



Climate Change: Policy and Mitigation

The Challenge

Climate change is a global problem that will require global cooperation to address. The objective of the UN Framework Convention on Climate Change (UNFCCC), which virtually all nations including the U.S. have ratified, is to stabilize greenhouse gas (GHG) concentrations at a level that will not cause “dangerous anthropogenic (human-induced) interference with the climate system.”¹ This will require reducing emissions of GHGs and switching to a range of alternative sources of energy. Prior to industrialization (ca. 1750), the CO₂ concentration in the atmosphere was approximately 280 parts per million (ppm); by 2005, fossil fuel combustion and land cover change had increased it to about 379 ppm and it is still increasing at a rate of about 1.9 ppm per year.² Due to the large heat capacity of the oceans and the persistence of the increased concentrations of GHGs, significant emissions reductions must be achieved in coming decades to meet the UNFCCC objective. Continuing with unrestricted growth in global emission is likely to lead to a tripling of the pre-industrial CO₂ concentration and to severe, irreversible (even “dangerous”) climate change.¹ Deploying a portfolio of currently available technologies and those that are expected to be commercialized in the coming decades, could stabilize GHG emissions, but future reductions will require much more drastic measures.³ Stabilizing CO₂ at 450 ppm, will require global CO₂ emissions to drop below 1990 levels within a few decades.⁴ Stabilization at 500 ppm, almost double the pre-industrial concentration, could be achieved by holding GHG emissions constant for 50 years and then reducing emissions by 2/3 over the following 50 years.⁵

General Policies

Market-Based Instruments

- Market-based approaches include emission taxes, tradable carbon permits, and subsidies.
- In a tradable carbon permit system, permits equal to an allowed level of emissions are distributed to each party. Parties with emissions below their allowance are able to sell their excess permits to other parties that have exceeded their emissions allowance.
- Tradable permit systems are recognized for their potential to cost-effectively reduce emissions. Already, companies are trading permits on the Chicago and European Climate Exchanges.

Regulatory Instruments

- Regulatory approaches include non-tradable permits, technology and performance standards, product bans, and direct government investment.
- Currently, carbon emissions are not regulated in the U.S., but are indirectly influenced through technology and performance standards, like the Corporate Average Fuel Economy (CAFE) standards for vehicles and household appliance standards.

Voluntary Agreements

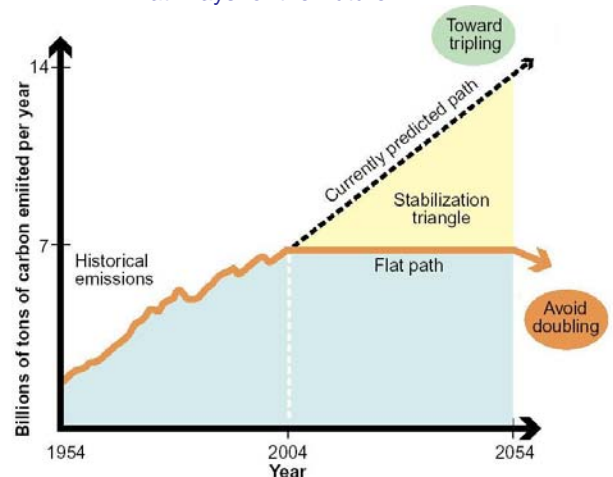
- Voluntary agreements take many forms, but in general, an agreement between a government agency and one or more private parties is to “achieve environmental objectives or to improve environmental performance beyond compliance.”⁷
- Many oil and natural gas companies are working under the U.S. EPA’s voluntary program to reduce leaks and losses of methane (CH₄).

The Kyoto Protocol

The Kyoto Protocol came into force on February 16, 2005. The Protocol established mandatory, enforceable targets for GHG emissions. Emissions reductions for participating countries range from -8% to +10% of 1990 levels, while the overall reduction goal is 5% below the 1990 level from 2008 to 2012. The Protocol is based on three GHG emission reduction mechanisms:

- Joint Implementation involves one country receiving emission reduction credits for implementing projects that reduce emissions or sequester carbon in another country that has an emission limit, e.g., Netherlands is implementing CH₄ capture projects in Germany.⁸

Historical Carbon Emissions with Two Potential Pathways for the Future⁶



¹ United Nations (1992) *United Nations Framework Convention on Climate Change*.

² IPCC (2007) *Climate Change 2007: The Physical Science Basis*. Intergovernmental Panel on Climate Change; Ed. S. Solomon et al.; Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

³ IPCC (2007) *Climate Change 2007: Mitigation*. Intergovernmental Panel on Climate Change; Ed. B. Metz et al.; Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁴ IPCC (2001) *Climate Change 2001: The Scientific Basis*. Intergovernmental Panel on Climate Change; Ed. J.T. Houghton et al.; Cambridge University Press, Cambridge, United Kingdom.

⁵ Pacala, S. and R. Socolow (2004) “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies.” *Science*. vol. 305, p. 968-972.

⁶ Socolow, R. et al. (2004) “Solving the climate problem: Technologies available to curb CO₂ emissions.” *Environment* 46:10, 8-19.

⁷ IPCC (2001) *Climate Change 2001: Mitigation*. Ed. Bert Metz et al.; Cambridge University Press, Cambridge, United Kingdom.

- The Clean Development Mechanism allows countries with emission limits to receive emission reduction credits for implementing projects that reduce emissions or sequester carbon in another country that does not have an emission limit, e.g., Finland is receiving credits for developing biomass-based power plants in India.⁸
- Emissions trading distributes permits equal to an allowed level of emissions to each country. Countries with emissions below their allowance are able to sell their excess permits to other countries that have exceeded their emissions allowance.

Government Actions in the U.S.

Federal Policy

- According to the U.S. Senate, "...Congress should enact a comprehensive and effective national program of mandatory, market-based limits and incentives on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions at a rate and in a manner that will not significantly harm the United States economy and will encourage comparable action by other nations..."⁹
- The United States has not ratified the Kyoto Protocol. Senate Resolution 98 of the 105th Congress stated that the U.S. should not be a signatory unless developing countries participate in mandatory emission reductions.
- In January 2003, the McCain-Lieberman Climate Stewardship Act was introduced in the U.S. Senate. This Act called for an economy-wide, cap-and-trade system for U.S. greenhouse gas emissions reductions. Although the Act was defeated, it was estimated that the economic impact of this Act would have amounted to less than \$20 per year per household.¹⁰

State Policy

- Without a federal policy to reduce GHG emissions in absolute terms, 29 states have their own plans to address climate change.¹¹
- California has established targets to reduce emissions to 1990 levels by 2020 and 80% below 1990 levels by 2050. New Mexico has established a similar emissions reduction target of 75% below 2000 levels by 2050.¹²
- Twenty-eight states and the District of Columbia have mandated that utilities generate a specified amount of electricity from renewable sources. Of these, 24 states and the District of Columbia have renewable portfolio standards in place, which specify a percentage of electricity from renewable sources be achieved by a certain date.¹²

Mitigation Strategies

Stabilizing atmospheric CO₂ concentration cannot be accomplished without significant changes in energy production and use. Following only one strategy is unlikely to result in sufficient GHG reductions; instead, a combination of strategies must be pursued.

- **Energy Savings:** Options for improving energy efficiency abound across economic sectors. Many energy efficiency efforts require an initial capital investment, but the payback period is often only a few years. For example, in 2002, IBM's energy conservation efforts saved the company more than \$38 million. See U.S. EPA Climate Leaders Program website for additional success stories.¹³
- **Fuel Switching:** Switching to a less carbon intensive fuel can achieve emission reductions in the short-term. For instance, switching from coal to natural gas reduces carbon emissions by 43% per unit of primary energy.¹⁴ Beyond these short-term efforts, renewable non-carbon energy sources are critical for reducing emissions.
- **Capturing and Storing Emissions:** CO₂ can be captured from large point sources during both pre- and post-combustion of fossil fuels. Once CO₂ is separated, it can be stored underground. For example, a Norwegian company, Statoil, is storing CO₂ captured during natural gas production in a sandstone aquifer under the North Sea.

Individual Action

In the U.S., residential homes and personal vehicles are responsible for one third of total GHG emissions. There are many actions that individuals can take to reduce GHG emissions from their everyday activities. Many of these actions that involve energy conservation can also yield economic benefits.

Transportation (see **Personal Transportation Factsheet**, <http://css.snre.umich.edu/facts>)

- Choose a fuel-efficient vehicle. See <http://www.fueleconomy.gov/>
- Decrease the amount you drive by using public transportation, walking, riding a bike, telecommuting, or living closer to your work.
- Keep your vehicle well maintained; an under inflated tire increases fuel use. See <http://www.fueleconomy.gov/feg/drive.shtml/>.
- Curb aggressive driving habits. During city driving, aggressive acceleration increases fuel use by 20-40% over smooth acceleration.¹⁵

Residential (see **Residential Buildings Factsheet**, <http://css.snre.umich.edu/facts>)

- Ask your energy supplier about options for purchasing energy from renewable sources.
- When purchasing appliances, look for the Energy Star[®] label and choose the most energy efficient model. See <http://www.energystar.gov> for more information.
- Switching to an Energy Star qualified compact fluorescent light (CFL) bulb uses about 75% less energy than a typical incandescent bulb.¹⁶ GHG emissions can also be reduced by simple actions like turning off the lights and appliances when they are not in use.
- Ensure that your home is properly sealed by reducing air leaks, installing the recommended level of insulation, and choosing Energy Star[®] qualified windows. See http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing/



⁸ Fenhann, J. (2005) "Capacity Development for the Clean Development Mechanism Pipeline Overview." UNEP Risk Centre.

⁹ U.S. House of Reps. (2005) *Energy Policy Act of 2005*. 109th Congress, 1st Session H.R.6 Amendment.

¹⁰ Paltsev, S. et al. (2003) *Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: The McCain-Lieberman Proposal*. MIT Joint Program on the Science and Policy of Global Change.

¹¹ U.S. EPA (2006) "State Action – State Action Plans."

¹² Pew Center on Global Climate Change (2007) "States with Renewable Energy Mandates." and "Emissions Targets: United States and Regional."

¹³ U.S. EPA (2004) *Climate Leaders Success Stories: Innovative Approaches to Reducing Greenhouse Gas Emissions*. <http://www.epa.gov/stateply/>

¹⁴ International Energy Agency (2002) *Beyond Kyoto: Energy Dynamics and Climate Stabilization*. France.

¹⁵ De Vlieger, I., et al. (2000) "Environmental Effects of Driving Behaviour and Congestion Related to Passenger Cars." *Atmospheric Environment* vol. 34 p.4649-4655.

¹⁶ U.S. EPA (2007) "Lighting - Compact Fluorescent Light Bulbs."

