



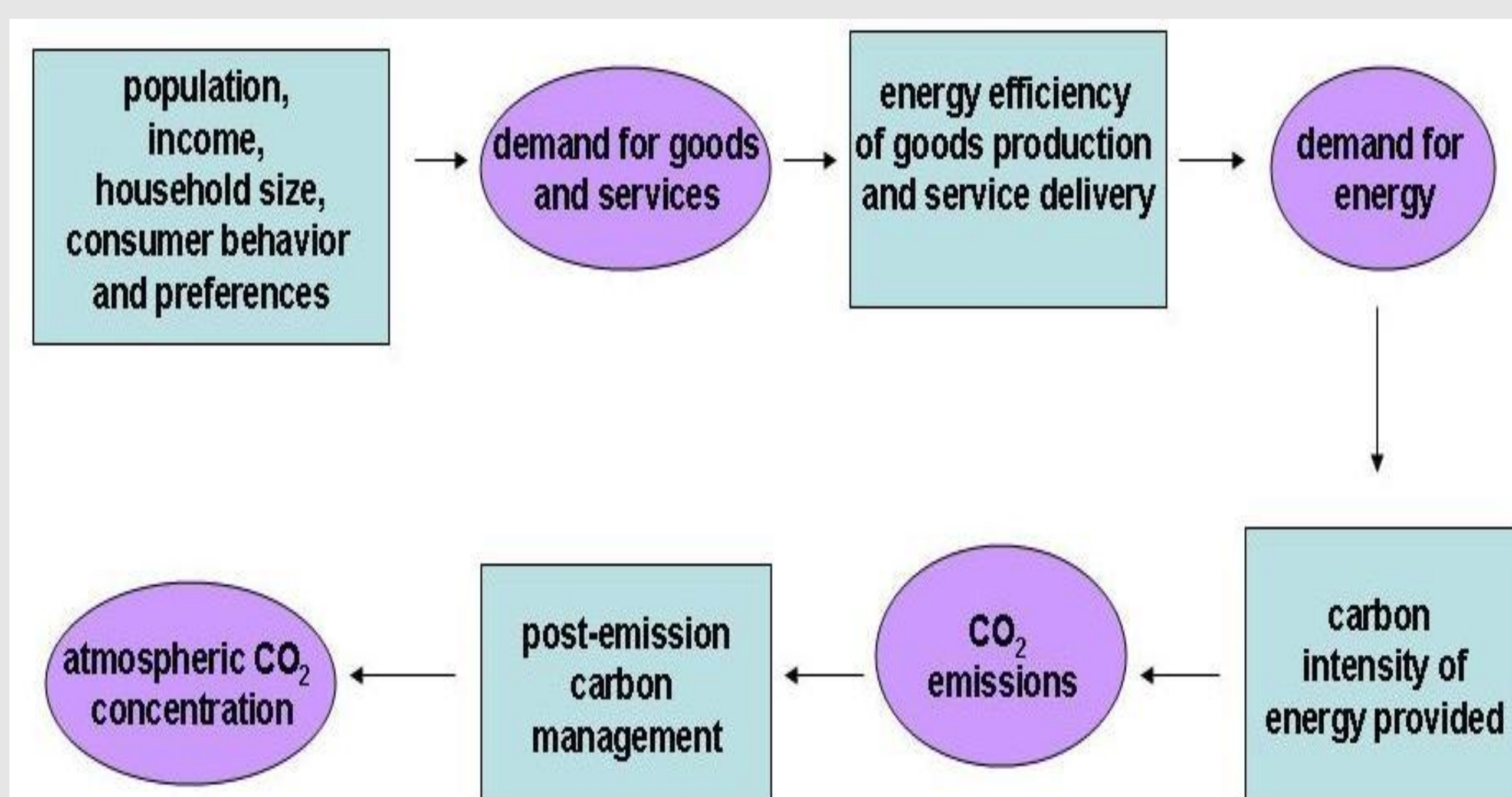
Limiting the Magnitude of Future Climate Change

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Statement of Task: This report, part of the *America's Climate Choices* suite of studies requested by Congress, discusses strategies to limit future climate change, by reducing greenhouse gas emissions and enhancing carbon sequestration.

Committee Members: Robert Fri (Chair), Marilyn Brown (Vice Chair), Doug Arent, Ann Carlson, Majora Carter, Francesco de la Chesnaye, George Eads, Genevieve Giuliano, Andrew Hoffman, Robert Keohane, Loren Lutzenhiser, Bruce McCarl, Mack McFarland, Mary Nichols, Edward Rubin, Tom Tietenburg, James Trainham III.

Opportunities to Reduce CO₂ Emissions



Chain of factors that determine how much CO₂ accumulates in the atmosphere. Blue boxes are factors that can be influenced to affect outcomes (purple ovals).



Reduce underlying demand for goods and services that require energy (e.g., expand education and incentive programs to influence consumer behavior and preferences; curtail sprawling development patterns that further our dependence on oil).



Improve the efficiency with which energy is used (e.g., use more efficient methods for insulating, heating, cooling, and lighting buildings; upgrade industrial equipment and processes to be more energy efficient; encourage the purchase of efficient home appliances and personal vehicles).

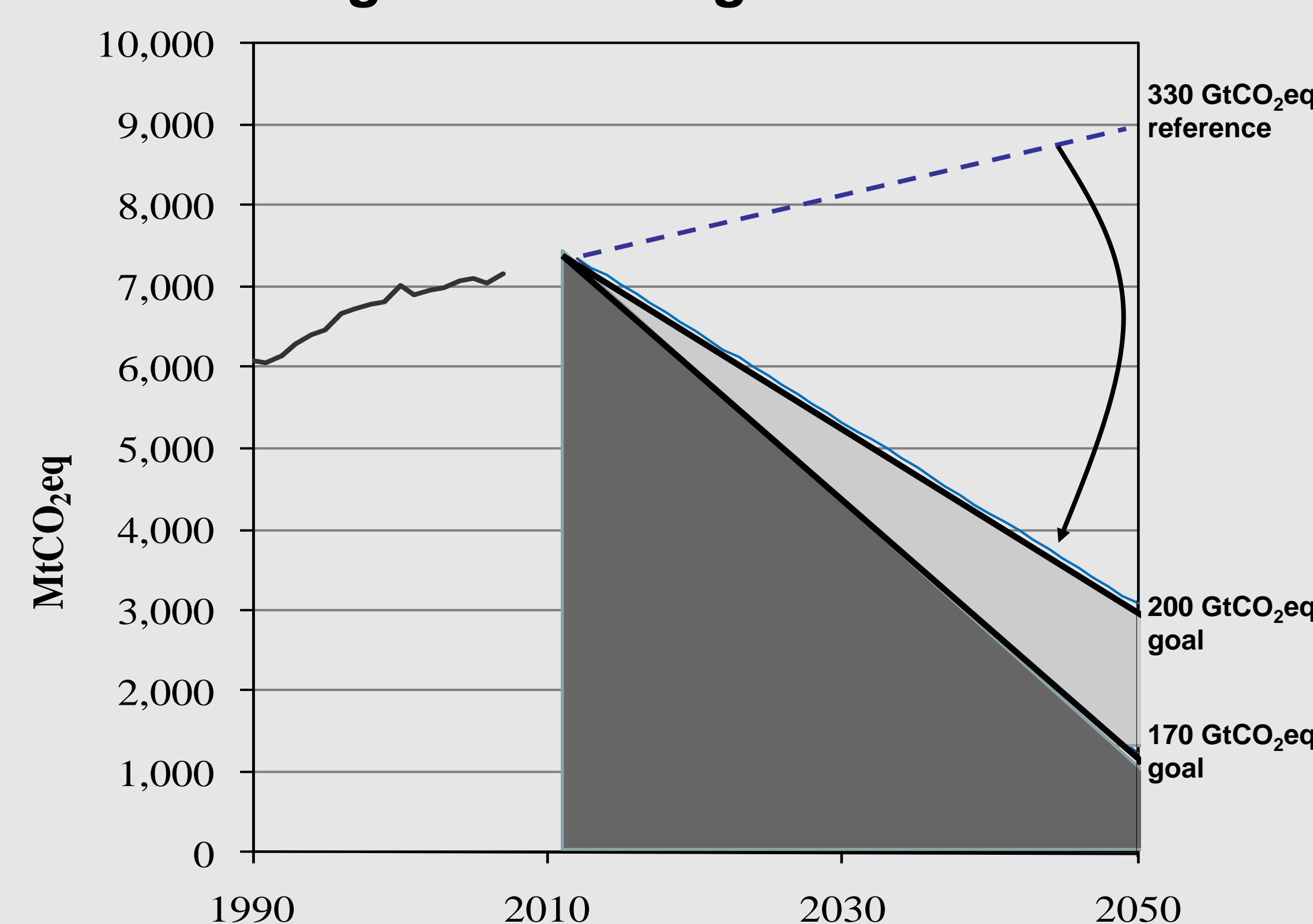


Expand the use of low- and zero-carbon energy sources (e.g., switch from coal and oil to natural gas, expand the use of nuclear power and renewable energy sources such as solar, wind, geothermal, and biomass; capture and sequester CO₂ from power plants and factories).



Capture and sequester CO₂ directly from the atmosphere (e.g., manage forests and soils to enhance carbon uptake; develop mechanical methods to “scrub” CO₂ directly from ambient air).

“Frame the U.S. goal as a cumulative budget for greenhouse gas emissions.”

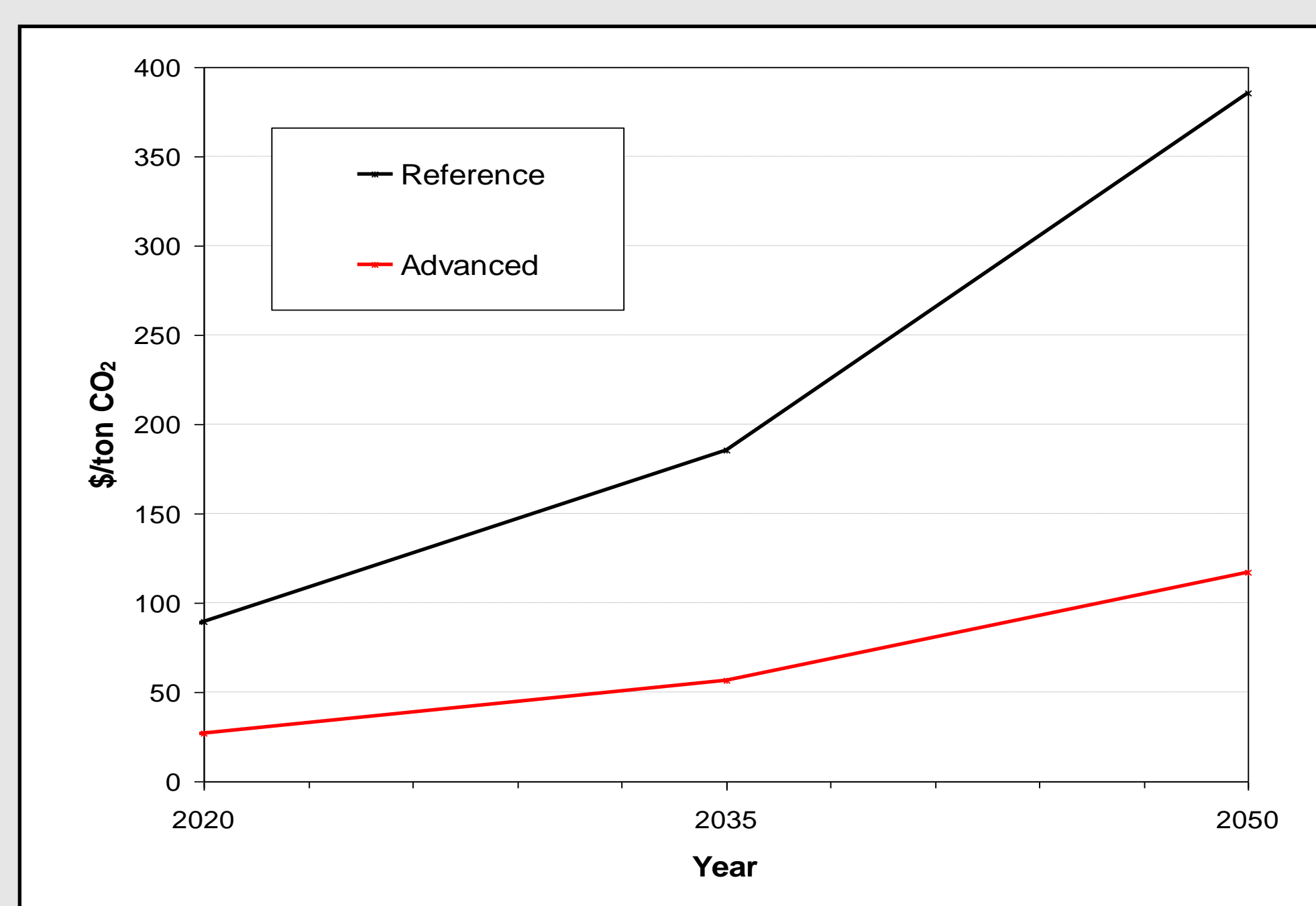


The Panel examined what it would take to meet an emissions budget in the range of 170 to 200 Gt CO₂(equivalent) for the period 2012 – 2050, which would be a major departure from ‘business as usual’ emission trends [based on estimates from the Energy Modeling Forum (emf.stanford.edu/research/emf22/)]

Meeting an emissions budget in this range could be technically possible, but will be very difficult. Within the electric power and transportation sectors, essentially all available options must be deployed at levels near the maximum extent of what is thought to be technically possible [based on estimates from NRC ‘America’s Energy Future’ (http://sites.nationalacademies.org/energy/Energy_043336)]

Full technical potential may not be fully realized, thus there remains a strong need to support R&D for helping to ensure better options in the future.

Estimating Costs



Model projections of the future price of CO₂ emissions under two scenarios: a “reference” case with continuation of historical rates of technological improvements and an “advanced” case with more rapid technological development.

The absolute costs are highly uncertain, but studies clearly show how investing in R&D can greatly mitigate long-term costs of reducing emissions [based on estimates from the Energy Modeling Forum (emf.stanford.edu/research/emf22/)]

Recommendations

1. Adopt an economy-wide carbon pricing system.

- Either carbon taxes, cap & trade, or a hybrid of the two can provide efficient incentives for emission reductions.
- Economic efficiency is best served by having a pricing system that is economy wide, rather than limited to particular sectors.

2. Complement the carbon pricing system with policies to ensure rapid progress in ‘high leverage’ areas.

- to realize full potential of energy efficiency and low-emission energy sources in the electric and transportation sector.
- to advance full-scale demonstration of carbon capture & storage, and new generation nuclear technologies.
- to accelerate the retirement or retrofit of emission-intensive infrastructure.

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

- Significantly increase both governmental and private-sector funding for energy R&D
- Establish and expand markets for low-emission technologies and more rapidly bring new technologies to commercial scale.

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

- Monitor, and consider options for minimizing, adverse impacts upon those groups likely to be adversely affected by climate response policies
- To address shifting employment opportunities, policy aimed at education, training and retraining will be instrumental.

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

- U.S. emission reductions alone are not sufficient for limiting future climate change, but what the U.S. does about its own emissions can have a major impact on how other countries act.

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, offering a valuable laboratory for policy experimentation and learning.
- In some instances it may be appropriate for state/federal efforts to be preempted by federal programs, but this must be balanced against the need to allow flexibility and innovation.

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. Durability is enhanced if key constituencies benefit from the policies and therefore have a vested interest in maintaining them.
- At the same time, policies must be sufficiently flexible to allow for evolution in response to new developments. It will be an on going challenge to find a balance between these goals.

The *America's Climate Choices* reports are available from National Academy Press (<http://www.nap.edu/>)

