

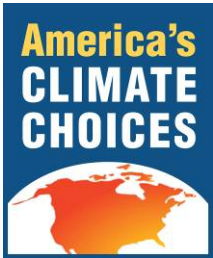
America's
CLIMATE CHOICES
AT THE NATIONAL ACADEMIES



***Limiting the Magnitude
of Future Climate Change***

<http://americasclimatechoices.org>

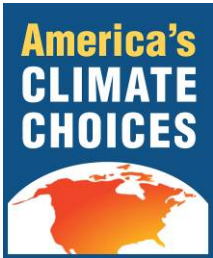
THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine



Charge to the 'Limiting' Panel

The Panel will analyze strategies for reducing 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 (e.g., land use changes), but will also consider the ***international*** dimensions of climate stabilization.



Panel Membership

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 Assoc.

Genevieve Giuliano, University of
Southern California

Andrew Hoffman, University of Michigan

Robert Keohane, Princeton University

Loren Lutzenhiser, Portland State Univ.

Bruce McCarl, Texas A&M University

Mack McFarland, DuPont

Mary Nichols, CA Air Resource Board

Edward Rubin, Carnegie Mellon Univ.

Thomas Tietenberg, Colby College (Ret.)

James Trainham III, RTI International.

Setting Goals

Target: limiting global mean temperature increase
(e.g., 2 deg, 3 deg)

What is a 'safe' amount of climate change?

Target: limiting global atmospheric GHG concentrations
(e.g., 450ppm, 550 ppm)

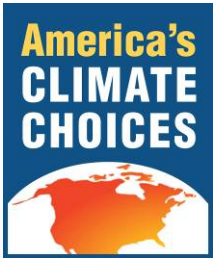
How does GHG concentration translate into global temperature change and other key impacts?

Target: limiting global GHG emissions
(e.g. global emission budget, or percent reduction)

How does a given level of emissions translate into atmospheric GHG concentrations?

Target: limiting U.S. GHG emissions
(e.g. national emission budget, or percent reduction)

What is a 'reasonable' share of U.S. emission reductions relative to the global targets?

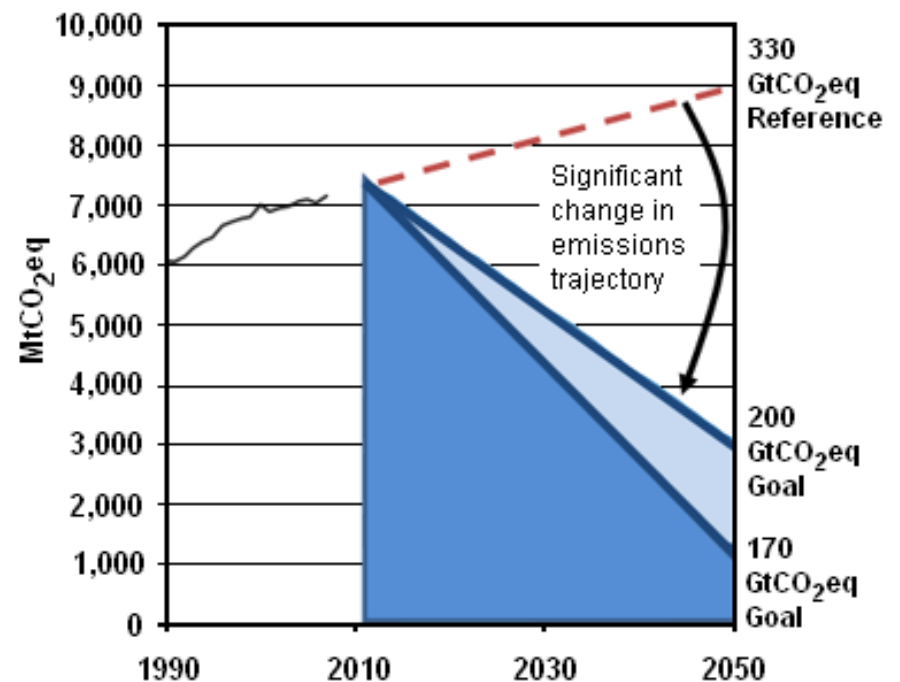


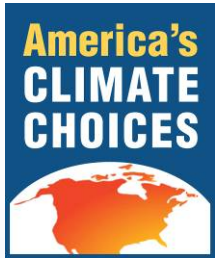
Setting Goals

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 number, but offer an illustrative budget range of:
170 - 200 gigatons
of CO₂-eq for 2012 - 2050.

Business-as-usual emissions would consume this budget well before 2050.





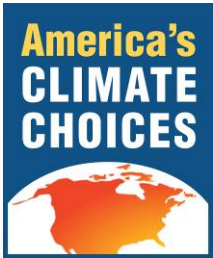
To suggest a reasonable emissions budget range and test its feasibility, the panel drew upon two recent studies:

Energy Modeling Forum (EMF)

A recently-published effort of 10 of the world's leading Integrated Assessment Models that relates global GHG concentration goals to U.S. emission budget goals

America's Energy Future (AEF)

An NRC series of studies that examined the technical potential for expanding use of efficiency, renewable electricity and fuels, CCS, and nuclear energy.



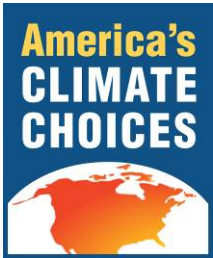
EMF / AEF results were used to assess feasibility of meeting budget goals.

Meeting an emissions budget in this range could be technically possible, but will be very difficult.

For the electricity sector, all technologies need to be deployed at levels close to full technical potential. For the transportation sector, biofuels alone are unlikely to be sufficient.

Technical potential estimates are based on optimistic assumptions; falling short of the full potential is likely.

THUS need to pursue all major near-term opportunities AND support R&D for creating new options.

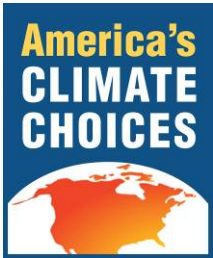


Economic Impact

Estimating long-term economic impacts is difficult, as results are highly sensitive to:

- **Timing**
- **Availability of advanced technology**
- **Price of international offsets**

An early start and a strong R&D program could mitigate economic impacts.



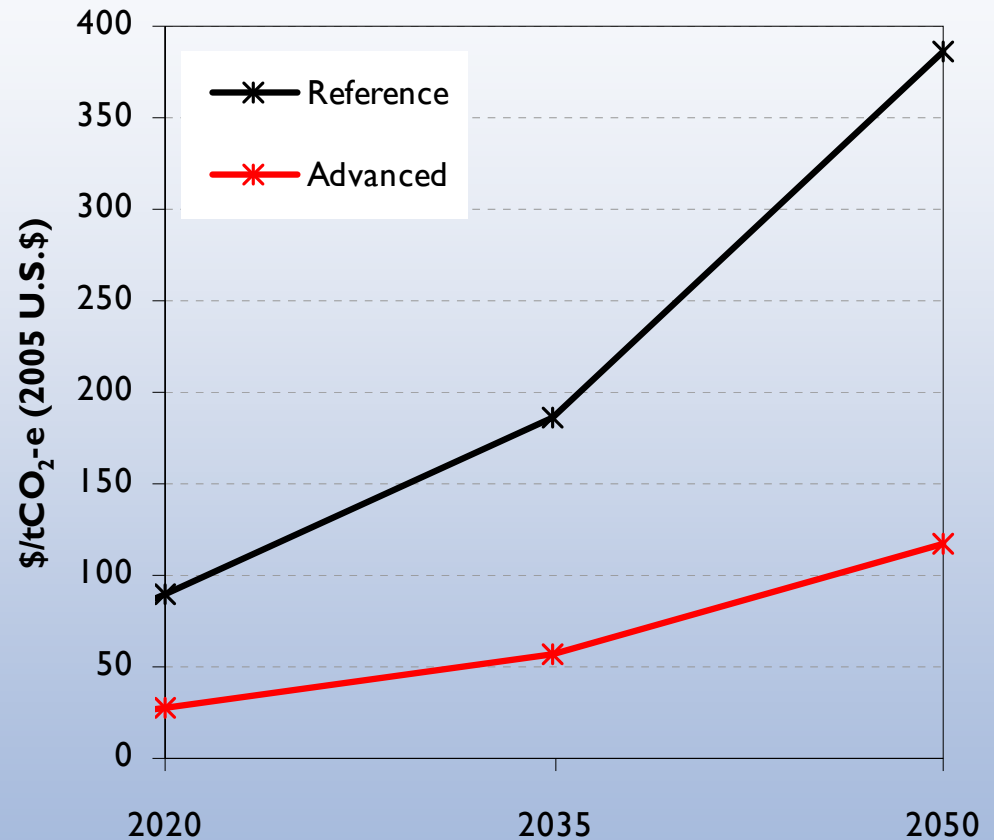
Economic Impact

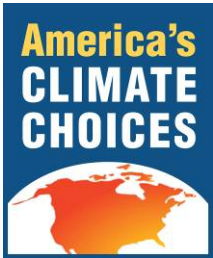
Projected carbon price emissions under 2 scenarios:

REFERENCE: continue historical rates of technology improvement

ADVANCED: more rapid technological change

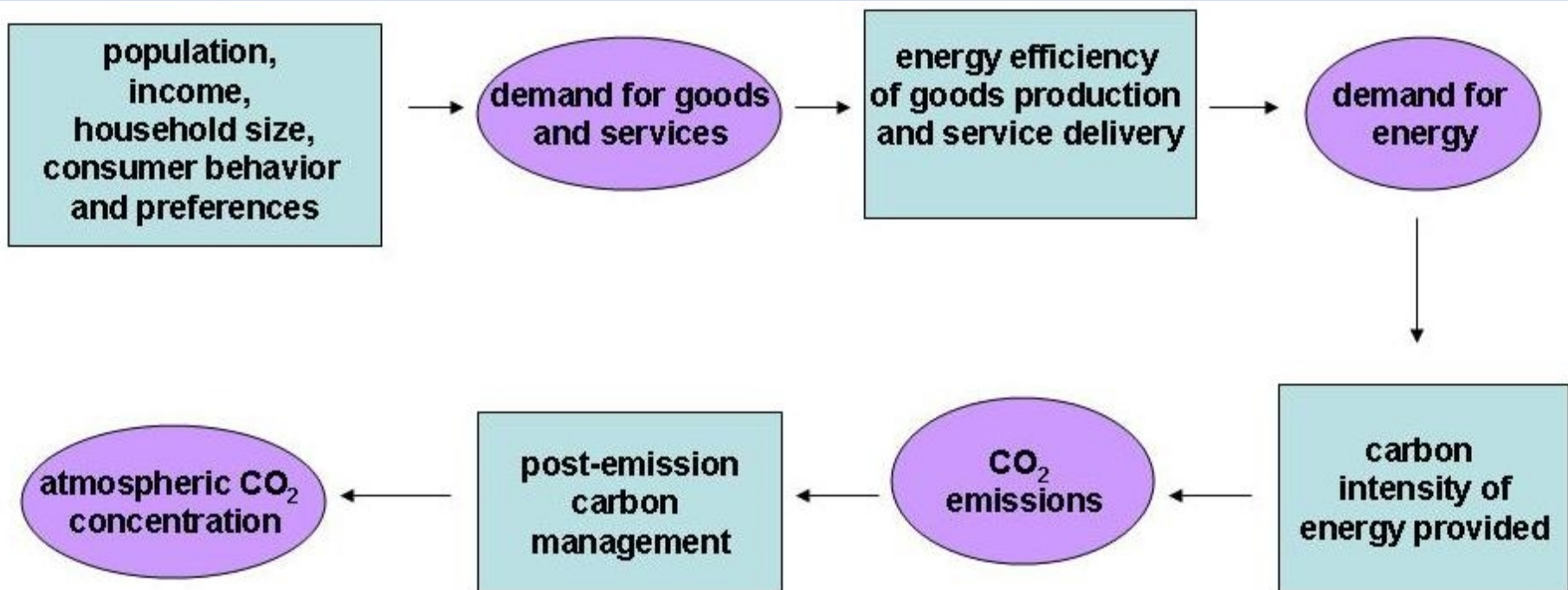
Availability of advanced technologies can greatly lower costs of emission reductions.

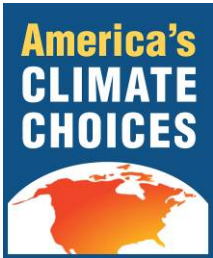




Options to reduce CO₂ emissions

- Reduce demand for goods & services requiring energy
- Improve the efficiency with which energy is used
- Expand the use of low- and zero- carbon energy sources
- Capture and sequester CO₂ directly from the atmosphere



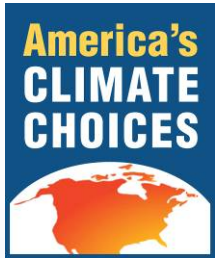


1. Adopt an economy-wide carbon pricing system

A price on GHG emissions (through cap-and-trade, taxes, or a hybrid of the two) creates incentives for emission reductions and markets for low-emission technologies. Cap-and-trade would be particularly compatible with an emissions budget, and perhaps more durable over time.

Evidence suggests that economic efficiency is best served by avoiding free emission allowances and having a system that is economy-wide rather than limited to particular sectors.

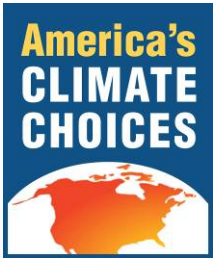
Domestic and international offsets can serve useful purposes, but only if adequate certification, monitoring, and verification of emission reductions are possible.



2. Complement the carbon pricing system.

Even with a strong carbon pricing system, timely emission reductions can be inhibited by many barriers. Complimentary policies are needed to focus on:

- (i) Assuring rapid progress with near-term, high-leverage emission reduction opportunities for producing electricity (*i.e., increase energy efficiency and low-GHG electricity generation options such as renewables; advance full-scale demonstration for CCS and new nuclear power*)
- (ii) Advancing efficiency and low GHG-emitting technologies in the transportation sector
- (iii) Accelerating the retirement, retrofitting, or replacement of emissions-intensive infrastructure.



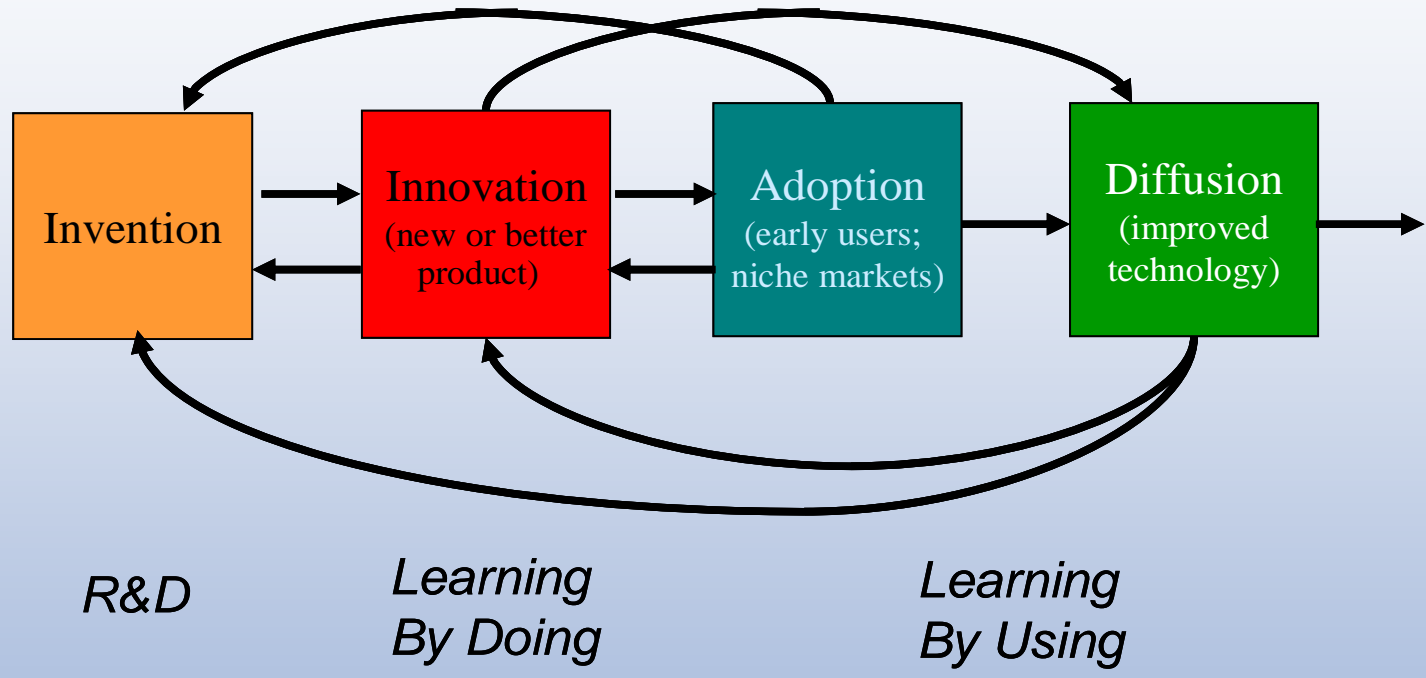
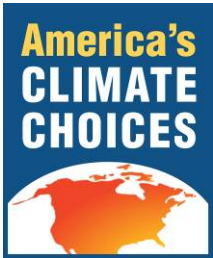
3. Create new technology choices

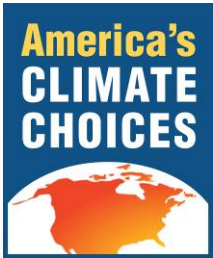
Significantly increase both government and private-sector funding for energy R&D

Establish and expand markets for low-GHG technologies and more rapidly bring new technologies to commercial scale

Foster workforce development and training

Improve understanding of how social and behavioral dynamics interact with technology.



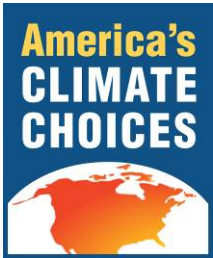


4. Consider equity implications when designing and implementing climate change limiting policies.

Disadvantaged groups likely to suffer disproportionately from adverse impacts of climate change may also be adversely affected by policies to limit climate change.

Monitor and consider options for minimizing adverse impacts on these groups (e.g., providing relief from higher energy prices; actively engaging these communities in planning efforts).

Major changes to our nation's energy system will inevitably lead to job gains in some sectors and regions, and losses in others. We can smooth this transition through targeted support for educational, training, and retraining programs.

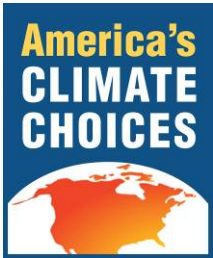


5. Establish the U.S. as a leader to stimulate other countries to adopt GHG emissions reduction targets

U.S. emissions reductions alone are not sufficient for limiting future climate change. But what the U.S. does about its own GHG emissions will have a major impact on how other countries act.

Is likely necessary for U.S. engagement to continue to operate at multiple levels (UNFCCC, bi-lateral/multi-lateral agreements; sectoral-based agreements)

International engagement will require both competitive and cooperative efforts. Of particular value are S&T initiatives that help developing countries limit emissions while advancing sustainable economic development.

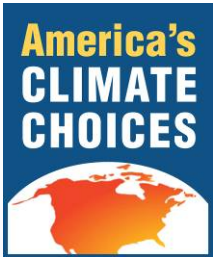


6. Enable flexibility and experimentation with emission reduction policies at regional, state, and local levels

Considerable state and local-level action to reduce emissions is already underway, and offers a valuable laboratory for policy experimentation and learning.

In some instances, it may be appropriate for state/local efforts to be preempted by new federal programs, but this must be balanced against the need for flexibility and innovation.

Avoid punishing those that have taken early action to limit emissions, and ensure that states and localities have sufficient resources to implement mandated national programs.



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

Policies must remain durable for decades and be resistant to undercutting by special interest pressures. Durability comes from creating a constituency that benefits from the policy and has a vested interest in maintaining it.

At the same time, policies must be sufficiently flexible to allow for adaptation as we gain experience and understanding.

There are inherent tensions between these goals of durability and adaptability, and it will be an ongoing challenge to find a balance between them.

America's
CLIMATE CHOICES
AT THE NATIONAL ACADEMIES

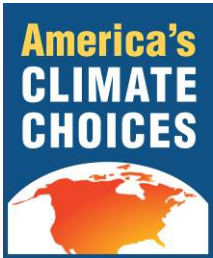


For more information:

<http://americasclimatechoices.org>

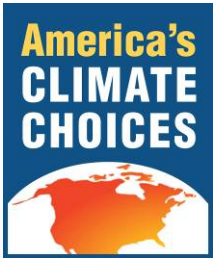
**For full report text online, free PDFs of
report Summary and 4-page “report in brief”,
or to order copies:**

<http://www.nap.edu>



Core 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 (cont...)

- 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 regional, state, and local levels.**
- 7. Design policies that balance durability and consistency with flexibility and capacity for modification as we learn from experience.**