America's CLIMATE CHOICES
AT THE NATIONAL ACADEMIES

Limiting the Magnitude Of Future Climate Change

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Request from Congress

"…investigate and study the serious and sweeping issues relating to global climate change and make recommendations regarding what steps must be taken and what strategies must be adopted in response to global climate change, including the science and technology challenges thereof."

Charge to the "Limiting" Panel

- The Panel will describe, analyze, and assess strategies for reducing the net future human influence on climate, including both technology and policy options

- The Panel will focus on actions to reduce **domestic** greenhouse gas emissions and other human drivers of climate change (such as changes in land use), but will also consider the international dimensions of climate stabilization

Panel Members

Robert Fri (*Chair*), Resources for the Future

Marilyn Brown (*Vice Chair*), Georgia Institute of Technology

Doug Arent, National Renewable Energy Laboratory

Ann Carlson, UCLA

Majora Carter, Majora Carter Group

Leon Clarke, Pacific Northwest National Laboratory

Francisco de la Chesnaye, Electric Power Research Institute

George Eads, Charles Rivers Associates

Genevieve Giuliano, University of Southern California

Andrew Hoffman, University of Michigan

Robert Keohane, Princeton University

Loren Lutzenhiser, Portland State University

Bruce McCarl, Texas A&M University

Mack McFarland, DuPont

Mary Nichols, CA Air Resource Board

Edward Rubin, Carnegie Mellon University

Thomas Tietenberg, Colby College (Ret.)

James Trainham III, Sundrop Fuels, Inc.

Structure of the Report

Summary

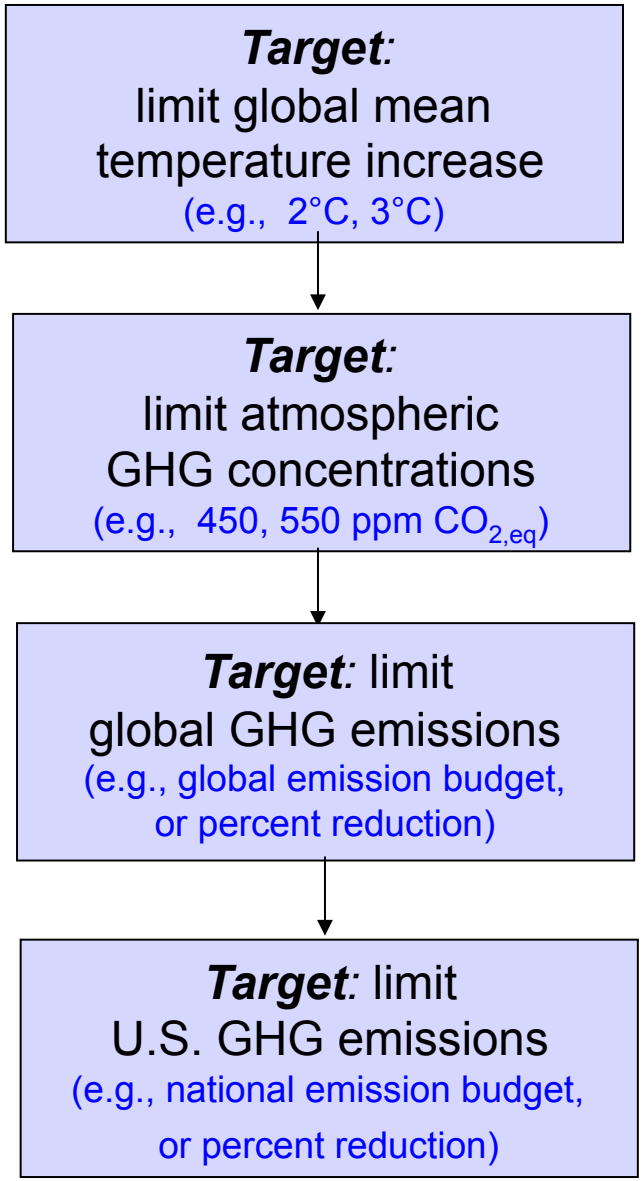
1. Introduction
2. Potential Emission Futures
3. Opportunities for Limiting Climate Change
4. Crafting a Portfolio of Energy and Climate Policies
5. Fostering Technological Innovations that Reduce GHG Emissions
6. Interactions with Other Issues of Concern to Policymakers
7. Multi-level Response Strategies
8. Policy Durability and Evolution

Take-Home Messages

A robust U.S. response to climate change requires:

- **Prompt and sustained efforts to reduce domestic GHG emissions**
- **An inclusive national framework to align the goals and efforts of actors at all levels**
- **Adaptable management of policy responses**

Setting Goals



What is a "safe" amount of climate change? What "limits" should be adopted as goals?

How do limits on global mean temperature change or other key impacts translate into limits on atmospheric GHG concentrations?

How do atmospheric GHG concentration limits translate into limits on global GHG emissions?

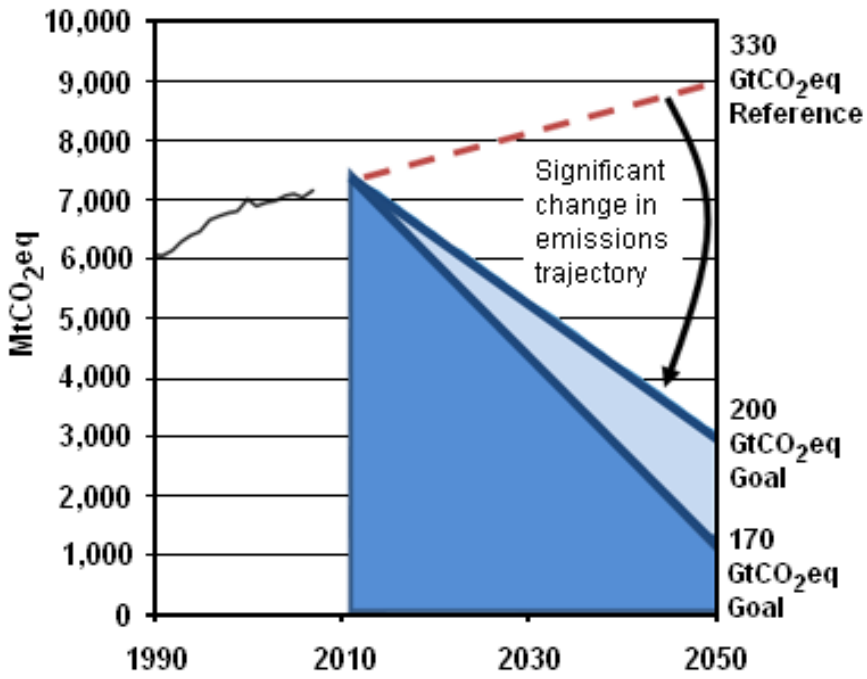
What is a reasonable share of U.S. emission reductions relative to the global targets? What is the implied emissions "budget"?

Set an Emissions Budget

We suggest that the U.S. establish a "budget" for cumulative GHG emissions over a set period of time

We do not recommend a specific budget for the U.S., but offer a representative range of: 170–200 gigatons (Gt) of CO_2-eq for 2012–2050.

Business-as-usual emissions would consume these budgets well before 2050; thus, there is a need for URGENCY



Guidance from Recent Studies

To suggest a reasonable emissions budget range and test its feasibility, the panel drew upon:

Energy Modeling Forum (EMF, 2009)

A recently-published effort of ten of the world's leading Integrated Assessment Models that relates global GHG concentration goals to U.S. emission budget goals <emf.stanford.edu/research/emf22/>

America's Energy Future (AEF, 2009)

A National Academies study that examined the technical potential for expanding the use of energy efficiency, renewable electricity and fuels, carbon capture & storage, and nuclear energy <www.nationalacademies.org/energy>

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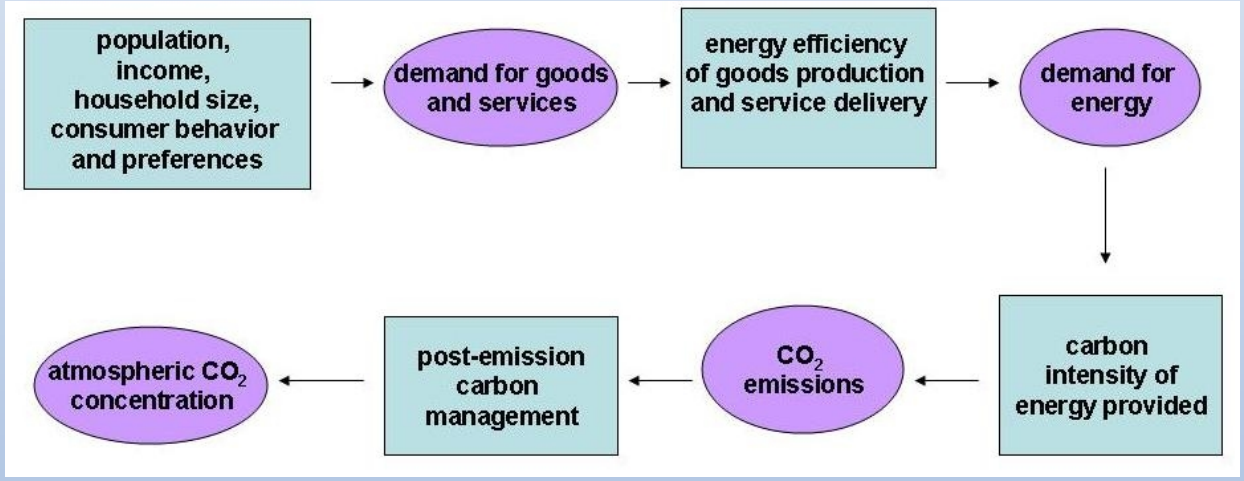
Ways to Reduce CO_2 Emissions

- Reduce demand for energy-intensive goods & services
- Improve the efficiency of energy use (at all stages)
- Expand use of low- and zero- carbon energy sources
- Capture and sequester CO_2 directly from ambient air



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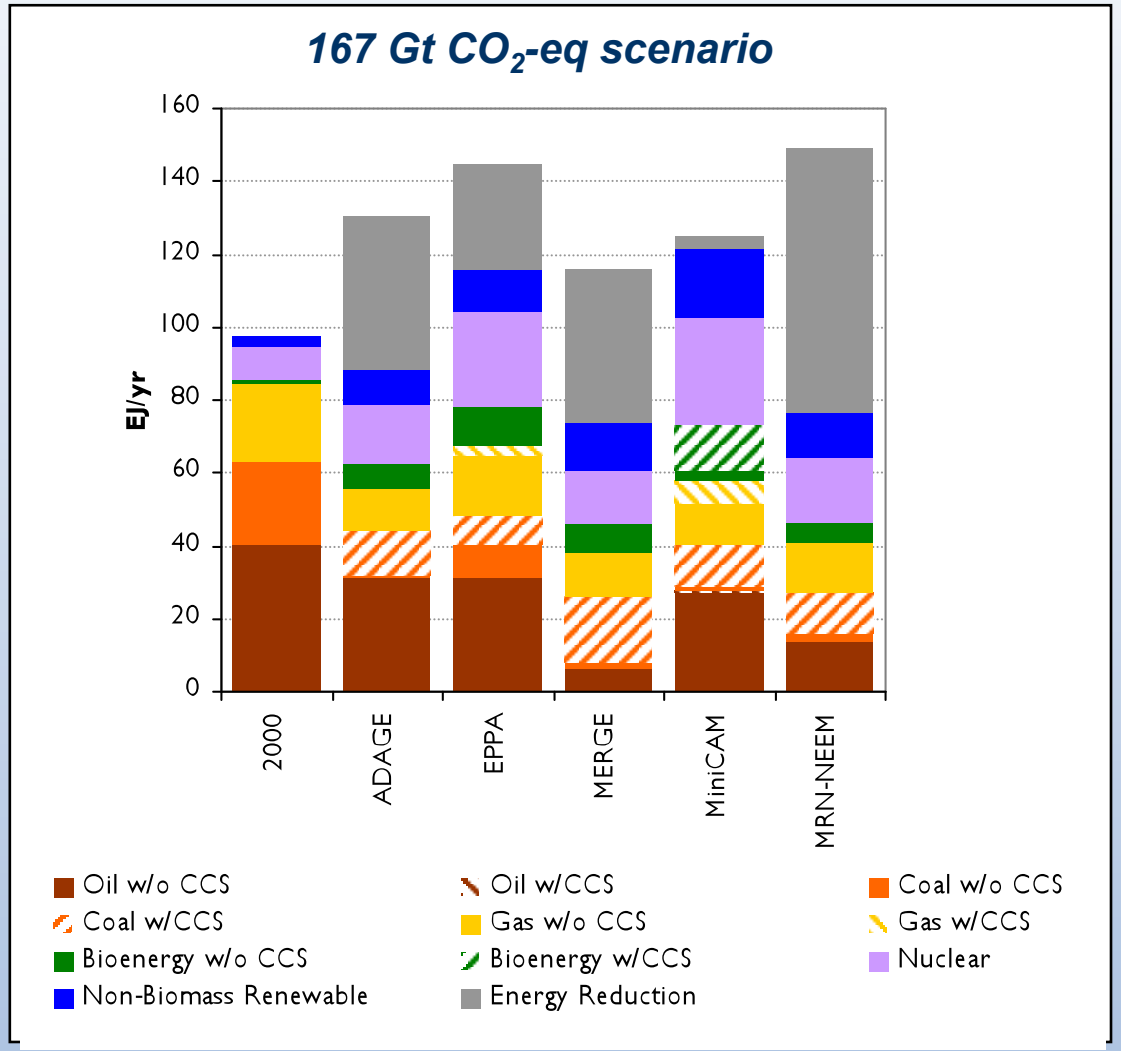
No Single Solution



Results from five models:

Least-cost U.S. energy mix in 2050 for a GHG budget of ~170 Gt CO_2-eq (~80% reduction below 1990 level)

(Source: EMF22, 2009)

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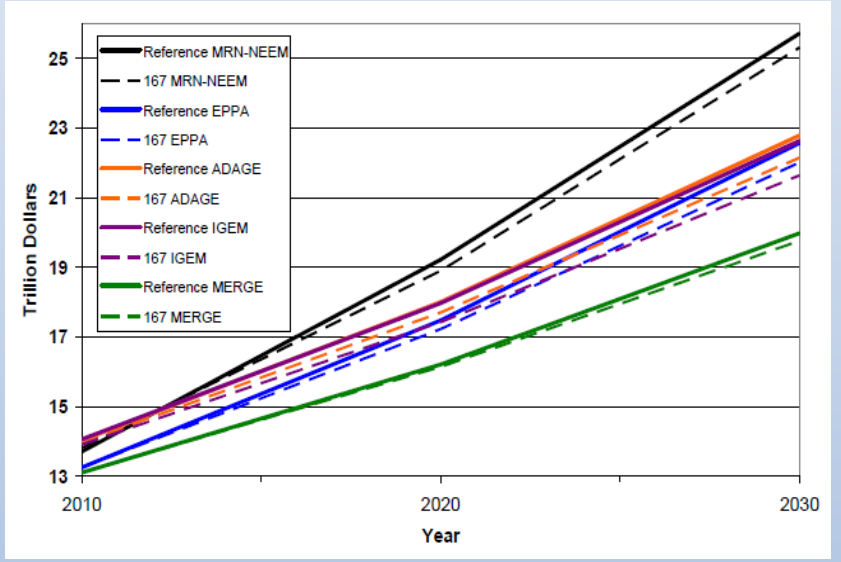
Feasible But Not Easy

- Based on analyses by the Energy Modeling Forum (EMF) and America's Energy Future (AEF), we conclude that an emissions budget in the 170–200 Gt CO_2-eq range is technically possible, but could be very difficult to achieve
- Within the electric power and transportation sectors, essentially all available options would have to be deployed at levels close to estimates of what is technically possible.

THUS, there is a need to aggressively pursue all major near-term emission reduction opportunities AND increase R&D support to create new options

Economic Impacts

- **Estimates of economic impacts through 2050 are especially sensitive to:**
  - **Timing of emission reductions**
  - **Availability of advanced technology**
  - **Availability and price of international *offsets***
- **GDP continues to grow, but at a somewhat lower rate than reference case**
- **An early start and a strong R&D program could reduce total costs significantly**



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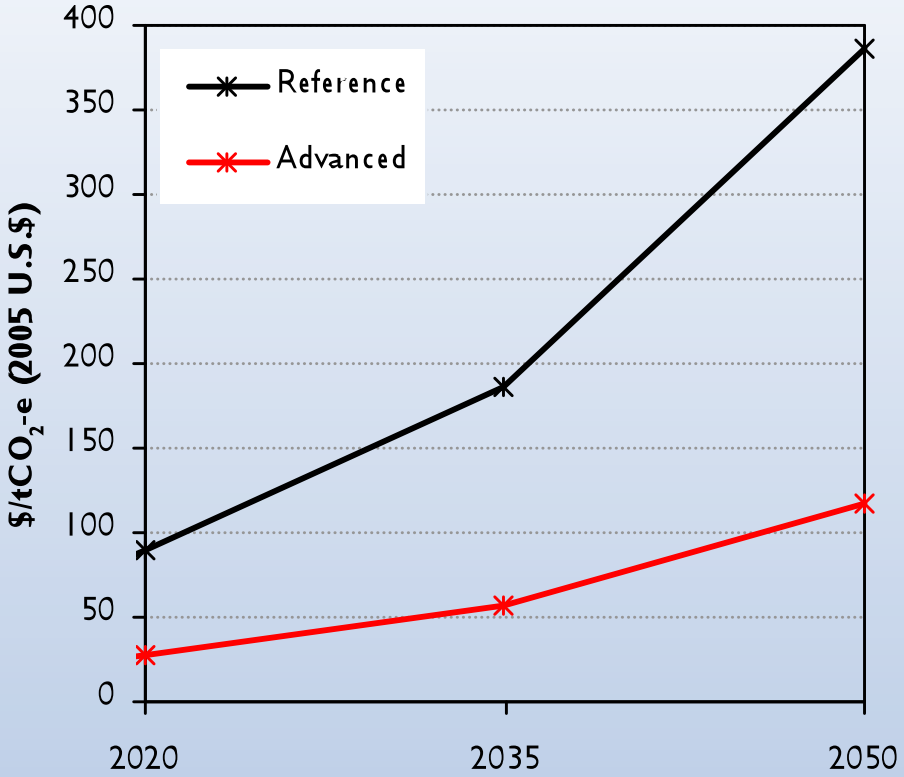
Value of Sustained R&D

Projected price of CO_2 emissions under two technology scenarios:

<u>REFERENCE CASE</u>: continue historical rates of technology improvement

<u>ADVANCED TECH</u>: more rapid technological change



The availability of advanced technologies can greatly reduce the cost of emission reductions

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Core Policy Recommendations

1. **Adopt a mechanism for setting an economy-wide carbon pricing system**

2. **Complement the carbon price with policies to:**
   - Realize the practical potential for energy efficiency and low-emission energy sources in the electric and transportation sectors;
   - Establish the feasibility of carbon capture and storage and new nuclear technologies;
   - Accelerate the retirement, retrofitting or replacement of GHG emission-intensive infrastructure.

3. **Create new technology choices by investing heavily in research and crafting policies to stimulate innovation**

Core Recommendations *(con't.)*

4. Consider potential equity implications when designing and implementing climate change-limiting policies, with special attention to disadvantaged populations

5. Establish the United States as a leader to stimulate other countries to adopt GHG reduction targets

6. Enable flexibility and experimentation with policies to reduce GHG emissions at the regional, state and local levels

7. Design policies that balance durability and consistency with flexibility and capacity for modification as we learn from experience

For More Information

ACC Website:

http://www.americasclimatechoices.org/

For questions, contact:

Laurie Geller, NRC, <lgeller@nas.edu>

Report available from:

National Academy Press

<http://www.nap.edu/catalog.php?record_id=12785>

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Thank You

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