installations throughout the region. These initiatives, along with the relative richness of water in Europe, are epitomized in the EU water slogan: "Sharing water is not a likely option, but an obligation imposed by reality."[31] Outside the EU, but still within Europe, disputes in former Soviet states have occurred in recent years, many of which were repressed by Moscow and boiled up during independence movements after the collapse of the Soviet Union.[32] These conflicts have come closer to resolution after years of hard fighting with NATO peacekeepers and UN mediating.

Amidst this political confrontation, some European publics, especially in the southern countries, are facing water shortages, higher water prices, and rolling blackouts during hot summer months due to lack of cooling water. For some time, glacial melting will produce increased flows of some rivers; however, as glaciers shrink the flows will likewise taper. Water availability will increase 5 to 15 percent in northern Europe but remain steady or decline up to 25 percent in southern Europe after 2015, which could cause some changing migration patterns within EU states. However, water stress could most dramatically affect Europe through immigration and instability, as 75 to 250 million Africans will endure increased water stress by 2015, growing to perhaps 350 to 600 million after 2050.[33]

Migration

All member states of the European Union are parties to the 1951 Refugee Convention except for Andorra, Montenegro, and San Marino. Those same countries, with the addition of Monaco, are the only EU states not party to the 1967 Protocol. Most states have declared reservations to one or more of the Articles of the Convention, though which Article(s) varies by country. Despite the general acceptance of the Convention, there is no harmonized system for asylum granting.

The EU created a common border and immigration policy in 2010, but it has been hampered by security concerns and by the gross complexities of aligning 27 different sets of immigration bureaucracies and practices.

Drought, food shortages and political instability especially in North Africa and the Sahel are triggering an influx of refugees to Europe. Food shortages and political unrest have resulted in a surge of African refugees into the EU, where they are not integrating well into mainstream

[30] See European Union Water Expo at http://expozaragoza2008.europa.eu/GBR/f/4/The-EU-Pavilion/The-human-nature-of-the-problem.
[31] See European Union Water Expo at http://expozaragoza2008.europa.eu/GBR/f/17/The-EU-Pavilion/Conclusions.
[32] See Timeline of Water Conflicts at http://worldwater.org/conflictchronology.pdf.
[33] Effects from Parry, et al. (2007): 66-67, paired with Jones and Siegel date projections for temperature rise.

CNAS Game Material

society. The primarily Muslim refugees tend to join or develop segregated communities on fringes of urban centers, triggering an uneasy societal balance and boiling over in to civil unrest at times. "Native" populations are increasingly hostile to immigrants. Consequently, European capitals are feeling domestic pressure to reassess their liberal border and migration policies. This situation will only intensify as Europe's Muslim population is expected to double by 2025.[34] This, along with water tensions and other issues in the Middle East, are creating security and stability issues and could also affect some of Europe's major energy import routes.[35]

Disasters

In southern and central Europe persistent heat waves and drought, especially along the Mediterranean region, have caused a competition for the allocation of water among agriculture, industry, and households. Summer wildfires such as those that struck Greece in 2007 have become common in the Mediterranean countries. Increased flash floods and winter floods are likely by 2020 in some areas of Europe. Droughts and heatwaves, and subsequently seasonal fires, will increase in frequency and intensity.[36]

The EU luckily is equipped to handle many such contingencies. In 2001, the European Civil Protection Force was established to enhance EU disaster preparedness and response,[37] however, it only responds if a nation is struck by a natural or man-made threat through the pooled resources of 27 states.[38] In order to do this, the ECP attempts to effectively deliver assistance and emergency teams to any member state. Since its inception, efforts have been made to bolster the resources available to the ECP in anticipation of future climate change related disasters.

There are two mechanisms of the ECP: 1) The Monitoring and Information Center (MIC) which is the communication hub at headquarters level between participating states, the affected country and dispatched field experts; and 2) the Common Emergency Communication and Information System (CECIS) that is a web-based alert and notification application created with the intention of facilitating emergency communication among the participating states. Appeals for assistance are made through the MIC.[39] The ECP has been requested at the disaster locations in Algeria, Iran, Morocco, Pakistan, South Asia, Portugal, Romania and Bulgaria, and for Hurricanes Katrina and Rita in the United States.

CNAS Game Material

[34] Kurt Campbell, et al., *The Age of Consequences: The Foreign Policy and National Security Implications of Climate Change* (2007): 59.
[35] High Representative and the European Commission, "Climate Change and International Security," Paper to the European Council (14 March 2008).
[36] Parry, et al., "Technical Summary," (2007): 51.
[37] See ECP website at http://ec.europa.eu/environment/civil/prote/mechanism.htm
[38] Ibid.
[39] Ibid.

India in 2015

Background

- Indian military capabilities for disaster relief, border control, and humanitarian assistance are under tremendous strain due to cyclone refugees from Bangladesh and flooding and civil unrest in several parts of the country.
- Rural to urban migration has contributed to falling agricultural productivity, supply imbalances, and rising food prices; popular unrest in rural and urban centers over food is common.
- India has not met its aspirational Copenhagen targets and, in fact, has seen a significant rise in total emissions and per capita emissions.
- Although there have been major advances in information technologies, energy efficiency, nanotechnology, carbon capture, nuclear power, and renewable technologies in India, they have not yet translated into commercial advances that have significantly displaced fossil fuels.
- About 80 percent of the country is considered prone to natural disasters, including some exacerbated by global climate change (severe weather events, flooding, heat waves).

Political and Climate Change Policy Profile

In 2015, India is governed by a coalition with a platform focused on ensuring continued economic growth of at least 7-8% per year and fostering sustained employment; protecting the livelihood of agricultural workers; fully empowering women in all areas of society; and facilitating entrepreneurship in business, the sciences and other professional economic sectors.[1]

The governing coalition desires to solidify the country's energy security, especially for oil. Additionally, it is interested in investing more in the overseas hydrocarbon industry.[2] Nuclear power remains an important energy option for the Indian government but international calls for greater IAEA oversight are impelling heated political debates about the appropriateness of it. India has large thorium reserves and many see fast breeders as India's future. The government of India also believes technology transfers from developed countries are essential for reducing carbon emissions in the developing world.

Since ratifying the Kyoto Protocol in 2002, India has taken various measures to reduce emissions through economic restructuring, local environmental protection and technological change. Some examples of national measures on emissions include: restructuring the coal sector through privatization, reducing subsidies, and technological improvements; introducing limited vehicle

[1] Adapted from the "National Common Minimum Programme of the Government of India," (May 2004).
[2] Ibid.

CNAS Game Material

emissions performance standards; and funding public investment to develop natural gas infrastructure and planning for conversion of public transportation to natural gas.[3] These measures have helped lower India's carbon intensity somewhat but overall emissions have grown.

High on India's climate change agenda is working with the private sector to meet its goals for energy security as well as emissions reductions. Indeed, partnerships such as the Asia-Pacific Partnership (APP) on Clean Development and Climate are central to India's emissions-cutting strategy.[4]

The Indian government's adaptation strategy to date has focused on ensuring that dependence on climate-sensitive sectors (e.g., agriculture and forestry) will not disrupt livelihoods.[5] Along these lines, between 2008 and 2015 India implemented parts of its National Action Plan on Climate Change, with special emphasis on efforts to build information collection tools and climate and environment monitoring systems. As the Indian government projected early that its agriculture sector would be particularly hard hit, the nation's scientists have worked to apply new monitoring systems to croplands and to engineer more drought- and flood-resistant crops.[6]

In 2008, the government of India spent 2.6% of the nation's GDP on adaptation measures, including disaster relief, water resource, and infrastructure improvements among the biggest concerns.[7] By 2015, especially as disaster relief operations have increased in quality and quantity, this has grown to 3% of GDP. India served as the host country for 32% of all registered Clean Development Mechanism projects by June 2008,[8] a ratio which held roughly the same through 2015. However, the nation consistently continued to lack adequate funding for the full range of R&D, development, and adaptation projects it wished and needed to implement, and therefore direct aide and tech transfers are high on its agenda for international negotiations.

CNAS Game Material

[3] William Chandler, et al., "Climate Change Mitigation in Developing Countries: Brazil, China, India, Mexico, South Africa, and Turkey," Pew Center on Global Climate Change (October 2002): 20-35.
[4] Under the auspices of the Asia Pacific Partnership, India and eight other countries have "agreed to work together and with private sector partners to meet goals for energy security, national air pollution reduction, and climate change in ways that promote sustainable economic growth and poverty reduction." Other signatories to the APP are Australia, Canada, China, India, Japan, Republic of Korea, and the United States. See http://www.asiapacificpartnership.org/.
[5] Adapted from "India's Initial National Communication to the United Nations Framework Convention on Climate Change," Government of India (2004): v-xi.
[6] Adapted from the Government of India, "National Action Plan on Climate Change," Prime Minister's Council on Climate Change (June 2008): 5, 15.
[7] Ibid.: 15.
[8] Ibid.: 45.

Economic and Demographic Profile

Gross domestic product in India in 2015 is $5.3 trillion (on a purchasing power parity [PPP] basis, in 2007 US dollars), up from $3.0 trillion in 2007. Growth has been rapid, at 7.4%, but a little slower than was registered in the half decade after the turn of the millennium. In spite of population growth from 1.12 billion people in 2007 to 1.27 billion in 2015 (1.6% annually), Indians have been experiencing substantial increases in their standard of living, as real per capita income increased by over 50% from 2007 through today (from $2,700 per capita to $4,200 per capita). As a result, India's share of the world economy has risen from 4.6% to 5.9%.[9] The urban population is expected to increase to 590 million by 2030, up from 317 million today; Utter Pradesh is the most heavily populated area.

Thirty-five percent of India's total population is younger than 15 years old, and 38% live in rural areas. Because of the age demographic, traditional roles of women in many areas, and the informal nature of some of India's economic activity, only 40% of its population is considered to be active participants of the economy.

Table 1: Long-term Population Trends (in millions of people)

	2000	2050	2050 versus 2000
China	1,300	1,500	+200
India	1,350	2,100	+750
Eastern Europe	150	150	0
Western Europe	350	400	+50
USA	300	500	+200
World Population	6,110	9,015	+2,905

Source: Oak Ridge National Laboratory; data results from ORNL population projections consistent with the IPCC scenarios, based on A1FI assumptions.

Some market reforms as well as the population increase have helped to accelerate growth, while poor infrastructure, poor education in some areas, and other development issues have hindered some growth potential at the same time. The service sector makes up a little over half of India's economy, and constitutes a small portion of the nation's energy use. There is more private and foreign direct investment in India today than prior to the current decade, but it still lags behind

[9] Projections care of the Brookings Institution, based on personal analysis and the International Monetary Fund, *World Economic Outlook* (2008).

CNA Material

what is necessary for full development of many sectors, including energy production and electricity infrastructure. The business atmosphere is still hampered by regulations, poor infrastructure, subsidies and other price distortions, and other issues that deter investment.

Energy Profile

As of 2005, coal supplied 39% of India's energy demand. India has the 3rd largest reserves of coal in the world, though domestic supplies are low quality and about 12% of its coal demand is met by imports. Oil supplies 24% of the nation's energy as of 2015, about 70% of which is imported. India's energy mix in 2015 is similar in composition to the past but has increased in quantity, from 539 million tons of oil equivalent (Mtoe) ten years prior to 770 Mtoe. Coal continues to grow as a percentage of total energy consumed through 2030. Electricity generation is expected to grow at 6.1% per year through 2030.

The iron and steel industries should continue with a strong increase because of growing demand in construction and transportation, which will continue to drive coal demand, including from imports for coking-quality coal. Chemicals, petrochemicals, and cement industries will continue to increase as well.

The number of cars on the road is expected to increase from 68 million in 2004 to about 295 million by 2030. India, notably, does not currently have vehicle fuel efficiency standards, but private sector decisions have kept the country's fleet quite efficient relative to Western standards. The agriculture sector will not change appreciably, and regardless does not account for much of India's energy consumption.

Between 2005 and 2015, energy consumed in India's industrial sector grew 4.7 percent per year, but is projected to slow to 3.7 percent annually through 2030. Transportation sector energy use is projected to grow 6.1% per year from 2005 to 2030, with annual energy use growth 1.6 percent in the residential sector, 3.8 percent in the services sector, and 3.2 percent in agriculture. By 2030, industry is projected to absorb the greatest percentage of India's energy consumed, at 34 percent of the total, with transportation making up 20 percent of the total, and services and agriculture at 4 percent each. Despite its steady growth, energy consumption by the residential sector drops from 44 percent of total energy used in 2005 to 29 percent of the total in 2030.

Coal usage has increased dramatically, and will nearly double from 2000 levels to be overwhelmingly the largest absolute energy source. Government-run or -owned companies will control 93% of coal production, and that sector is somewhat more efficient in 2015. By 2030, India is expected to import to cover 28% of its coal demand, up from 12% in 2005. Today, most coking coal imports are from Australia; some imports are also met by China but it is expected

CNAS Game Material

that the Chinese government will restrict exports as its own domestic demand increases. Public discontent is growing over the high levels of pollution and health effects of increased coal burning.

Oil consumption will continue to trend upward, and India will roughly correspondingly increase its domestic refining capacity. India imported about 2 million barrels per day (bpd) of crude in 2008, about 67% of which was from the Middle East. This has risen to 3 million bpd by 2015, and will rise to 7.6 million bpd by 2030. India does and will continue to export some petroleum products, particularly refined diesel, but by 2030 it will be about 90% reliant on crude oil imports.

India will need significant investment to fully tap its underdeveloped natural gas reserves as its developed ones decline. Its natural gas imports doubled between 2005 and 2010, then stabilized as new domestic production has begun to come on line; it is projected to quadruple between 2020 and 2030 as domestic sources peak and then will begin to decline. Demand will be rising continuously during that time. India has 7 operating LNG hubs by 2015. Notably, much of India's current production and potential reserves are located in its coastal areas, and may be vulnerable to the effects of climate change.

Table 2. India's Energy Mix, 1990 to 2050.

	1990	% of total[10]	2005	% of total	2015	% of total	2030	% of total	2050	% of total
Total Energy (Mtoe)	320	100	539	100	770	100	1,299	100	2,737	100
Coal	106	33	208	39	330	43	620	48	1,437	53
Biomass (including fuel wood and waste)	133	42	158	30	171	22	194	15	230	8
Oil	63	20	129	24	188	24	328	25	689	25
Natural Gas	10	3	29	5	48	6	93	7	225	8
Nuclear	2	.6	5	.9	16	2	33	3	87	3
Other renewables (including hydro, wind and solar)	6	.2	10	1.9	17	2	31	2	69	3

[10] Percentages rounded; total of all columns may therefore be +/- 100%.

Game Material

Military Posture and Capabilities

Since its independence in 1947, India has predominantly pursued a defensive military posture focused on conventional wars of attrition. Under this military paradigm, the Indian Army was organized into a defensive and offensive corps focused on defending its borders from an enemy attack. However, India's military strategy (known as the Sundarji doctrine) was tested during the December 2001 attack on the Indian Parliament by Kashmiri militants. Following the attack, the Indian government launched military operations, Operation Parakram, against Pakistan, which had backed the militants. After a ten-month standoff, the Indian Army withdrew its forces without success. Consequently, many military leaders acknowledged the shortcomings of the Sundarji doctrine in dealing with indirect and unconventional challenges such as terrorist attacks. In essence, a new approach was needed to meet contemporary security challenges.[11]

In 2004, the Indian Army introduced a new Cold Start doctrine, which was focused on breaking from the military's primary focus on a defensive stance. Key elements of the Cold Start doctrine included: the ability to quickly mobilize limited offensive operations; improving joint-service warfare, especially between the Army and Air Force; and instituting better situational awareness across large distances (network centric warfare).[12] Since 2004, the Indian Army has been making steady progress on implementing its Cold Start strategy, through simulations, wargames, and fielding pilot programs. However, in 2015, Cold Start is not yet a fully fielded concept within the Indian Army.

As India has focused on transforming its military, it has also been facing new unconventional challenges, including from climate change. Climate events such as the 2013 Bhola cyclone and extreme monsoon rains have tested India's humanitarian assistance, disaster response, and border patrol capabilities.

In 2015, the Indian military is closely modeled after the American military. It relies heavily on new technologies, for example, and it has expanded missile, attack helicopter, submarines, reconnaissance drones, tank, and carrier/destroyer numbers. Efforts are also underway to develop a vibrant domestic military industrial complex that, modeled off of American military developers, will incorporate private and public sectors in weapons development and manufacturing.

Modernization and expansion have overshadowed the development of disaster relief capabilities over the past decade. The impression is that India is attempting to prove that its military

[11] Walter Ladwig III, "A Cold Start for Hot Wars?: The Indian Army's New Limited War Doctrine," *International Security*, Vol. 32, No. 3 (Winter 2007/08): 158-167.
[12] Ibid.: 163-167.

CNAS Game Material

supremacy is on par with its economic ascendency. In light of this effort, very little energy or funds are going into systems that are primarily fitted for disaster relief.

India has added some military items that have dual roles, particularly in the Navy and Air Force, including one heavy lift utility helicopter squadron.[13] India also has 80 upgraded versions of the MI-17s, and 6 C-130J military transport helicopters.[14]

India purchased an aircraft carrier from Russia that became operational in 2010. The carrier, the INS Vikramaditya, can launch 7 helicopters simultaneously if a disaster should arise. This capability, along with India's long coast, gives the country a significant disaster relief potential.[15] Heavy lift helicopters stationed on the carrier can ferry supplies and men into affected zones. The MI-17, with a range of about 600 miles, can reach most of India and all of Bangladesh from the carrier. Stationing these forces at sea also expands the range of disaster relief to Indonesia, Malaysia, Burma, Myanmar, and Sri Lanka.

On the policy/diplomacy front, India and the United States have agreed to a disaster initiative that makes both parties a partner in future efforts. The initiative states that both nations will improve their military capabilities to deal with disasters as well as their interoperability for such missions and their cooperation with NGOs and the UN. They plan to identify military training needs, share best practices, and implement an early warning system.[16] While some training and consultations have occurred, this program has been unsuccessful in dramatically improving India's capabilities, especially in light of new challenges, or in improving U.S.-Indian interoperability. The coalition government has trouble making any agreement that constrains their options – particularly those affecting growth.

It is interesting to note that although there is not considerable expansion specifically related to disaster relief, many of India's weapons platforms are dual use. The 2004 tsunami saw the deployment of 14 ships (mostly frigates), nearly 1,000 military personnel and several dozen helicopters and airplanes. On the Indian coast, the army was busy collecting bodies, running medical camps and building shelters within 2 days after the disaster.[17] The first unit mobilizations occurred within the 6-9 hours.[18]

[13] India Defense Research Wing, "IAF to Induct New Attack and Heavy Lift Helicopters: Air Chief," (6 February 2008).
[14] Arun Kumar, "Lockheed gets $596 mn contract for India-bound military planes," *Thaindian* (29 March 2008), available at http://www.thaindian.com/newsportal/world-news/lockheed-gets-596-mn-contract-for-india-bound-military-planes_10032447.html.
[15] "Ahead of PM's Russia Visit, Cabinet Clears Defence Deals," *The Times of India* (9 November 2007), available at http://timesofindia.indiatimes.com/India/Ahead_of_PMs_Russia_visit_Cabinet_clears_defence_deals/articleshow/2529619.cms.
[16] See the Indian Embassy, at http://www.indianembassy.org/press_release/2005/July/17.htm.
[17] John Lancaster, "India Takes Major Role In Sri Lanka Relief Effort," *The Washington Post* (20 January 2005).
[18] See the Indian Army, at http://indianarmy.nic.in/araid.htm#DISASTER%20RELIEF.

CNAS Game Material

Table 3: India Military End Strength

	Branch	Manpower
Total Active Service 1,288,000	Army	1,100,000
	Navy	55,000
	Air Force	125,000
	Coast Guard	8,000
	Paramilitary	1,300,586
Total Reserves 1,155,00	Army Reserves*	960,000
	Navy Reserves	55,000
	Air Force Reserves	140,000
	Paramilitary Reserves	987,821

Source: *The Military Balance*, International Institute for Strategic Studies, (London, UK: Routledge, 2008).

Table 4: India's Capabilities Relevant to Addressing the Effects of Climate Change

Capability	Service	Quantity	Applicability		
			Humanitarian Assistance	Basic Services Restoration	Security
Selected Platforms					
Utility Helicopters	Army	150: (50 HAL*Cheetah* (SA-315B) *Lam;* 100 HAL *Chetak* (SA-316B) *Allouette III)*	X	X	X
Logistics & Support	Navy	2 Water Tankers(AWT)	X		
Utility Helicopters	Navy	51: 4 *Dhruv* Advanced Light Helicopters; 6 HAL *Chetak* (SA-316B) *Allouette III;* 25 SA-319 *Alouette III*	X	X	X
Search & Rescue	Navy	6 *Sea King* MK42C	X		
Utility Helicopters	Air Force	80: 8 Dhruv Advanced Light Helicopters (150 on	X	X	X

CNAS Game Material

		order); 24 HAL Cheetah (SA-315B) *Lam* SA-315; 48 HAL *Cheta*k (SA-316B) *Allouette III*			
Utility Helicopters	Coast Guard	17 HAL *Cheta*k (SA-316B) *Allouette III*	X	X	X
Selected Manpower Capabilities					
Infantry	Army	4 RAPID divisions; 18 divisions	X		X
Engineers	Army	3 brigades		X	
Search and Rescue	Navy	1 squadron	X		
Border Security Force	Paramilitary	157+ battalions			X
Anti-Terrorism (National Security Guards) [19]	Paramilitary	Approximately 7,000			X
Special Frontier Force	Paramilitary	10,000			X
Civil Defense[20]	Reserves	500,000	X	X	X
Home Guard[21]	Reserves	487,821	X	X	

Source: *The Military Balance*, International Institute for Strategic Studies, (London, UK: Routledge, 2008).
Note: Military tables depict manpower and capabilities in 2008, but game players should use these figures as a baseline of existing capabilities in 2015.

CNAS Game Material

[19] Anti-terrorism units are made up of elements within the armed forces and Border Security Force.
[20] Reservists are fully trained in 225 categorized towns in 32 states. Some units are for nuclear, biological, and chemical defense purposes.

Resources

India has the potential to produce massive amounts of food crops. However, it has a serious gap in agricultural productivity due to inefficient supply chains. Other problems include depleted groundwater tables; lack of refrigerated transport to support the distribution of specialized produce; failure of the government to support small farmers with loans and irrigation projects; and competition for land resources from developers and rapid suburbanization. Only 40 percent of Indian farms are irrigated, meaning that a lot of potentially farmable land is left idle.[22] In 2014, Punjab's crop harvest only produced half its normal amount. Similarly, the southeastern states of Andhra Pradesh, Tamil Nadu and Karnataka, also major producers of rice, experienced significantly lower crop yields. The government declared a drought in many of its regions (Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh and Andhra Pradesh) and waived many government farm loans.[23] Many agricultural laborers have been left jobless and migrated towards overcrowded urban centers, especially New Delhi, Hyderabad, Pune and Ahmedabad.[24] Once the rains arrived, many parts of India experienced severe flooding, further damaging crop harvests. In the northeastern state of Assam, flood waters rose one meter above the "danger" level, washing away rows of villages and crop seeds.[25] Unlike previous years, the flash flood waters did not quickly recede and Indian Army units were deployed to assist in relief operations.

India's population and demand for food keep growing, but the population is also demanding a more diverse quality of food, putting pressure on farmers to grow high-value crops instead of staple crops in order to make more money. The reluctance to grow staple crops such as wheat is exacerbated by the Indian government's habit of setting an extremely low fixed price for the wheat that it buys.[26] There is extreme waste of food and money due to the inefficiency of the process and corruption among certain intermediaries between farmers, the government, and the poor who receive food.[27] India imports much of its food (including two staples of the Indian diet: vegetable oil and pulses),[28] and is a major recipient of food aid. [29]

On the Indian subcontinent, groundwater in many regions is highly polluted and over-exploited.[30] The main quality problem with ground water in India is due to excess fluoride, arsenic, iron, nitrate and salinity. Salinity is the most common problem because of the seepage of

[22] Somini Sengupta, "In Fertile India, Growth Outstrips Agriculture," *The New York Times* (22 June 2008).
[23] "Indian Fears Over Monsoon Delay," *BBC News* (17 July 2002).
[24] Ibid.
[25] Jill McGivering, "India battles floodwaters," *BBC News* (6 July 2002).
[26] Sengupta, op. cit.
[27] "Making India Food-Secure"
[28] Ibid.
[29] World Food Programme, "Food Aid Flows 2007," available online at http://www.wfp.org/interfais/2008/pdf_2008/Food_Aid_Flows%202007_FINAL.pdf
[30] A. Maria, "The Cost of Water Pollution in India." CERNA (2003), at http://www.cerna.ensmp.fr/cerna_globalisation/Documents/maria-delhi.pdf

CNAS Game Material

brackish water into fresh aquifers due to the over-exploitation of the aquifer.[31] Groundwater makes up between 50-80% of Indian water usage, and up to 94% of groundwater resources in certain regions (Punjab) may already be diminished. The detrimental effect of this over-exploitation and pollution will be most dramatic in India's agricultural sector, which is 70-80% dependant on groundwater. A number of water acts have been passed to curtail the problem although treatment now seems to be a major hurdle.[32] There are also disputes in India over water usage, and it conducts mediation by assigning a tribunal that makes a binding judgment.[33] Many water sources in India will be susceptible to increased salinization in the future, particularly in coastal areas, and per capita water levels in India will decline through 2050.

Migration

India is not a party to the 1951 Convention on Refugees or the 1967 Protocol, but it is on the UNHCR Executive Committee. India had a population of 420,400 refugees and asylum-seekers at the end of 2007, and the rate of increase of refugees has climbed annually. The primary source countries for refugees are China, Sri Lanka, Burma, Nepal, Bangladesh, Afghanistan, and Bhutan. The total number of internally displaced people is too difficult to determine as the government does not collect data on these populations. In 2013, the Bhola cyclone caused millions of Bangladeshis to lose their livelihoods in the agriculture and fishing industry and, subsequently, hundreds of thousands have migrated into India. Many subsistence farmers were also devastated by the Bhola cyclone and, as a result, some Bangladeshis have migrated internally, eastward to the Chittagong Hill Tracts. The migrating farmers have caused tension and intermittent conflict with Chittagong Hill tribes. There has also been an influx of environmental refugees to India (approximately 250,000), with extensive refugee camps forming on the border, resulting in land rights tension with the local Indian population.[34]

As in China, beyond 2015 agriculture and resource issues are expected to drive rural-to-urban migration in India, at times in sudden spikes. India will also experience increased migration due to climate change effects in other parts of Asia.[35]

CNAS Game Material

[31] Ibid.
[32] See Indian Central Pollution Control Board at http://www.cpcb.nic.in/water.php.
[33] Ibid.
[34] Dan Smith and Janani Vivekananda, *A Climate of Conflict: The links between climate change, peace and war,* International Alert (November 2007); and Robert Schubert, *et. al. Climate Change as a Security Risk,* German Advisory Council on Global Change (Sterling, Virginia: Earthscan, 2008): 143-146.
[35] Unless otherwise noted, India information from: R.V. Cruz, H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Huu Ninh, "Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., (Cambridge, UK: Cambridge University Press, 2007): 469-506.

Disasters

According to the World Bank, 80 percent of India's land is vulnerable to natural disasters – floods, cyclones, drought, landslides, and earthquakes, creating major development problems.[36] Responsibility for disaster response in India is split among state, local, and federal governments, but the onus is at the state and local levels for planning and carrying out responses. The role of the federal government is traditionally reserved for large-scale mobilizations and information dissemination, and funding responses to supplement state and local efforts.[37] In recent years, the Indian government has passed legislation and taken more serious steps toward better domestic disaster response capabilities. At the federal level, a National Disaster Management program was created to better coordinate aid funds, direct operations, and provide education and training for mitigation and prevention.[38] India's Disaster Management Bill of 2005 also set out to create state- and local-level disaster management authorities, as well as an 8,000-strong paramilitary response team under the authority of the National Disaster Management program.[39]

USAID and other international organizations also contribute to nonprofit organizations that operate in India, such as the Asian Disaster Preparedness Center, which provides expertise, technical assistance, and training on disaster mitigation and management in Asia.[40]

India's disaster response resources have been strained in recent years. The 2014 monsoon arrived especially late, causing significant damage to wheat and rice crop yields. The northwestern state of Punjab, "India's bread basket" was especially affected by the drought. In the western state of Maharashtra, torrential rainfall paralyzed Mumbai as the city experienced its heaviest recorded rainfall: over 99 cm (39 inches) fell in 24-hours.[41] The heavy rains left the city center under water, shut down the local transportation system, and closed the Stock Exchange for two days.[42] Residents protested against what they considered a slow and inadequate government response to the power outages, lack of drinking water, and debris clean up.[43] Subsequently, the Army was deployed to help with local communities' recovery efforts.[44]

CIAS Game Material

[36] Dipankar C. Patnaik, "An Assessment of National Disaster Management Framework in India," World Bank Institute Natural Disaster Risk Management Program (2005).
[37] India Ministry of Home Affairs, National Disaster Management Response Policy, at http://www.ndmindia.nic.in/manageplan/manageplan.html.
[38] Ministry of Environment & Forests and Ministry of Power, "India: Addressing Energy Security and Climate Change," (October 2007), at http://envfor.nic.in/divisions/ccd/Addressing_CC_09-10-07.pdf.
[39] The full text of the bill can be found at http://aurangabad.nic.in/htmldocs/disastermanagementact2005.pdf.
[40] Asian Disaster Preparedness Center, at http://www.adpc.net/v2007/Default.asp.
[41] "Millions suffer in Indian monsoon," BBC News, August 1, 2005; and "India Rain Death Toll Nears 750," *CNN.com*, July 29, 2005
[42] "Millions suffer in Indian monsoon", BBC News, August 1, 2005
[43] Ibid.
[44] "Flood havoc mounts in South Asia", BBC News, July 13, 2004; "Millions suffer in Indian monsoon", BBC News, August 1, 2005

Since 2010, there has been a shifting trend in wind and precipitation patterns in South Asia, causing unpredictable monsoon seasons and extreme weather events (e.g., droughts, flash floods). Named after a 1970s cyclone, the Bhola cyclone was a devastating storm that hit Bangladesh in November 2013. Despite improvements in emergency planning and evacuation systems, the official government death toll reached 200,000 people. Most deaths occurred as a result of the storm surges in the Ganges Delta, an area that is home to approximately 76 million Bangladeshis.[45]

CNAS Game Material

[45] The consequences of the 2013 Bhola cyclone was adapted from Frank, Neil and Husain, S. A., "The Deadliest tropical cyclone in history?" *Bulletin of the American Meteorological Society*, June 1971; and Sudhir Chella Rajan, *Blue Alert: Climate Migrants in South Asia – Estimates and Solutions*, Greenpeace, 2008, and Population Reference Bureau, *Bangladesh*, available at http://www.prb.org/Datafinder/Geography/Summary.aspx?region=137&region_type=2

United States in 2015

Background

- U.S .military capabilities for disaster relief and humanitarian assistance are under tremendous strain as a result of severe domestic weather events, which are engaging these assets and have damaged some military facilities.
- Popular support for assistance to other nations, including private giving, has fallen dramatically. At the same time, popular belief in global climate change, including that current observed effects are caused by a buildup of anthropogenic GHG, has reached new heights.
- The energy intensity of the U.S. economy has declined, as has per capita consumption of oil. However, the United States has not met its Copenhagen targets and, in fact, has seen a slight rise in emissions.
- Although there have been major advances in the United States in private sector and national labs in energy efficiency, composite materials, battery storage, nanotechnology, carbon capture, next generation nuclear, solar, biodiesel, hydrogen and geothermal energies, they have not yet translated into commercial advances that have significantly displaced fossil fuels.

Political and Climate Change Policy Profile

The political situation in the United States has been relatively consistent from 2008 to 2015. There are still two major political parties, and voting and party identification vary but remain close to average trends. Twenty-seven percent of Americans identify themselves as Republican in 2015, 33 percent as Democrats, and 34 percent as Independents.[1] However, voting patterns split quite evenly, especially after the 2008 presidential election season. There is no veto-proof majority for either party in Congress.

The trend continues through 2015 of significant environmental and energy-related decisions being made at state and local levels. Private industry is therefore still grappling with a complex regulatory web, just as the knowledge that the country is moving to a cleaner-fuel economy spurs investment in innovation. There is continuing political pressure from state politicians and some constituents to bring federal environmental regulation in line with those of states.

Environmental concerns, and climate change specifically, have risen to top-tier national concerns as measured by public opinion. However, there is still limited enthusiasm, with sharp regional

[1] This number is the average of two polling data sets, one of party identification from three surveys in January-February 2007, and the other of average yearly party identification from 1987 to 2006. Data from Pew Research Center, "2007 Values Update Survey," Final Topline (2007): 80-81.

CIAS Game Material

variations, for individual actions to cut energy consumption and carbon emissions. At the same time, the president has been distracted by other issues: entitlement payments for Social Security and health care on the rise; security concerns, particularly transnational issues such as terrorism; and the wars in Iraq and Afghanistan. So although public concern is growing, by 2015 climate change has not found a spot as a top presidential concern, a top budget priority, or a top strategic concern of the national security community.

The strongest action to date in this area is that Congress did pass legislation establishing a cap and trade regime for the United States, which went into effect in 2012 and is still in a startup phase. The private sector has responded to public environmental interest, however, and 2015 marks a new high in venture capital investment in renewable and low-emission energy.

On the international relations front, the U.S. State Department has set up two state-to-state Joint Climate Change Task Forces, one with Australia and one with Japan. These task forces, similar to U.S. arrangements on terrorism and nonproliferation, serve to keep both nations connected and informed about one another's climate change-related initiatives, problems, and policy movements.[2] These trial arrangements have been productive, particularly on sharing crisis response information and ideas, but they are independent of the many cooperative arrangements agreed to as part of the Copenhagen Agreement.

The National Security Council (NSC) has an energy directorate, headed by a special assistant to the national security advisor. This directorate helps to ensure that energy security analysis is integrated into national security recommendations and information that funnels up to the president.[3] There has been no other significant reorganization of agencies responsible for advising on and implementing energy policy. The NSC office has primary responsibility for the preparation of a quadrennial National Adaptation Plan for climate change, first required by law in 2010. The first plan was scheduled to be released in 2014 but has been delayed.

Economic and Demographic Profile

Gross domestic product in the United States today is $16.4 trillion (on a PPP basis, in 2007 US dollars), up from $13.8 trillion in 2007. Real growth since 2007 has been a little faster than Europe's, but has also slowed down compared to growth from 2001 to 2007. Driven by immigration, population has continued to grow at about 1% annually and now stands at 327 million (up from 302 million in 2007). As in Europe per capita income has recently increased; in

[2] See Barry M. Blechman, Thomas Pickering, and Newt Gingrich, Participating Members, "Final Report of the State Department in 2025 Working Group," Advisory Committee on Transformational Diplomacy: page 44; at http://www.state.gov/secretary/diplomacy/99774.htm.
[3] See, for example, John Deutch and James R. Schlesinger, Chairs, "National Security Consequences of U.S. Oil Dependence," Council on Foreign Relations Independent Task Force Report No. 58 (2006): 72.

CNAS Game Material

the case of the United States by about $4,300, from $45,800 in 2007 to $50,100 today. As in Europe, the U.S. share of the world economy has fallen by about three percentage points: from 21.4% in 2007 to 18.4% today.[4]

Table 1: Long-term Population Trends (in millions of people)

	2000	2050	2050 versus 2000
China	1,300	1,500	+200
India	1,350	2,100	+750
Eastern Europe	150	150	0
Western Europe	350	400	+50
USA	300	500	+200
World Population	6,110	9,015	+2,905

Source: Oak Ridge National Laboratory; data results from ORNL population projections consistent with the IPCC scenarios, based on A1FI assumptions.

As of 2006, the United States was the second-highest merchandise exporter in the world and top importer, as well as the top commercial services exporter and importer; it remains the top importer of goods in the world. Thirty-seven percent of its imports come from Asia, 16% of that from China, and 35% of exports are to North America (second highest to Asia, at 27%).[5] There has been a steady loss of manufacturing jobs, especially to Asia.

Energy Profile

Total energy demand in the United States grew 1.2% annually from 2005 to 2015, with 2015 tallying 2,629 million tons of oil equivalent (Mtoe). Growth in energy demand is projected to slow to .9% per year through 2030, reaching 2,925 Mtoe. Renewables grow the fastest in the United States between 2005 and 2015 in absolute growth, at 10.3 percent per year, followed by biomass and other waste, at 4.5%. In 2015, new car sales and electricity use in the United States are outpaced by China for the first time.

[4] Projections care of the Brookings Institution, based on personal analysis and the International Monetary Fund, *World Economic Outlook* (2008).
[5] World Trade Organization, Annual Report 2007.

CIAS Game Material

In 2015, the United States is 69% dependent on imports to cover oil demand and is expected to be 74% dependent by 2030.[6] Domestic U.S. oil production is 6.7 mbpd in 2015, down from 7.1 mpbd in 2006, and thus its increase in demand is increasingly met by imports. The United States is a leading producer and consumer of biofuels, along with Brazil and the EU, as it produces 20 Mtoe of biofuels per year by 2015, up from 7 Mtoe in 2004.[7]

Natural gas demand begins to decline as a percentage of total energy by 2030, after holding flat between 2005 and 2015. Between 2008 and 2030, the Middle East and Africa will account for the largest increases in natural gas production, with Europe and the United States as their biggest customers. However, increased capacity of natural gas-fired power generation is restrained by high prices and limited LNG infrastructure in the United States.[8]

By 2030, U.S. coal production is expected to be keeping pace with increased demand, and it is a net exporter of some types of coal and a net importer of others. Rail infrastructure in the United States needs improvement to be adequate for increased demand.[9]

Table 2: U.S. Energy Mix, 1990 to 2050.

	1990	% of total[10]	2005	% of total	2015	% of total	2030	% of total	2050	% of total
Total Energy (Mtoe)	1,922	100	2,336	100	2,629	100	2,926	100	3,426	100
Coal	458	24	556	24	624	24	715	24	857	25
Biomass (including fuel wood and waste)	62	3	74	3	115	4	165	7	267	8
Oil	767	40	952	41	1,042	40	1,118	38	1,228	36
Natural Gas	439	23	508	22	571	22	595	20	629	18
Nuclear	159	8	211	9	221	8	243	8	276	8
Other renewables (including hydro, wind and solar)	37	2	35	1	56	2	90	3	169	5

[6] WEO (2006): 101.
[7] WEO (2006).
[8] "Between today…in the United States," WEO (2006): 111-120.
[9] WEO (2006).
[10] Totals and percentages rounded; total of all columns may therefore be +/- 100%.

NAC Game Material

Military Posture and Capabilities

America's military strategy rests on securing the homeland, preserving stability around the world, deterring the rise of a competitive power, defeating terrorism, and preventing the spread of weapons of mass destruction. The Department of Defense's Quadrennial Defense Review (QDR) in 2006 focused on shifting the mindset of America's military to "prepare for wider asymmetric challenges and to hedge against uncertainty over the next 20 years;"[11] and this has been borne out through 2015.

The Army grew the force by adding 65,000 active duty troops by 2010, over half of which was already complete by 2008. The end goal for the active duty component of the Army is 547,000.[12] The Army also grew its reserves by 9,200.[13]

While the United States remains engaged in Afghanistan and Iraq, and continues its efforts under the larger framework of the Global War on Terrorism, a growing array of complex challenges to American military dominance as well as political and economic stability around the world has prompted calls for a more long-term vision and investment planning.[14] While some would have the U.S. military shift to prepare for possible future peer competitors, others push back that the services must place a stronger priority on fighting the current wars and anticipating similar types of conflicts.[15] With earlier prodding in this direction from the civilian leadership in DOD, the military has emphasized its modernization programs that deal with unconventional operations over those aimed at long-term peer competitors.

The nature of the wars in Iraq and Afghanistan led military strategists to shift away from some of the approaches that had previously gained popularity, such as Effects Based Operations and technology-intensive "transformation" programs. While America's technological advantage remains vital to its military dominance, the range of future operations will call for a more diverse array of innovations. As a result, recent updates to military doctrine have emphasized military strategies and tactics that harmonize with political approaches and goals.

There is a trend in analysts' recognition – shared by civilians and the military – that the threats of the future will be more complex and will require a more integrated approach. Through the QDR and other strategic planning processes, the U.S. military is actively preparing for situations that will require flexibility, rapid response, and unity of effort.

CNAS Game Material

[11] U.S. Department of Defense, "Quadrennial Defense Review Report," (6 February 2006), available at http://www.defenselink.mil/qdr/.
[12] See *AP* "Pentagon Seeking $20 Billion to Increase Size of Army, Marine Corps," (8 June 2008).
[13] See the U.S. Army, "Grow the Army," at http://www.army.mil/growthearmy/.
[14] See the QDR (2006).
[15] Robert Gates, "Remarks to the Heritage Foundation," (13 May 2008).

Table 3: U.S. End Strength, 2008

	Branch	2008 Manpower[16]
Total Active Service 1,416,037	Army	524,681
	Navy	331,566
	Air Force	328,202
	Marines	189,546
	Coast Guard	42,042
Total Reserves 1,082,718	Army Reserves	555,000[17]
	Navy Reserves	67,500[18]
	Air Force Reserves	174,200[19]
	Marine Reserves	39,600[20]
	Coast Guard Reserves	8,100[21]

CNAS Game Material

[16] Data as of April 2008, according to "Active Duty Military Strength Service Totals," compiled by the Defense Manpower Data Center (unless otherwise noted). Available at http://siadapp.dmdc.osd.mil/personnel/MILITARY/Miltop.htm.
[17] Includes 205,000 members of the Army Reserve. See Lt. Gen. Jack C. Stultz, "Memorial Day Message from the Chief Army Reserve," (22 May 2008) available at http://www.armyreserve.army.mil/ARWEB/NEWS/WORD/20080522.htm); and 350,000 members of the Army National Guard. See http://www.ngb.army.mil/About/default.aspx.
[18] The Commission on the National Guard and Reserves, "Final Report to Congress and the Secretary of Defense," (31 January 2008).
[19] Includes U.S. Air Force Reserve and Air National Guard. Statistics for the Air Force Reserve from "U.S. Air Force Reserve Snapshot," HQAF/RES (April–May 2008): 1, available at *http://www.afrc.af.mil/shared/media/document/AFD-060712-018.pdf*. Statistics for the Air National Guard are available via "Air National Guard Snapshot," NGB/CFX (January–March 2008): 1, available at *http://www.ang.af.mil/shared/media/document/AFD-080204-033.pdf*.
[20] The Commission on the National Guard and Reserves, "Final Report to Congress and the Secretary of Defense," (31 January 2008).
[21] See "Coast Guard Reserve," at http://www.todaysmilitary.com/service-branches/coast-guard-reserve.

Table 4: U.S. Capabilities Relevant to Climate Change Effects

Capability	Service	Quantity	Applicability		
			Humanitarian Assistance	Basic Services Restoration	Security
Selected Air Capabilities					
Fixed Wing Cargo	Army	183: 46 *Huron* (C-12C); 90 *Huron* (C-12D/F/J); 47 *Sherpa* (C-23A/B)	X	X	
Utility Helicopters	Army	1935: 447 *Iroquois* (UH1-H/V); 1484 *Black Hawk* (UH-60A/A/M); 4 *Black Hawk* (UH-60Q)	X	X	X
Cargo Helicopters	Army	399 *Chinook* (CH-47D)	X	X	X
Search and Rescue Helicopters	Army	7 HH-60 L *Black Hawk*			
Fixed Wing Cargo	Air Force	790: 126 *Galaxy* (C-5A/B/C); 150 *Globemaster III* (C-17); 514 *Hercules* (C-130)	X	X	
Search and Rescue Fixed Wing	Air Force	36 HC-130P/N	X	X	
Search and Rescue Helicopters	Air Force	105 *Pave Hawk* (HH-60G)	X	X	
Fixed Wing Cargo	Navy	114: 20 *Hercules* (C-130); 37 *Greyhound* (C-2A); 9 *Clipper* (C-40A); 32 *Huron* (UC-12B); 6 *Huron* (UC-12F); 10 *Huron* (UC-12M)	X	X	
Utility Helicopters	Navy	402: 23 *Iroquois* (HH-1N); 54 *Seahawk* (HH-60H); 85 *Knight Hawk* (MH-60S); 153 *Seahawk* (SH-60B); 78 *Seahawk* (SH-60F); 9 *Sea Knight* (UH-46D)	X	X	X
Fixed Wing	Marines	73: 11 *Huron* (UC-12B); 6	X	X	

CNAS Game Material

Cargo		*Hercules* (KC-130F); 25 *Hercules* (KC-130J); 7 *Hercules* (KC-130R); 24 *Hercules* (KC-130T)			
Cargo Helicopters	Marines	400: 205 *Sea Knight* (CH-46E); 34 *Sea Stallion* (CH-53D); 161 *Sea Stallion* (CH-53E)	X	X	X
Utility Helicopters	Marines	98: 11 *Iroquois* (HH-1N); 87 *Huey* (UH-1N)	X	X	X
Fixed Wing Cargo	Coast Guard	6 *Hercules* (C-130J)	X	X	
Search and Rescue Fixed Wing	Coast Guard	23 *Hercules* (MC-130H)	X	X	
Search and Rescue Helicopters	Coast Guard	137: 42 *Jayhawk* (HH-60J); 95 *Dauphin II* (HH-65C)	X	X	
Selected Sea Capabilities					
Aircraft Carriers	Navy	11	X		X
Amphibious Assault	Navy	32 Amphibious Assault Ships	X		X
Small Amphibious	Navy	334 Amphibious Craft	X	X	
Strategic Sea Lift	Navy	25 Logistics and Support Ships	X	X	
Search and Rescue	Air Force	6 Squadrons	X		
Search and Rescue Reserve	Air Force Reserve	9 Squadrons	X		
Selected Manpower Capabilities					
Infantry	Army	10 Divisions	X		X
Engineers	Army	About 35,000 individuals	X	X	
Reserve Infantry	Army National	21 BCTs	X		X

CNAS Game Material

	Guard				
Reserve Engineers	Army National Guard	8 Brigades	X	X	
Reserve Support	Army National Guard	9 Support Brigades, 17 Regional Support Groups	X	X	
Reserve Infantry	Army Reserve	8 Divisions	X		X
Reserve Engineers	Army Reserve	3 Brigades	X	X	
Reserve Support	Army Reserve	6 Support Brigades	X	X	
Infantry	Marines	8 Regiments	X		X
Engineers	Marines	3 Battalions	X	X	
Reserve Infantry	Marine Reserves	3 Regiments	X		X
Reserve Engineers	Marine Reserves	1 Battalion	X	X	

Source: *The Military Balance*, International Institute for Strategic Studies, (London, UK: Routledge, 2008).
Note: Military tables depict manpower and capabilities in 2008, but game players should use these figures as a baseline of existing capabilities in 2015.

Resources

The United States produces a massive quantity and variety of food, both staple crops and cash crops of specialty produce. The major food staple crops, such as wheat and corn, are mostly grown in the "bread belt" region of the Great Plains and the Midwest.[22] However, for three of the last five years before 2015, the U.S. Midwest has experienced lower crop yields due to persistent droughts interlaced with frequent hailstorms and flash floods,[23] primarily affecting wheat and corn crops in Missouri, Iowa, Nebraska, and Kansas. The year 2014 was an especially bad year, when agricultural production in this region was reduced by 17 percent.[24] In response to the

[22] Maps of crop growth in the United States can be found with the Department of Agriculture, World Agricultural Outlook Board, Joint Agricultural Weather Facility, available at http://www.usda.gov/oce/weather/pubs/Other/MWCACP/Graphs/USA/us_corn.pdf and http://www.usda.gov/oce/weather/pubs/Other/MWCACP/Graphs/USA/us_winter_wheat.pdf

[23] Jay Gulledge, "Climate Change Risks in the Context of Scientific Uncertainty," in *The Global Politics of Energy*, Kurt Campbell and Jonathon Price, eds., (Washington, D.C.: The Aspen Institute, 2008).

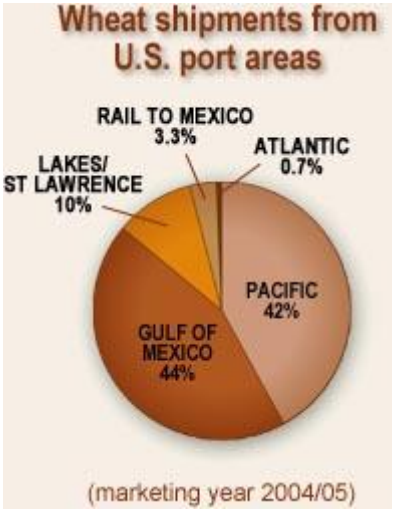
[24] Projections based off Rosenberg and Crosson (1991) Study on Missouri, Iowa, Nebraska, and Kansas, prepared for the US Department of Energy. The study used actual climate conditions in the 1930s as an analogy for the climate by the 2030s. Need to get a hold of study and/or other applicable U.S. agricultural studies that assess climate

CNAS Game Material

adverse weather conditions, many Midwestern farmers have adapted their crop management (e.g., crop rotation variation, switching on more sustainable crops). This adaptation has slightly improved agriculture production; however, annual crop yields are well below pre-2010 levels. Low U.S. crop yields add to an already dire global food crisis. By 2015, the world's agricultural gross domestic product (GDP) has decreased 16 percent and global commodity prices have increased 15 percent from 2007 levels.[25]

Beyond 2015, in some parts of the United States warming lengthens growing seasons, although increased potential agricultural output could be offset by increases in rate and severity of natural events, and by late frosts. Areas with reduced rainfall, such as in the southwest, will suffer from lower irrigation capabilities; other areas, including parts of the Great Plains regions, will struggle to adapt to climate change effects because of unsustainable agricultural practices.[26] Although total U.S. food donations have dropped slightly, the United States remains a major donor of food aid.

Exports of food crops travel from various points around the country. The graph above shows what percentage of wheat is shipped from each port area, as an example.[27] The Mississippi River is a major transportation route for grains and other products grown in the Midwest; when this waterway or its ultimate destination (the ports in the Gulf of Mexico) are shut down or operating below maximum efficiency, exportation of products is severely affected. An example of this contingency was seen during the aftermath of Hurricane Katrina, in which the river became completely logjammed due to the destruction along the Gulf Coast and hundreds of shipments of goods were delayed. This waterway is not only a source for food exports; it is also the route by which many goods (both imports and domestic products) are distributed throughout the United States. Damage to shipping routes, therefore, can contribute to food shortages and spikes in food prices.[28]



change impacts on agriculture.

[25] "The World Food Situation: New Driving Forces and Required Actions," International Food Policy and Research Institute, December 4, 2007; and Cline, W. R. and Peter G. Peterson, *Global warming and agriculture: Impact estimates by country*, Center for Global Development, Washington, D.C. (2007).

[26] C.B. Field, L.D. Mortsch,, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott, "North America: Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., (Cambridge, UK: Cambridge University Press, 2007): 627-635.

[27] U.S. Wheat Associates, "U.S. Wheat for Every Need," http://www.uswheat.org/everyNeed.

[28] Alexei Barrionueavo and Claudia H. Deutsch, "A Distribution System Brought to Its Knees" The New *York Times* (1 September 2005).

DNAS Game Material

Water scarcity in the United States, particularly in the Southeast, has caused conflict between Georgia and Tennessee.[29] The state of Georgia lost a court case over an effort to expand its borders by 1.6 sq. mi. in order to gain access to the Tennessee River and relieve pressure from Lake Lanier, the main water source for Atlanta. In recent years, the water level at Lake Lanier has been dropping; Georgia is negotiating the purchase of water rights to the Tennessee River in order to cut back on the number of homes and businesses drawing from this source.

In the southwestern U.S. and northern Mexico, relatively high annual mean temperatures have led to a more arid climate, a decrease in annual precipitation, and a reduction of mountain snow packs. As a result, southwestern states are experiencing longer and more severe droughts and, ultimately, drastic decreases in their main river arteries: the San Joaqin-Sacramento, the Colorado, and the Rio Grande.[30] The prolonged drought has led to water shortages in San Diego, Los Angeles, Phoenix and Tucson, prompting a heated debate about who has the responsibility to pay for a regional desalination plant (e.g., local, state, or federal government).

In 2013, the growing domestic competition for scarce water resources (e.g., power generation, irrigation) is exacerbated by tensions with Mexico over disputed water rights for the Rio Grande. Water systems such as the Columbia River that are strained or overused and that rely on snowmelt runoff are becoming especially vulnerable, and there is general groundwater stress in the southwestern United States. It is projected that the Great Lakes may experience lower water levels, causing some tensions between states and with Canada and affecting various economic sectors.[31] In neighboring states of Latin America, increased water stress is expected to affect between 10 and 80 million people after 2015 and up to 180 million after 2050,[32] which will drive increases in migration and instability.

Disasters

A series of Category 3, 4 and 5 hurricanes hit Texas, Louisiana, Florida, South Carolina, North Carolina, Georgia, and a number of Caribbean and Central American countries between 2010 and 2015, resulting in significant economic damage and a number of environmental refugees. During the 2011 and 2012 hurricane seasons, a 4 hurricane hit Houston and Louisiana, exacting a

[29] Partik Jonsson, "Drought-stricken Georgia, eyeing Tennessee River, revives old border feud," *Christian Science* Monitor (15 February 2008).
[30] Gregg Garfin and Melanie Lenart, "Climate Assessment for the Southwest, University of Arizona Effects on Southwest Water Resources," *Southwest Hydrology* (January/February 2007): 16-34.
[31] C.B. Field, L.D. Mortsch,, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott, "North America: Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., (Cambridge, UK: Cambridge University Press, 2007): 627-635.
[32] Effects from Parry, et al. (2007): 66-67, paired with Jones and Siegel date projections for temperature rise.

CNAS Game Material

great toll on the infrastructure and economic vitality of the region. In 2015, a Category 5 hurricane struck Miami, flooding a majority of the city and damaging much of its infrastructure. Before the hurricane hit Miami, a series of tropical storms passed through the Caribbean. As a result, Florida is receiving an influx of refugees from Haiti and the Dominican Republic, some of them sick with a variety of diseases, including tuberculosis, cholera, and HIV/AIDS. The magnitude of the domestic and international challenges overwhelms the response capacity of both the Coast Guard and the City of Miami. Subsequently, the President and the Governor of Florida temporarily enact National Guard Dual Status Act. Under the Dual Status Act, a National Guard General can command both Title 10 (federal troops) and Title 32 (National Guard/Reserves) for a specific situation. In this case, the National Guard General is designated the lead in the disaster relief effort.

In April 2013 a powerful nor'easter storm hit the entire eastern seaboard, stretching from South Carolina to Maine.[33] The most affected states were New Jersey and New York. The storm knocked out power to hundreds of thousands of people and was blamed for at least 250 deaths. In New Jersey, storm waters caused the Raritan River to overrun and damage surrounding infrastructure. As a result, the state was placed under a state of emergency and instituted an Emergency Management Assistance Compact (EMAC) with New York. Under the EMAC, New Jersey received temporary assistance from New York National Guardsmen to address the emergency.[34] In New York City, flooding caused parts of the metro system to shut down for two-days. In total, New York had activated 5,000 National Guard members to help with relief efforts in both New Jersey and New York.[35] Annual flooding in other parts of the country, such as the Midwest, and wildfires in the western and mountain states grow have been more frequent and intense than is historically true.

As the population of U.S. coastal areas increases by 25 million people by 2035, it is projected that disasters in such areas will have graver impacts than in earlier decades and that these areas will be less resilient to major events.[36] The United States is generally well prepared for dealing with disaster situations, though its resources can be easily overwhelmed. In the United States, state, local, and federal governments split responsibilities in times of severe disasters, although most responsibility falls to state and local governments. In the wake of a disaster, the governor's office in the affected state must work with local officials to quickly assess whether recovery is within the means of their own resources. If they determine that state and local resources are insufficient to grapple with the disaster, the governor may declare a state of emergency. At that point, the Federal Emergency Management Agency (FEMA) works with state and local

[33] "Floods Batter Northeast as Nor'easter Stalls Off East Coast", *Associated Press*, Tuesday, April 17, 2007.
[34] EMAC, the Emergency Management Assistance Compact, is a congressionally ratified organization that provides form and structure to interstate mutual aid. Through EMAC, a disaster impacted state can request and receive assistance from other member states quickly and efficiently, resolving two key issues upfront: liability and reimbursement. See www.emacweb.org.
[35] "Floods Batter Northeast as Nor'easter Stalls Off East Coast", *Associated Press*, Tuesday, April 17, 2007.
[36] Field, et al. (2007).

CNAS Game Material

authorities to assess the situation and bring in federal resources.[37] In 2007, FEMA logged 63 disaster declarations,[38] and that number has risen each year since. The Department of Homeland Security also runs Citizen Corps, a local citizens' response preparedness program, but by 2015, Citizen Corps is proving to be inadequate for disaster relief areas in many parts of the country. By Congressional charter, the Red Cross also has the right to perform disaster response anywhere in the United States. Its operations mostly provide for immediate human needs such as shelter, food, and water, and it provides preparedness and educational materials and courses.[39] In the United States, independent organizations such as corporations and churches, as well as individual donors, often provide disaster relief, and some are party to formal and informal relief networks. These networks are increasingly feeling the strain of recurring disasters.

On the military side, USNORTHCOM conducts Civil Support operations, and conducts relief operations in the wake of disasters.[40] NORTHCOM's responsibilities during an emergency are to assist when an emergency exceeds the capabilities of local, state and federal agencies. Support will be limited, localized and specific and when the disaster becomes manageable the civilian agency can again assume full control and management without military assistance. Under direct control by USNORTHCOM, the Army North Combat Command was specifically stood up in 2002 to provide defense support of civil authorities (DSCA) for local, state, regional, and federal emergency service agencies.[41] It is the main disaster relief branch of NORTHCOM.

Migration

The United States is not a party to the 1951 Refugee Convention, and in addition has expressed reservations to Articles 24 and 29. The country is on the UNHCR Executive Committee. The United States had a population of 147,200 refugees and asylum-seekers at the end of 2007. The primary source countries for refugees were China, Haiti, Cuba, Somalia, Colombia, Russia, Liberia, Iran, Guatemala, Vietnam, Ethiopia, Indonesia, Ukraine, India, Nicaragua, Myanmar, and Sudan. It is also estimated that approximately 500,000 illegal migrants enter the United States from Mexico each year. The United States also has an internally displaced population of approximately 1.3 million people due to Hurricanes Katrina and Rita in 2004.

Today, in 2015, most migration into the United States is people from Latin America and Mexico. Approximately 18 percent (8.2 million) of Mexico's work force is employed in the agriculture

[37] See FEMA, "The Emergency Response Process," at http://www.fema.gov/media/fact_sheets/declaration_process.shtm.
[38] FEMA, "Declared Disasters by Year or State," at http://www.fema.gov/news/disaster_totals_annual.fema.
[39] American Red Cross, "Disaster Services," at http://www.redcross.org/services/disaster/0,1082,0_319_,00.html.
[40] See NORTHCOM, http://www.northcom.mil/About/index.html
[41] See Army North at http://www.arnorth.army.mil/about_us.htm

CNAS Game Material

sector.[42] The persistent drought and subsequent reduced water supply has affected the cotton, wheat, fruit and vegetables, and oilseeds crops.[43] The loss of job security in these regions has increased migration into the United States; many of those crossing the border are claiming environmental refugee status with the U.S. Citizen and Immigration Service. However, the U.S. Government is rebuffing this status and, in turn, southwestern states activate more National Guard units to the border area. Climate models suggest that the United States can expect dramatic increases in migration from Latin America, Mexico, and the Caribbean beyond 2015 as a result of climate stresses..[44]

CNAS Game Material

[42] Central Intelligence Agency (CIA), *The 2008 World Fact Book*, at www.cia.gov.
[43] Encyclopedia Britannica Online, www.brittanica.com
[44] Unless otherwise noted, U.S. information from: C.B. Field, L.D. Mortsch,, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running and M.J. Scott, "North America: Climate Change 2007: Impacts, Adaptation and Vulnerability," Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., (Cambridge, UK: Cambridge University Press, 2007): 627-635.

Appendix: IPCC Fifth Assessment Report

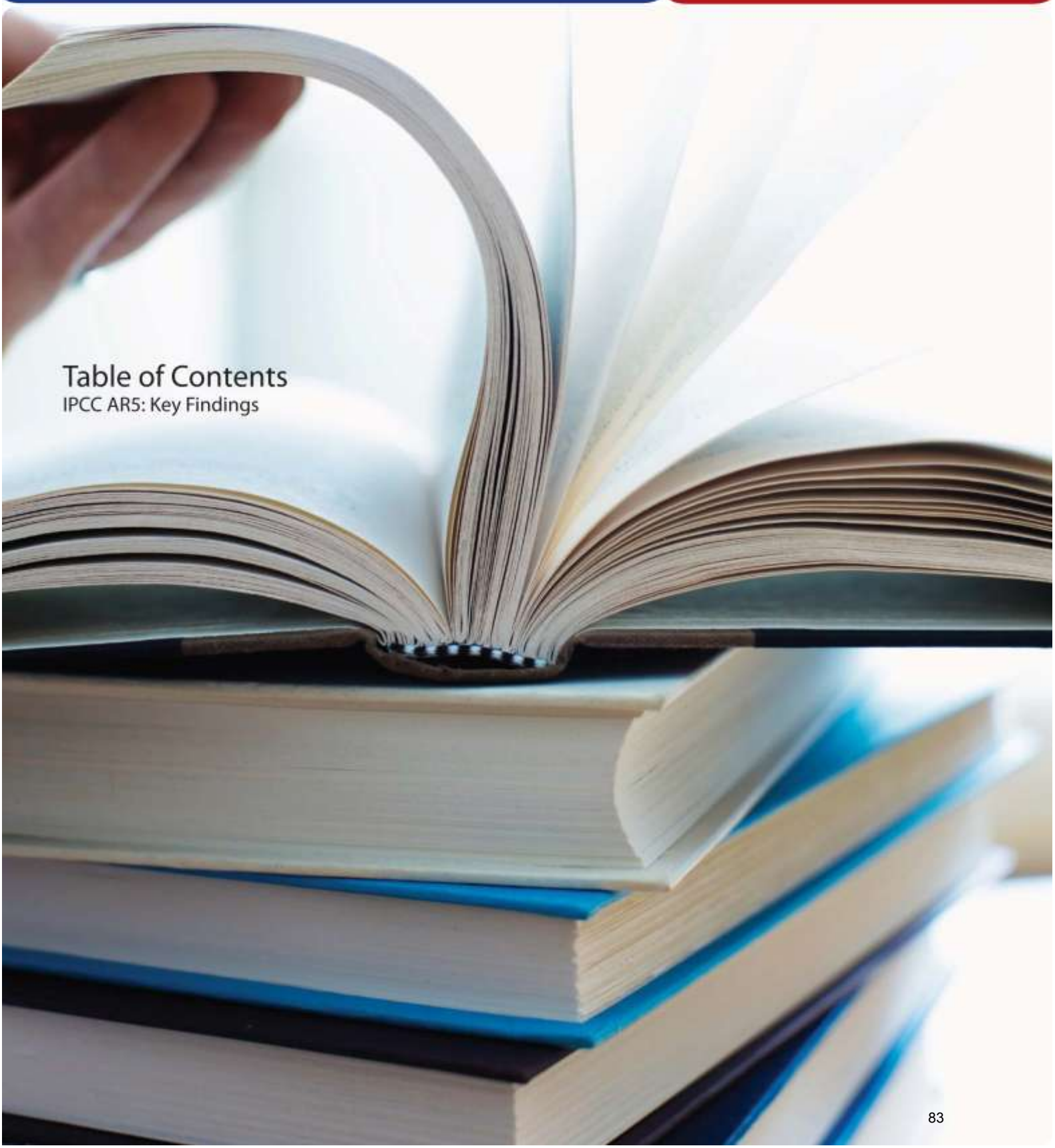


Table of Contents

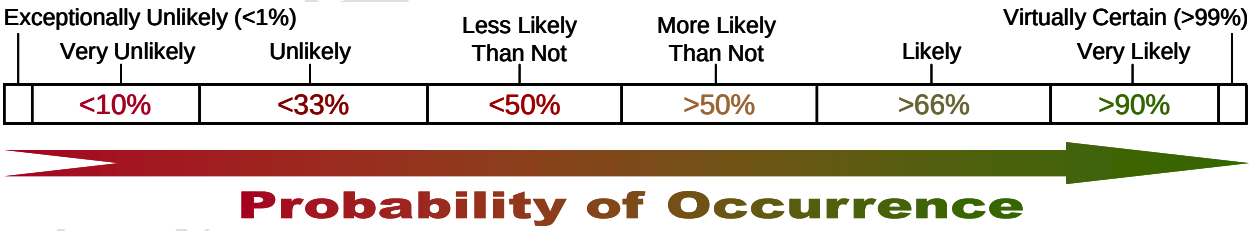
IPCC AR5: Key Findings

Appendix A
Key Findings of Climate Change 2014
Summary for Policymakers of the Synthesis Report
of the IPCC Fifth Assessment Report

This extract was prepared by the Pew Center on Global Climate Change, Oak Ridge National Laboratory, and the Woods Hole Oceanographic Institution in preparation for the E-4 Major Emitters Meeting. Its contents are derived directly from the Summary for Policymakers of the Synthesis Report of the IPCC Fifth Assessment Report and have not been altered other than as necessary to achieve brevity and clarity.

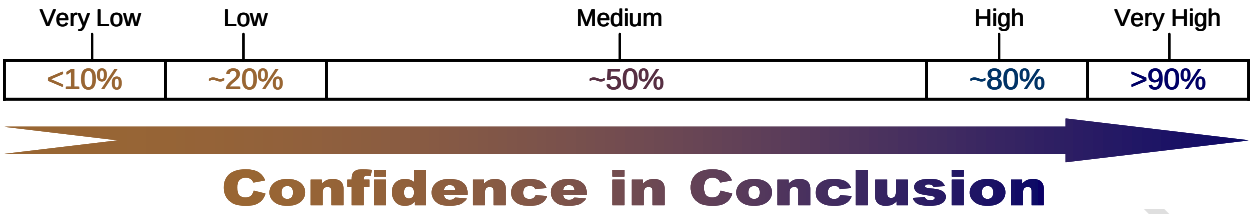
On November 17, 2014, the Intergovernmental Panel on Climate Change released its Summary for Policymakers for the Synthesis Report of the IPCC Fifth Assessment Report (AR5) on climate change science. The Synthesis Report summarizes, in plain language, the main findings of the three working group reports released earlier in the year. The three working groups (WG) summarized the state of knowledge regarding the physical science of climate change (WGI); the observed and projected impacts of climate change and prospects for adaptation (WGII); and options for mitigating future climate change (WGIII).

In order to communicate the most policy-relevant conclusions of its assessments, the IPCC's summaries for policymakers generally focus on conclusions and projections with fairly high certainty and confidence. The IPCC describes certainty based on varying levels of likelihood of an observed or projected outcome and confidence in a given conclusion as follows:



Likelihood is based on quantifiable probabilities from data or model output or, when quantitative measures are lacking, systematic survey of expert opinion within relevant fields of science. For example, ***more likely than not*** signifies better than 50:50 odds and ***very likely*** signifies greater than 9 out of 10 odds that an outcome has occurred or will occur. In addition to the terms shown above, the IPCC uses the term ***unequivocal*** to signify absolute certainty about an observed outcome.

For Purposes of Game Play Only – Do Not Cite, Quote, or Distribute



Confidence is based on subjective expert opinion as agreed upon by the authors involved in the assessment. For example, ***medium confidence*** signifies more or less even odds and ***very high confidence*** signifies at least a 9 out of 10 chance that a statement is correct.

CNAS Game Material

1. Observed changes in climate and their effects

The AR4 concluded that the warming of the climate system was ***unequivocal***, as was evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Warming and is effects on the global climate system have continued since the AR4.

- Between 2005 and 2013 global surface temperature warmed by 0.26°C per decade, 30% more rapidly than projected in the AR4.
- Eighteen of the 20 warmest years since 1850 occurred between 1991 and 2013.
- Warming has been detected in more components of the climate system, including the oceans. The heat content of the oceans has continued to rise rapidly following a period of diminished growth from 2004 to 2009. The deep waters (3,000 meters, 9,800 feet) of the northern North Atlantic Ocean are warmer and lower in salinity, slightly reducing the density of deep water mass but not yet interfering with deep water production rates.
- Global ice cover continues to decrease. Arctic sea ice experienced a series of record-breaking low extents between 2002 and 2011, with the largest single-year decrease occurring in 2007 and the lowest summertime extent on record occurring in 2011. The annual minimum extent in September has declined at an average rate of 8.2% per year while the wintertime maximum in March has declined at an average rate of 4.7% per year.
- The net loss of ice from the Greenland and West Antarctic ice sheets accelerated between 1996 and 2013, but with large year-to-year variability. Since the AR4, a clearer picture of dynamical ice changes has emerged. Positive feedbacks, including basal lubrication from drainage of surface melt-water and loss of floating ice shelves, result in a large summertime acceleration of ice sheet flow, with smaller acceleration of outlet glacier flow.
- Satellite observations show that between 1993 and 2011, the average rate of global mean sea level rise was 3.8 cm (1.5 inches) per decade, approximately twice the average rate of the 20th century. Rates measured by coastal tide gauges indicate that sea level rise greater than 3.0 cm (1.2 inches) per decade dates back to the mid 1980s. This rate of sea level rise sustained for more than three decades ***likely*** represents a long-term acceleration of sea level rise rather than decadal variability. This conclusion represents an advance since the AR4, which declined to distinguish between decadal variability and long-term acceleration.

It is ***very likely*** that global average annual precipitation has increased.

- Regionally, the subtropics have experienced decreased annual precipitation whereas the wet tropics and latitudes north of 45 degrees north have generally experienced increased precipitation relative to the average for 1951 to 1980.

CIAS Game Material

- A larger fraction of annual precipitation falls as rain rather than snow and a larger fraction of both snow and rain fall in extreme precipitation events, even in areas experiencing less annual rainfall. Flash flooding has increased in wet tropical and mid-latitude regions.
- Mid-latitude and polar storm tracks have shifted poleward, increasing the incidence of severe weather events in areas on the northern margins of storm tracks in the late 20th century.

It is ***likely*** that drought has become more widespread and frequent in the subtropics and continental interiors between 30 and 50 degrees North. Even some areas with increased annual rainfall experience drought more frequently relative to 1951 to 1980.

Observational evidence from all continents and all oceans shows that nearly all physical systems are being affected by regional climate changes, including temperature increases, changes in precipitation patterns, and ocean acidification.

- The previously observed trend in decreased snow cover area, increased thaw depth over most permafrost regions, and decrease in sea ice extent have continued since the AR4.
- Acidification has been detected in widespread areas of the shallow oceans as well as in some intermediate and deep ocean locations where surface waters are known to sink to form deep water.
- The timing of the Asian monsoon appears to have become more variable, although it is not yet clear whether this shift represents decadal variability or a long-term trend.

Since the AR4, new observations show with ***virtual certainty*** that a wide variety of impacts are appearing that are consistent with climate model projections, and in many cases impacts are occurring sooner than projected, although attribution to climate change is not yet possible.

- A greater number of people than is historically observed have been hospitalized for heat stress in urban areas of Europe and North America and for vector-borne tropical diseases in high-altitude locations of Africa and Central and South America, and in high-latitude locations in Europe and North and South America. In several cases, emergency response systems were overwhelmed during heatwaves in Central and Eastern Europe and a vector disease outbreak in Brazil.
- Since 2004, crop production has declined in several grain-exporting regions in Asia, Australia, and South America, primarily a result of regional drought, leading to declining grain exports and a persistent rise in global food prices. In 2007 and 2011, grain exports were also reduced in North America as a result of severe flooding, contributing to volatility of food prices. Prevalence of malnutrition has increased in grain-importing regions, especially in parts of Asia and Africa.
- Since 1980, biological and economic productivity of managed forests has declined in southern and central Europe and western North America, apparently because of higher

CNAS Game Material

summer temperatures, more drought and insect damage, and increased area burned by wildfires.

- In mountainous regions of Europe, North America, South America, and Central and South Asia, flash floods have increased during spring snowmelt and summertime glacier melting. Glacier outburst floods affected human settlements about twice as often between 2001 and 2010 as in previous decades since 1950.
- Many natural and manmade freshwater reservoirs in subtropical regions, including the Mediterranean region, western and southern Africa, southwestern North America, and northwestern South America, have experienced chronically low water levels for the past decade. Climate models project persistently and progressively less surface water availability for these regions through the 21st century.
- Thawing of permafrost soils throughout the Arctic and subarctic regions has damaged many human settlements and roads and forced the relocation of several coastal settlements in Alaska and northern Canada. The number of days that ice roads are usable by settlements and oil and mining industries in Alaska and Canada has declined by about 50% since 1980.
- Damage to roads, railways, airports, harbors, power stations, and power, water, and sewer lines has increased spending on infrastructure in Arctic and subarctic regions of North America.

2. Causes of change

Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 95% between 1970 and 2010.

- Carbon dioxide (CO_2) is the most important anthropogenic GHG. Its annual emissions grew by 115% between 1970 and 2010. The long-term trend of declining CO_2 emissions per unit of GDP reversed after 2000 and continued to grow through 2011. The rate of CO_2 emissions growth since 2000 exceeds the most rapid growth rate depicted in all IPCC SRES emissions scenarios.
- Global atmospheric concentrations of CO_2, methane (CH_4) and nitrous oxide (N_2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning the past one million years. Current CO_2 concentration in the atmosphere is 41 percent higher than the preindustrial concentration.
- The net effect of anthropogenic aerosols on global average surface temperature is one of cooling as a result of reflective sulfate aerosols. However, the effects vary regionally. The optical density of atmospheric aerosols is highest over South and East Asia. It is ***likely*** that mid-troposphere warming caused by black carbon aerosols over Asia has contributed to the loss of mountain snowpack and glacier retreat and caused atmospheric drying, contributing to increasing seasonal drought in continental regions. In the Arctic, the net effect is warming, as

CNAS Game Material

black carbon aerosols decrease the reflectivity of snow and ice. Observations indicate that increased navigation in the Arctic Ocean facilitated by retreating summer sea ice has increased the deposition of black carbon on ice and snow surfaces, contributing to accelerated warming.

- It is ***virtually certain*** that the net effect of human activities since 1750 has been one of warming.

The AR4 concluded that most of the observed increase in globally-averaged temperatures since the mid-20th century is ***very likely*** due to the observed increase in anthropogenic GHG concentrations. More than three decades of space-born observations are now available for assessing changes in the global climate system and attribution studies since the AR4 have focused more intensely on detecting causes of warming since 1980 using high-resolution satellite data.

- Satellite-based attribution studies provide ***very high confidence*** that human activities are responsible for the majority of the rapid warming observed between 1980 and 2010.
- It is ***very likely*** that there has been significant anthropogenic warming over the past 30 years averaged over each continent, except Antarctica, and in all ocean basins.
- Since 1960, the sum of solar and volcanic forcings ***very likely*** has contributed to a net cooling, which has been masked by the larger warming effects of forcing from increasing greenhouse gas concentrations. In the absence of this net natural cooling, human activities would have produced greater warming than has occurred.
- Since 1978, total solar irradiance has undergone three complete 11-year solar cycles with an associated 0.1°C oscillation in global average surface temperature, but there has been no long-term trend in total solar irradiance. It is ***very unlikely*** that changes in solar activity have contributed to the warming trend since 1980.
- Human influences have:
  - ***likely*** contributed to sea level rise since 1980;
  - ***very likely*** contributed to changes in wind patterns, affecting extra-tropical storm tracks and precipitation patterns;
  - ***very likely*** increased temperatures of extreme hot nights and increased the minimum temperatures of cold nights and cold days;
  - ***very likely*** increased frequency, duration, and temperature of heat waves;
  - ***very likely*** increased frequency of heavy precipitation events and ***likely*** increased land area affected by drought since 1980.

CNAS Game Material

3. Projected climate change and its impacts

Since the AR4, the Copenhagen Agreement has resulted in more policies designed to mitigate and adapt to climate change. Even with these new policies, however, there is ***high agreement*** and ***much evidence*** that with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow for several more decades. Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would ***very likely*** be larger than those observed during the 20th century.

- For the next two decades warming of about 0.25°C per decade is projected for a range of SRES emissions scenarios. This rate is 25% greater than projected in the AR4 due to earth system interactions and sensitivities still being studied, including carbon cycle feedbacks.
- Multi-model projection of global average surface temperature increase for various marker emissions scenarios range from 1.1 to 2.7°C (2.0 to 4.9 °F) in 2050 and 2.7 to 5.8°C (4.9 to 10.4°F) in 2100 compared to 2000. The highest single-model projection was 7.2°C (13.0°F). These projections are also higher than in the AR4.

In the AR4, understanding of some important processes driving sea level rise was too limited to provide a best estimate or an upper bound for sea level rise. Improvements since AR4 in understanding of changes in ice sheet flow, the incorporation of carbon cycle uncertainties, and integrative assessment of paleoclimate evidence for past patterns of sea level rise permit a more complete assessment of future sea level rise, although estimating an upper bound for the end of this century remains highly uncertain, whereas the lower bound has been raised with ***high confidence***.

- Multi-model projection averages of global mean sea level rise for a variety of SRES emissions scenarios range from 38 to 117 cm (1.25 to 3.84 feet) in 2100 relative to 1990.
- It is ***unlikely*** that the lower bound of sea level rise during the 21st century will be less than would result from continued sea level rise at the average rate observed over the past three decades (3.8 cm or 1.5 inches per decade).
- Global mean sea level was 4 to 6 meters higher during the warmest part of last interglacial period 125,000 years ago when the global average temperature was about 1°C (1.8°F) warmer than today. At that time, sea level rose on average by 1.6 meters (5 feet) per century. Since even warmer temperatures could occur after the middle of this century in the absence of policies to mitigate climate change, similar or greater rates of sea level rise are possible by the end of this century and for several centuries into the future.
- With sustained warming of more than 2°C (3.6°F), an amount of sea level rise equivalent to the present Greenland Ice Sheet (6 meters or 20 feet) could occur in about four centuries.

CNAS Game Material

There is now higher confidence than in the AR4 in projected patterns of warming and other features of climate change, including regional features.

- Warming will ***very likely*** be greatest over land and at high northern latitudes and least over the Southern Ocean, Antarctica, and parts of the North Atlantic Ocean.
- It is ***very likely*** that the frequency of hot extremes, heat waves, and heavy precipitation will increase.
- Precipitation ***very likely*** will increase in high latitudes and decrease in most subtropical land regions, continuing observed recent trends.
- It is ***very likely*** that total land experiencing drought will increase, particularly in the dry subtropics and continental interiors. Some areas that experience increased total precipitation and extreme precipitation events will also experience increased drought due to increased evaporation of soil moisture and longer periods between rain events.
- ***More likely than not***, Antarctica will remain cooler than the southern hemisphere as a whole for the next two decades as a result of stratospheric ozone depletion, after which time the continent will likely begin to warm as stratospheric ozone recovers and atmospheric greenhouse gases become dominant in the regional energy balance.
- It is ***virtually certain*** that recent observed trends in contraction of snow-covered area, increases in thaw depth over permafrost regions, and decrease in sea ice extent will continue. It is ***very likely*** that these trends will accelerate by the middle of this century. In tropical regions of South America and Africa, most tropical mountain glaciers will be gone within one to two decades.
- Adding carbon cycle feedbacks and improving albedo (surface reflectivity) feedbacks has improved sea ice representation in global climate models, although the multi-model average still underestimates the observed decline in late-summer sea ice extent by about 50 percent. In several model projections, Arctic late-summer sea ice disappears almost entirely by the middle of the 21st century. In most models, summer sea ice disappears completely before 2100.
- It is ***very likely*** that tropical cyclone intensity will increase in all oceans where tropical storms form, although frequency ***more likely than not*** will decrease in some basins, including the North Atlantic, as a result of atmospheric conditions less favorable to tropical storm formation. In other basins, including the Indian and western North Pacific, atmospheric conditions ***more likely than not*** will become more favorable to tropical storm formation, leading to both more frequent and more intense cyclones.
- It is ***likely*** that mid-latitude storm tracks in the northern hemisphere will continue to shift northward with consequent regional changes in wind, precipitation, and temperature patterns.

There is ***very high confidence*** that by mid-century, annual river runoff and water availability will increase at high latitudes (and in some tropical wet areas) and decrease in some dry regions

CNAS Game Material

in the mid-latitudes and tropics, continuing observed trends. There is also ***very high confidence*** that many semi-arid areas (e.g., the Mediterranean basin, western United States, southern Africa, and northeast Brazil) will suffer a decrease in water resources due to climate change, also continuing observed trends.

Some systems, sectors and regions are ***very likely*** to be especially affected by climate change.

Systems and sectors:

- Ecosystems:
  - *terrestrial:* tundra, boreal forest and mountain regions because of large projected warming in the relevant climate zones; Mediterranean-type ecosystems because of reduction in rainfall; and tropical rainforests that experience less precipitation.
  - *coastal:* mangroves and salt marshes, due to multiple stresses including sea level rise, increased coastal storm intensity and, in some cases, frequency, and human impacts such as pollution, erosion, ground water extraction, hypoxia, and development.
  - *marine:* coral reefs due to multiple stresses including warming, acidification, pollution and sediment runoff from land; the sea ice biome because of sea ice loss; pelagic (open water) and deep ocean systems because of acidification and reduced productivity of calcareous marine organisms, and over-harvesting of ocean resources.
- Water resources in some dry regions at mid-latitudes and in the dry tropics, due to changes in rainfall and evapotranspiration, and in areas dependent on snow and ice melt.
- Agriculture in low latitudes, due to heat stress and reduced water availability.
- Low-lying coastal systems, due to sea level rise and extreme weather events.
- Human health in populations that are typically affected by extreme weather events and vector-borne diseases in both developing and developed countries. Populations with low adaptive capacity in developing countries and in poor populations in developed countries will be affected disproportionately.

Regions:

- The Arctic, because of the impacts of high rates of projected warming on natural systems and human settlements and infrastructure.
- Africa, because of low adaptive capacity and projected climate change impacts.
- Small islands, where there is high exposure of population and infrastructure to projected climate change impacts, especially sea level rise and more intense storms.

CNAS Game Material

- Asian and African megadeltas, due to large populations, high exposure to sea level rise, storm surges and river flooding, and agricultural losses from sea level rise and extreme weather events.
- Tropical South America in mountainous regions historically dependent on glacier water supplies.
- The Mediterranean basin and the southwestern United States because of more persistent drought, hotter, longer heatwaves, and more area burned by wildfires.

Ocean Acidification. The uptake of anthropogenic carbon since 1750 has led to the ocean becoming more acidic with an average decrease in pH of 0.1 units. Projections based on SRES scenarios give a reduction in average global surface ocean pH of between 0.19 and 0.5 units over the 21st century. These projections are higher than in the AR4 because of carbon cycle feedbacks included in newer versions of climate models. New information available since the AR4 increases confidence that calcareous marine species will be negatively impacted by ocean acidification, especially corals and their dependent species, and pelagic nanoplankton, many of which serve as the base of food chains that support global fisheries.

Altered frequencies and intensities of extreme weather events, together with sea level rise, are expected to have mostly adverse effects on natural and human systems. Examples of extreme events include more hot days and nights, more heat waves, more intense thunderstorms and more frequent heavy precipitation events, larger land area in drought, more strong hurricanes, increased incidence of extreme high sea level and higher storm surges. Each of these changes is associated with a variety of impacts on agriculture, forestry and ecosystems; water resources; human health; and industry, settlements, and society.

Anthropogenic warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of climate change.

- Partial loss of ice sheets on polar land could imply meters of sea level rise, major changes in coastlines with inundation of low-lying areas, with greatest effects in river deltas and low-lying islands. In the AR4, such changes were projected to occur over millennial time scales, but more recent evidence from paleoclimate observations and model-based replication of ancient climates suggests that multi-meter sea level rise on century time scales is more likely than previously thought. Sustained warming of more than 1.0°C (relative to 1990) would ***likely*** lead to 4-6 meters of sea level rise. Sustained warming of 2.0°C more could lead to melting of most of the ice on Earth over millennia, leading to almost 75 meters of sea level rise.
- Climate change is ***very likely*** to lead to some species extinctions. There is ***medium confidence*** that approximately 20-30% of species assessed so far are likely to be at increased risk of extinction if increases in global average warming exceed 1.0-2.0°C

CNAS Game Material

(relative to 1990). As global average warming increase exceeds about 3.0°C, model projections suggest significant extinctions (more than 50% of species assessed) around the globe, although adaptive actions are being studied that may reduce this impact.

- The meridional overturning circulation (MOC) of the Atlantic Ocean will ***very likely*** slow down during the 21st century; nevertheless temperatures over the North Atlantic and Europe are projected to increase because of strong warming effects of greenhouse gases. The AR4 concluded that the MOC was very unlikely to undergo a large abrupt transition during the 21st century based on the earlier generation of global climate models. Some newer generation models include ice sheets, carbon cycle feedbacks, and improved ice albedo feedbacks, together with more rapid increases in GHG emissions than previously considered, now show a collapse or near collapse of the MOC during the 21st century. The timing varies widely among models and several models do not show a collapse. Solicitations of expert opinion also show disagreement, but a majority of those surveyed agreed that an MOC collapse was ***more likely than not*** or ***likely*** during the 21st century in the case of a continued strong warming trend. Longer-term MOC changes cannot be assessed with confidence. Among the models in which the MOC collapses, some show a long-term persistence of collapse whereas others show recovery of the MOC on time scales ranging from decades to centuries. Impacts of persistent changes in the MOC are ***very likely*** to include changes in marine ecosystem productivity, fisheries, ocean CO_2 uptake, oceanic oxygen concentrations and terrestrial vegetation. Some regions outside of the North Atlantic region are ***likely*** to warm more than they would if the MOC did not collapse. In the North Atlantic, collapse of the MOC would ***more likely than not*** increase regional sea level rise by as much as one meter (3.3 feet). Perhaps the greatest risk from collapse of the North Atlantic MOC is the potential for unpredictable, large-scale atmospheric reorganization that could shift global precipitation patterns.

4. Adaptation and mitigation options

Since the AR4, ratification of the Copenhagen Agreement has improved the level of adaptation being implemented to prepare for future climate change impacts. However, some barriers to adaptation remain and additional adaptation is needed to account for the degree of climate change to which society is committed as a result of greenhouse gases already in the atmosphere. Future greenhouse gas emissions will increase the needed level further. Some limits and costs remain that are not fully understood.

Adaptive capacity is intimately connected to social and economic development but is unevenly distributed across and within societies.

The Copenhagen Agreement also called for emissions reduction targets for 2050. Recent analyses indicate that emissions of greenhouse gases since the treaty was ratified are higher than

CNAS Game Material

the rates required to meet the targets. Given the inertia in economic and energy systems, it is ***unlikely*** that society will be able to meet the goals stated in the Copenhagen Agreement.

There is ***high agreement*** and ***considerable evidence*** of substantial economic potential for the mitigation of global greenhouse gas emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels, although the rate of deployment remains in question.

- No single technology can provide all of the mitigation potential in any sector. The economic mitigation potential can only be achieved when technologies have been improved and adequate policies are in place and barriers removed.
- The AR4 concluded that mitigation opportunities with net negative costs [i.e. net savings] have the potential to reduce emissions by around 6 GtCO2-eq/yr in 2030. However, the passage of several years without implementation of stringent emissions reduction policies that would encourage investment in such opportunities has pushed these opportunities further into the future. It is now ***unlikely*** that negative cost emissions reductions of the same scale could be met by 2030.

Future energy infrastructure investment decisions, expected to exceed US$25 trillion between 2015 and 2040, will have long-term impacts on greenhouse gas emissions, because of the long lifetimes of energy plants and other infrastructure capital stock. Widespread diffusion of low-carbon technologies may take many decades, even if early investments in these technologies are made attractive. Initial estimates show that returning global energy-related CO_2 emissions to 2010 levels by 2035 would require a large shift in investment patterns. The net additional investment required ranges from 5-10% of expected investment. Some incentives for such investments have been implemented through the Copenhagen Agreement, but the lack of clear market signals still inhibits development and penetration of low-emission technologies in the energy sector.

A wide variety of policies and instruments are available to governments to increase incentives for mitigation action. Their applicability depends on national circumstances and sectoral context. They include integrating climate policies in wider development policies, regulations and standards, taxes and charges, tradable permits, financial incentives, voluntary agreements, information instruments, and research, development and demonstration.

- There is ***high agreement*** and ***much evidence*** that many mitigation actions can result in near-term co-benefits (e.g., improved health due to reduced air pollution and reduced costs from co-generation of heat and electricity) that may offset a fraction of mitigation costs.
- There is ***high agreement*** and ***much evidence*** that Annex I countries' actions may affect the economy and emissions in developing countries. Barriers remain to the flow of mitigation

CNAS Game Material

technologies from Annex I countries to non-Annex I countries, including trade restrictions and carbon leakage.

- The assessment indicated that mitigation could lower demand and prices and lower GDP growth due to mitigation policies. While this remains true in principle, mitigation policies to date have not dampened demand for oil and prices remain historically high. There is ***high agreement*** and ***much evidence*** that mitigation policies have increased demand for natural gas, raising its price to historic levels as well. The extent of future effects of mitigation policies on fossil fuel prices depends strongly on assumptions related to policy decisions and market conditions.

Many options for reducing global greenhouse gas emissions through international cooperation exist. There is ***high agreement*** and ***much evidence*** that notable achievements of the UNFCCC and the Copenhagen Agreement are the establishment of a global response to climate change, stimulation of an array of national policies, implementation of an international agreement to significantly reduce greenhouse gas emissions by the middle of the 21st century, and the creation of new institutional mechanisms that have allowed mitigation efforts to grow and evolve over time. Progress has also been made in addressing adaptation within the UNFCCC, with significant enhancements in the Copenhagen Agreement.

- Greater cooperative efforts and expansion of international market mechanisms provide a means to reduce global costs for achieving a given level of mitigation. Incomplete international integration of a carbon market and carbon leakage in the first years of the Copenhagen Agreement have created price volatility and have generally held carbon prices down to ineffective levels, thus suppressing capital investment in development and transfer of new technologies.
- Additional policies are needed to expand financing instruments for technology investments and transfer of technologies to some developing countries, whose emissions continue to grow at the fastest rates globally.
- In several sectors, additional climate response options can be implemented to realize synergies and avoid conflicts with other dimensions of sustainable development. Decisions about macroeconomic and other non-climate policies can significantly affect emissions, adaptive capacity and vulnerability.
- Making development more sustainable can enhance mitigative and adaptive capacities, reduce emissions, and reduce vulnerability, but there may be barriers to implementation. On the other hand, it is ***very likely*** that climate change can slow the pace of progress towards sustainable development.

CNAS Game Material

5. The long-term perspective

Determining what constitutes "dangerous anthropogenic interference with the climate system" in relation to Article 2 of the UNFCCC involves value judgments. Science can support informed decisions on this issue, including by providing criteria for judging key vulnerabilities.

Avoiding dangerous interference with the climate system requires large reductions in human-induced greenhouse gas emissions in order to stabilize the concentrations of greenhouse gases in the atmosphere. Stabilizing atmospheric greenhouse gases followed by gradual decreases in atmospheric concentrations will result in a long-term global cooling trend, but ***more likely than not*** significant cooling will not occur for more than 500 years because of excess heat stored in the ocean.

- Since the AR4, more assessments have been conducted of the consequences of a wider range of greenhouse gas stabilization levels, ranging from 350 ppm CO_2e to 1050 ppm CO_2e.
- Paleoclimate data and observations of current climate change suggest that many large-scale negative impacts of climate change will occur as a result of current greenhouse gas concentrations.

The five "reasons for concern" identified in the AR4 remain a viable framework to consider key vulnerabilities. These "reasons" are assessed here to be stronger than in the AR4. Many risks are identified with higher confidence. Some risks are projected to be larger or to occur at lower increases in temperature.

1. *Risks to unique and threatened systems*. There is ***new and stronger evidence*** of observed impacts of climate change on unique and vulnerable systems (such as polar and high mountain communities and ecosystems), with increasing levels of adverse impacts as temperatures increase further. There is ***medium confidence*** that approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5°C over [1990] levels. Confidence has increased that a 1-2°C increase in global mean temperature above 1990 levels (about 1.5-2.5°C above pre-industrial) poses significant risks to many unique and threatened systems including many biodiversity hotspots. Corals are vulnerable to thermal stress and have low adaptive capacity. Increasing vulnerability of indigenous communities in the Arctic and small island communities to warming is projected.
2. *Risks of extreme weather events*. Responses to some recent extreme events reveal higher levels of vulnerability than the AR4. There is now higher confidence in the projected increases in droughts, heatwaves, and floods as well as their adverse impacts.

CNAS Game Material

3. *Distribution of impacts and vulnerabilities*. There is increasing evidence of greater vulnerability of specific groups such as the poor and elderly in not only developing but also developed countries. Moreover, there is increased evidence that low-latitude and less-developed areas generally face greater risk, for example in dry areas and mega-deltas.
4. *Aggregate impacts*. Compared to the AR4, initial net market-based benefits from climate change are projected to peak at a lower magnitude of warming, while damages would be higher for larger magnitudes of warming. The net costs of impacts of increased warming are projected to increase over time.
5. *Risks of large-scale singularities*. There is ***high confidence*** that global warming over many centuries would lead to a sea level rise contribution from thermal expansion alone which is projected to be much larger than observed over the 20th century, with loss of coastal area and associated impacts. There is better understanding than in the AR4 that the risk of additional contributions to sea level rise from both the Greenland and possibly Antarctic ice sheets may be larger than projected by ice sheet models and could occur on century time scales.

There is ***high confidence*** that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change.

- Adaptation is necessary in the short and longer term to address impacts resulting from the warming that would occur even for the lowest stabilization scenarios assessed.
- Unmitigated climate change would, in the long term, be ***likely*** to exceed the capacity of natural, managed and human systems to adapt. The time at which such limits could be reached will vary between sectors and regions.
- Early mitigation actions would avoid further locking in carbon intensive infrastructure and reduce climate change and associated adaptation needs.

Many impacts can be reduced, delayed or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts.

In order to stabilize the concentration of greenhouse gases in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilization level, the more quickly this peak and decline would need to occur. In order to stabilize below 490 ppm, emissions would have needed to peak by 2015.

CNAS Game Material

Table 1. Characteristics of stabilization scenarios and resulting long-term equilibrium global average temperature and the sea level rise component from thermal expansion only [contributions from ice sheets could be much larger].

Category	CO_2 concentration at stabilization (2005 = 379 ppm) [b]	CO_2-equivalent Concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) [b]	Peaking year for CO_2 emissions [a, c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions) [a, c]	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity [d, e]
	ppm	ppm	Year	Percent	°C
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1

There are different views as to whether all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion, and addressing related barriers – mainly because of the magnitude of energy services needed for sustained economic growth in the developing world.

- All assessed stabilization scenarios indicate that 60-80% of the reductions would come from energy supply and use, and industrial processes, with energy efficiency playing a key role in many scenarios. Including non-CO_2 and CO_2 land-use and forestry mitigation options provides greater flexibility and cost-effectiveness. Low stabilization levels require early investments and substantially more rapid diffusion and commercialization of advanced low-emissions technologies.
- Without substantial investment flows and effective technology transfer, it may be difficult to achieve emission reduction at a significant scale. Mobilizing financing of incremental costs of low-carbon technologies is important.
- It is ***likely*** that stabilization without adverse impacts on developing economies may require transformational energy technology breakthroughs, but investments in energy R&D since the ratification of the Copenhagen Agreement do not appear to have accelerated progress toward such breakthroughs.

CNAS Game Material