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BEFORE THE
COMMITTEE ON WAYS AND MEANS
U.S. HOUSE OF REPRESENTATIVES

THE HONORABLE CHARLES B. RANGEL, CHAIRMAN

Honorable Chairman and Members of the House Committee on Ways and Means, I respectfully submit the following testimony in response to your invitation of February 19, 2009.

Legislative hearing on "Scientific Objectives of Climate Change Legislation"

Mr. Chairman and distinguished Members of the Committee, thank you for this opportunity to speak with you today on the scientific objectives of climate change legislation. I appreciate the opportunity to testify before you today on behalf of the Union of Concerned Scientists (UCS). UCS is a leading science-based nonprofit with more than 275,000 activists and members, which has been working for a healthy environment and a safer world for almost 40 years.

I am Dr. Brenda Ekwurzel, a geochemist with a deep understanding of climate science. In September of 1991, I was conducting research aboard an icebreaker in the Arctic Ocean. As our ship approached the North Pole station, I was astonished to find extensive open water that we easily passed through. Ever since, I have been committed to understanding climate change impacts in the Arctic and especially here in the United States. In 2007, the Nobel-prize winning IPCC released a report with the input of more than 1,200 authors and 2,500 scientific expert reviewers from more than 130 countries. This report found that human-induced warming is already having negative effects from rising sea level to more intense storms to severe drought.

For our nation, the most important objective of climate legislation is to cut heat-trapping emissions as quickly and as deeply as possible in order to avoid the worst consequences of global warming. At the same time, climate legislation needs to provide the funding necessary to invest in clean home-grown energy, transition assistance for consumers and affected workers, and climate adaptation to make our nation more resilient. The good news is that many of the solutions that will curb global warming will also have profound benefits for public health, energy security, and our economy. UCS supports a comprehensive package of climate and energy policies of which cap and trade is a linchpin. If designed well, a cap and trade program sets the emission reductions that are necessary and then allows the market to achieve these reductions in a cost-effective and efficient manner.

In May 2008, more than 1,700 scientists and economists released a joint statement calling on our nation's leaders to swiftly establish and implement policies to bring about deep reductions in heat-trapping emissions. This was the first time in history that U.S. scientists and economists joined together to call for U.S. emission reduction targets. In their call to action they stated:

> "The strength of the science on climate change compels us to warn the nation about the growing risk of irreversible consequences as global average temperatures continue to increase over pre-industrial levels (i.e., prior to 1860). As temperatures rise further, the scope and severity of global warming impacts will continue to accelerate."
>
> "We urge U.S. policy makers to put our nation onto a path today to reduce emissions on the order of 80 percent below 2000 levels by 2050. The first step on this path should be reductions on the order of 15-20 percent below 2000 levels by 2020, which is achievable and consistent with sound economic policy."

They also warned that emerging science must be regularly evaluated to assess whether the goals set today are sufficient. In the nine months since the scientists and economists' call to action, the observations we're seeing are increasingly bleak and already may imply that more aggressive near-term emissions reduction targets are imperative. This is why we encourage members of Congress to include a "rapid response" science review provision in any climate legislation to ensure that the government updates policies in light of the latest evidence. In the science update in Appendix 1 of this testimony, we highlight a few of the latest scientific observations. These include sea level rising faster than expected and summer Arctic sea ice area plummeting which in turn places the frozen tundra at risk of releasing vast stores of carbon.

The most relevant fact for today is one that many may not be aware of. It is well documented that human activities have pumped excessive amounts of carbon dioxide (CO2) into the atmosphere and studies have also concluded that the processes that absorb CO2 simply cannot keep up. The ocean is critical to these processes. As it absorbs carbon dioxide, it becomes more acidic. This combined with increasing ocean temperatures, diminishes the ocean's ability to absorb CO2 and clean the atmosphere which makes global warming worse.

By a simple analogy, my stomach would have no trouble digesting one slice of pizza. If I continued to eat, however, by the 12th slice of pizza my stomach would complain and have immense difficulty digesting one more slice. But I could easily eat those 12 slices over the course of a week. Likewise, the ocean is complaining and is starting to slow down its digestion of the excess CO2 we have pumped into the atmosphere. Now that the "ocean's stomach" is almost full, it will take at least a thousand years for the ocean to digest the excess CO2. Hence, a ton of CO2 emitted to the atmosphere today is worse than a ton emitted decades ago and means we cannot afford further delay. This is why a comprehensive climate solution to reduce emissions swiftly and deeply should be a top priority. The question is how swift and how deep.

Overview: Setting a U.S. Emissions Reduction Target

Establishing an emissions reduction target that avoids the worst consequences of climate change should be the central objective of well-designed climate legislation.

Step 1: Define a Global Temperature Limit & Atmospheric Concentration

Substantial scientific evidence from the IPCC indicates that an increase in the global average temperature of more than two degrees Celsius (°C) above pre-industrial levels (i.e., those that existed prior to 1860) poses severe risks to natural systems and human health and well-being. That's about 2 degrees F above where we are today. Studies indicate that, to have even a 50/50 chance of preventing temperatures from rising above this level, we must stabilize the concentration of heat-trapping gases in the atmosphere at or ***below*** 450 parts per million CO2-equivalent (450 ppm CO2eq—a measurement that expresses the concentration of all heat-trapping gases in terms of CO2). As you've already heard from Dr. Hansen, a lower concentration may be prudent.

Step 2: Define the Global Emissions Budget

Lingering CO2 in the atmosphere builds up as we continue to emit global warming pollution. We can only emit so much before we exceed our goals. Just like a spending budget, we have a limited budget of emissions. We must make specific assumptions in order to make the calculations to stick within our budget. For illustrative purposes we are going to focus this example around a 450ppm atmospheric concentration goal, even though that level may not be sufficiently precautionary. We consider this level an absolute minimum in order to avoid the worst consequences of global warming. Studies suggest that in order not to exceed 450ppm, we must limit worldwide cumulative emissions to around 1,700 gigatons (Gt) CO2eq over the 2000–2050 time period.

Step 3: Define the U.S. Share of Global Emissions Reduction

There are several ways to determine the U.S. share of the overall industrialized nations' emissions budget, such as comparing it with our share of those nations' population, gross domestic product (GDP), or heat-trapping emissions. In this example, over this same 50-year period, let's assume that 40 percent or 700 GtCO2eq of the global budget is allocated to the industrialized nations based on their emissions share in 2005. For the United States' share of these emissions, this would mean our budget is 265 GtCO2eq. However, if it were based on U.S. share of population it would be as low as 160 GtCO2eq. As was stated, a concentration of 450ppm only has a 50 percent chance of staying below 2 degrees C and therefore the top end of this range (265 billion tons) is probably too high. Therefore it may be prudent to recommend a deeper reduction target. Now, how does this cumulative budget translate into percent emissions reductions?

Step 4: Define the U.S. Emission Reduction Targets

To meet the cumulative budget of no more than 265 GtCO2eq, the United States must reduce its emissions at least 80% by 2050. As we strive to make these reductions, the earlier we start, the more flexibility we will have later. If, however, U.S. emissions continue to increase until 2020 (even on a "low-growth" path projected by the Energy Information Administration (EIA)), we would need to double the rate of reductions to avoid a crash finish. Companies are making decisions today about how to invest in our energy infrastructure. Considering the life of a power plant can be upwards of 60 years, we must send the signal now to build clean energy infrastructure and avoid dirtier choices that will lock in irreversible consequences. That's why we need to set a near-term emissions reduction target for the next ten years. To set a near-term target for U.S. reductions, we must consider the need to:

1. Limit "lock-in" of carbon-intensive technologies;
2. Guarantee we're on track to stay within our long-term cumulative budget; and
3. Maintain options if scientific evidence reveals effects are worse than expected.

Taken together, these considerations suggest that near-term reductions should be as swift and deep as possible. In its most recent report, the IPCC looked at a range of studies on what different countries would have to do to reach 450ppm. The range the IPCC reports for the industrialized nations is 25-40% below 1990 levels by 2020, which is at least 35% below today's levels.

Given the urgency of the science, the danger of carbon lock-in, and the need to hit long-term goals, UCS thinks it is prudent to reduce our U.S. emissions by approximately 35% from today's levels (about 25% below 1990 levels) by 2020. In our analysis approximately 10% of these reductions can come from tropical forest protection and the rest can come from emissions reductions in the electric, transport and agricultural sectors of the economy. To reach this goal we recommend a comprehensive package of climate and energy policies, including a cap and trade program that ensures near-term reductions and includes a mechanism for course correction to respond to new scientific evidence. We look forward to working with Congress on a policy that achieves the needed emissions reductions to ensure a safe climate for us and our children.

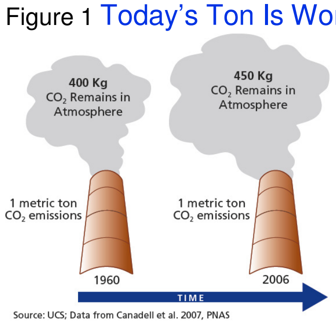
Latest Climate Science Underscores Urgent Need to Reduce Heat-trapping Emissions

Major developments in climate change science have been reported since the publication of the comprehensive 2007 Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC).[1] Recent publications indicate that the consequences of climate change are already occurring at a faster pace and are of greater magnitude than the climate models used by the IPCC projected. A few of the most compelling findings are summarized below.

More CO_2 Remains in the Atmosphere

Human activities have pumped excessive amounts of carbon dioxide (CO_2) into the atmosphere. Natural processes that absorb CO_2 cannot keep up. As the ocean absorbs carbon dioxide, it becomes more acidic. This combined with increasing ocean temperatures, diminishes its ability to continue absorbing CO_2. As a result, more CO_2 stays in the atmosphere. In 1960, a metric ton (1,000 kilograms; ~2,205 pounds) of CO_2 emissions resulted in around 400 kilograms (~881 pounds) of CO_2 remaining in the atmosphere (Figure 1). In 2006, a metric ton of CO_2 emissions results in around 450 kilograms (~992 pounds) remaining in the atmosphere.[2] Hence a ton of CO2 emissions today results in more heat-trapping capacity in the atmosphere than the same ton emitted decades ago.

Figure 1 Today's Ton Is Worse Than a Ton Emitted Decades Ago

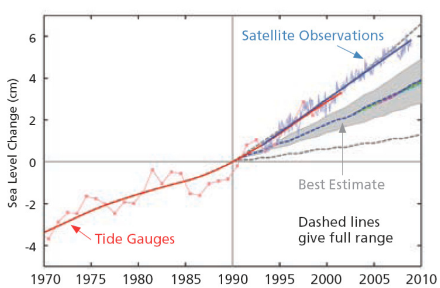


The natural processes that have helped clean up the excess CO_2 pumped into the atmosphere by human activities have not been able to keep up at the same rate.

Increased Sea Level Rise

Increased contributions from melting mountain glaciers and ice sheets on land, as well as thermal expansion due to continued ocean warming, are resulting in higher sea level rise. The IPCC (AR4) noted that sea level has risen 50 percent faster than projected by models for the 1963–2001 period. Recent observations confirm that sea level rise is in the upper range projected by models used by the IPCC (Figure 2).[3]

Figure 2 Sea Level Rise in Line with Highest Projection



Changes in sea level since 1973, compared with IPCC scenarios (dashed lines and gray ranges), based on tide gauges (red) and satellites (blue). From Rahmstorf et al. (2007) updated by Rahmstorf (personal communication).

The IPCC (AR4) estimated global average sea level rise for the end of this century (2090–2099) compared with the end of the last century (1980–1999) at between ~0.6–1.9 feet (~0.2–0.6 meter). These projections were based primarily on thermal expansion due to ocean warming with only modest contributions from mountain glaciers, leaving the potential contributions from ice sheets covering Antarctica and Greenland unclear.[4] Because understanding of ice sheet behavior is still evolving, future ice sheet disintegration was not included in models used by the IPCC at that time. Researchers have since examined plausible contributions from ice sheets given current understanding of accelerating ice sheet melt and other factors. New analysis indicates that meltwater from ice on land could lead to a sea level rise increase of ~2.6 feet (0.8 meter) by the end of the century; and although ~6.6 feet (2.0 meters) is less likely, it is still physically possible.[5] As depicted in Figure 3, when increased contributions from glaciers and ice sheets are taken into account, plausible twenty-first century sea level rise is higher than IPCC estimates.

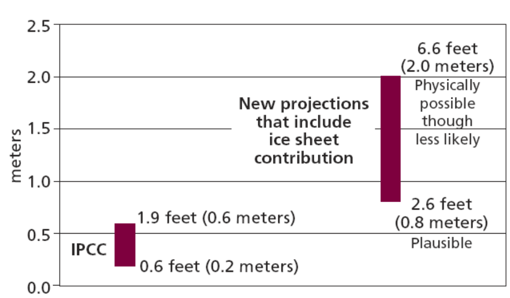


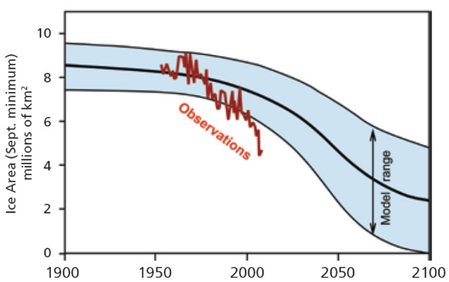
Figure 3 Sea Level Rise by End of This Century

New analysis provides estimates for sea level rise by the end of this century between a plausible level and a physically possible though less likely level. Source (IPCC 2007 and Pfeffer et al. 2008).[4, 5]

Plummeting Arctic Sea Ice

Arctic sea ice area models used by the IPCC are in general agreement with the observed area decrease over the last 50 years and indicate that heat-trapping gases are a major factor in the decline. Current observations show a much steeper drop in ice area than expected.[6] Global warming and natural cycles combine to create the observed Arctic seaice trend. When sea ice would naturally rebound, global warming limits the full sea ice area achieved. When sea ice naturally would be less extensive in area, global warming exacerbates this natural tendency and contributes to sea ice plummeting. For example, the atmospheric pressure and wind patterns in 2007 have naturally occurred in a similar fashion at various times in decades past. However, this type of weather pattern occurring after several decades of ice thinning combined to create a record breaking lowest summer sea ice area since satellite observations began.[7] Recent evidence shows that periods of rapid Arctic sea ice loss lead to faster warming over land in the polar region.[8] As sea ice retreats it exposes dark ocean, which absorbs more of the sun's heat than white ice. Toward the end of summer this ocean heat dissipates to the atmosphere as the region enters winter and the ocean freezes again into sea ice. This warmer air extends over land and allows bacteria more time to decompose thawing plant and other organic matter that had been long frozen.[9] This process can lead to a release of heat-trapping gases (CO2 and methane) into the atmosphere, amplifying global warming.

Figure 4 Shrinking Summer Arctic Sea Ice Area



Arctic models of September sea ice area underestimate the rate of observed sea ice retreat. Based on Stroeve et al. 2007. Source: Dirk Notz from Hamburg adapted figure from *http://www.nsidc.org/news/ images/20070430Figure1.png.*

CO_2 Effects Will Be Felt for Generations

Studies indicate that even after excess human-caused CO2 emissions stop, the planet will experience the resulting warming for at least a thousand years. The higher the peak of atmospheric concentrations of CO2, the greater is the level of irreversible consequences, such as species loss and sea level rise.[10] These and other peer-reviewed studies published since the release of the IPCC AR4 provide ever more compelling evidence that swift and deep reductions of heat-trapping gasses are needed if we are to avoid catastrophic climate change. United States leadership is essential, and there is no time to waste.

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This summary, drafted by B. Ekwurzel of the Union of Concerned Scientists (UCS), benefited from helpful reviews by J. Canadell (CSIRO Marine and Atmospheric Research), S. Rahmstorf (Potsdam Institute for Climate Impact Research), W.T. Pfeffer (Institute of Arctic and Alpine Research, University of Colorado at Boulder), J. Harper (University of Montana), J.C. Stroeve (NSIDC University of Colorado), N. Cole, P. Frumhoff, A. Huertas, L.M. Perera, L. Shultz, and E. Spanger-Siegfried (UCS). The information contained herein is the sole responsibility of UCS.

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A Target for U.S. Emissions Reductions

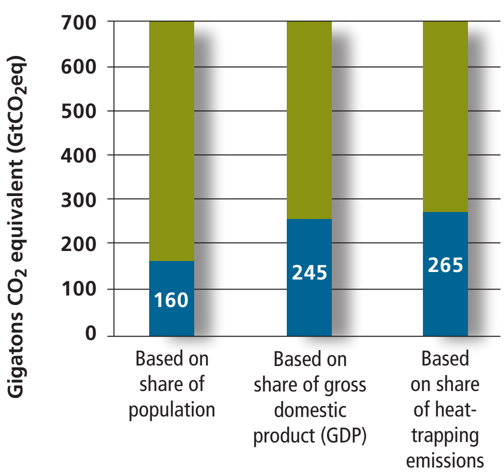
Substantial scientific evidence indicates that an increase in the global average temperature of more than two degrees Celsius (°C) above pre-industrial levels (i.e., those that existed prior to 1860) poses severe risks to natural systems and human health and well-being. Sustained warming of this magnitude could, for example, result in the extinction of many species and extensive melting of the Greenland and West Antarctic ice sheets—causing global sea level to rise between 12 and 40 feet. In light of this evidence, policy makers in the European Union have committed their countries to a long-term goal of limiting warming to 2°C above pre-industrial levels.

The United States has agreed in principle to work with more than 180 other nations under the United Nations Framework Convention on Climate Change to bring about the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-caused] interference with the climate system." Though the federal government has done little to live up to that agreement thus far, there is now growing momentum to pursue deep reductions in emissions of carbon dioxide (CO_2) and other heat-trapping gases that cause global warming. California, Florida, Hawaii, Minnesota, New Jersey, Oregon, and Washington have all enacted laws or established policies setting global warming pollution reduction targets, while states in both the Northeast and West have signed agreements to achieve regional targets. Now the U.S. Congress is considering several bills that propose a variety of global warming emissions reduction targets.

Setting a Reasonable Target

A proper evaluation of the adequacy of these bills must consider what is needed to avoid the potentially dangerous consequences of temperatures rising more than 2°C. Scientific studies

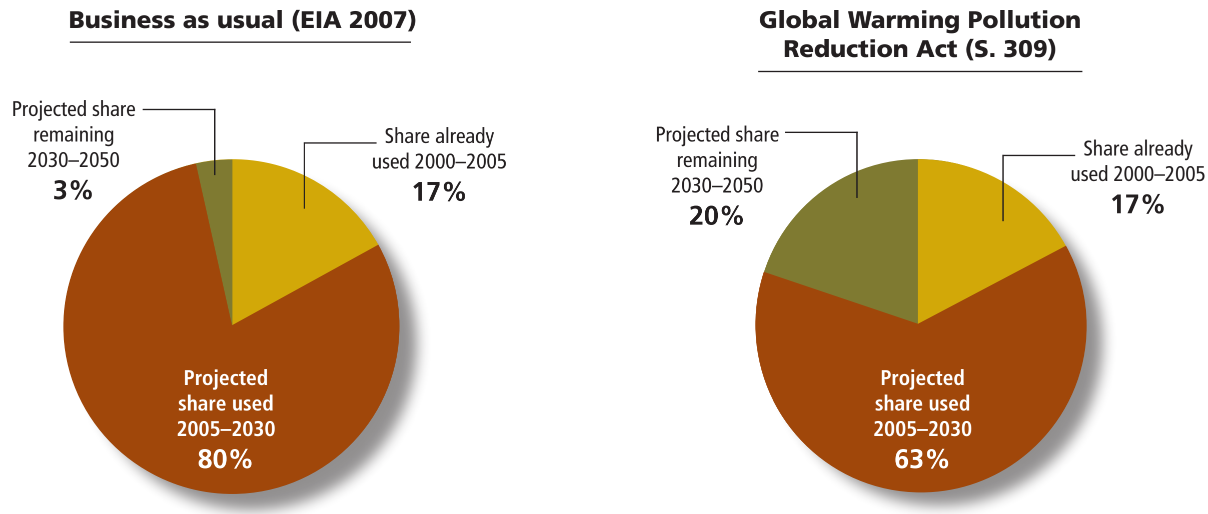
FIGURE 1. Defining the U.S. Share of the Industrialized World's Cumulative Emissions Budget (2000–2050)



The United States' share of the total industrialized nations' budget of 700 $GtCO_2eq$ varies based on the three allocation methods depicted here. A budget based on the current U.S. percentage of industrialized nations' total heat-trapping emissions would give American policy makers the most flexibility.

*All heat-trapping emissions, including those from land use and land cover changes. The budget assumes industrialized nations' emissions peak in 2010 and developing nations' emissions peak in 2020.

FIGURE 2. Spending the U.S. Cumulative Emissions Budget



Under a "business as usual" scenario projected by the Energy Information Administration, the United States would use nearly all of its emissions budget by 2030, requiring unrealistically drastic cuts thereafter to achieve the 450 ppm CO_2eq stabilization target by 2050. In contrast, the emissions cuts required by S. 309 (the Global Warming Pollution Reduction Act) would allow reductions to proceed in a more gradual fashion, providing greater flexibility in the method and timing of reductions.

indicate that, to have a reasonable chance of preventing temperatures from rising above this level, we must stabilize the concentration of heat-trapping gases in the atmosphere at or below 450 parts per million CO_2-equivalent (450 ppm CO_2eq—a measurement that expresses the concentration of all heat-trapping gases in terms of CO_2). This "stabilization target" would provide a roughly 50 percent chance of keeping the global average temperature from rising more than 2°C, or 3.6 degrees Fahrenheit, above pre-industrial levels, and a 67 percent chance of rising less than 3°C. Therefore, **any policy that seeks to avoid dangerous climate change should set a maximum stabilization target of 450 ppm CO_2eq.**

To meet this target, worldwide cumulative emissions of heat-trapping gases must be limited to approximately 1,700 gigatons (Gt) CO_2eq for the period 2000–2050—of which approximately 330 GtCO_2eq has already been emitted. Staying within this 1,700 GtCO_2eq "global cumulative emissions budget" will require aggressive reductions in worldwide emissions (i.e., those of industrialized and developing nations combined).

Dividing Up the Work

If we assume the world's developing nations pursue the most aggressive reductions that can reasonably be expected of them, the world's industrialized nations will have to reduce their emissions an average of 70 to 80 percent below 2000 levels by 2050. In addition, industrialized nations' cumulative emissions over this period must be no more than 700 GtCO_2eq (approximately 40 percent of the global budget).

This 70 to 80 percent range for reductions by 2050 assumes that industrialized nations' emissions will peak in 2010 before starting to decline, and that those from developing nations will peak between 2020 and 2025. A delay in the peak of either group would require increasingly steep and unrealistic global reduction rates in order to stay within the cumulative emissions budget for 2000–2050.

Defining the U.S. Share of Global Emissions Reductions

There are several ways to determine the United States' share of the industrialized nations' emissions budget, including allocations based on the current U.S. share (among industrialized countries) of population, gross domestic product (GDP), and heat-trapping emissions. Using these criteria, **the U.S. cumulative emissions budget ranges from 160 to 265 GtCO_2eq for the period 2000–2050, of which approximately 45 GtCO_2eq has already been emitted** (Figure 1).

Given our aggressive assumptions about reductions by other nations and the fact that 450 ppm CO_2eq represents the upper limit needed to avoid a potentially dangerous temperature increase, **the United States should reduce its emissions *at least* 80 percent below 2000 levels by 2050.**

The costs of delay are high. To meet this minimum target, the United States must reduce its emissions an average of 4 percent per year starting in 2010.† If, however, U.S. emissions continue to increase until 2020—even on a "low-growth" path projected by the Energy Information Administration (EIA)—the United States would have to make much sharper cuts later: approximately 8 percent per year on average from 2020 to 2050, or about double the annual reductions that would be required if we started promptly. The earlier we start, the more flexibility we will have later (Figure 2).

FIGURE 3a. U.S. Emissions Reductions under Federal Proposals

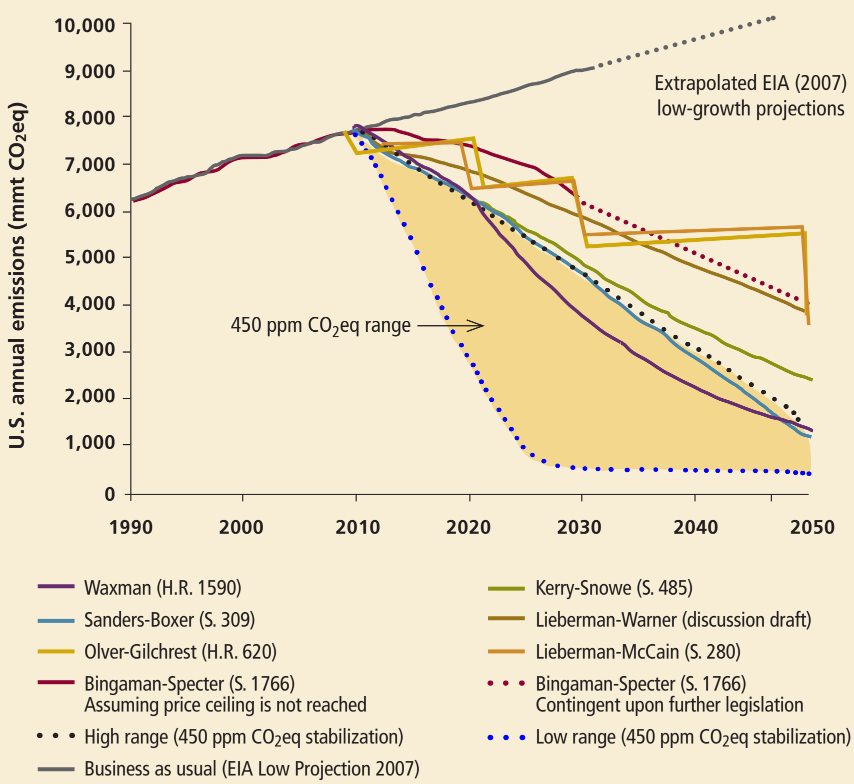
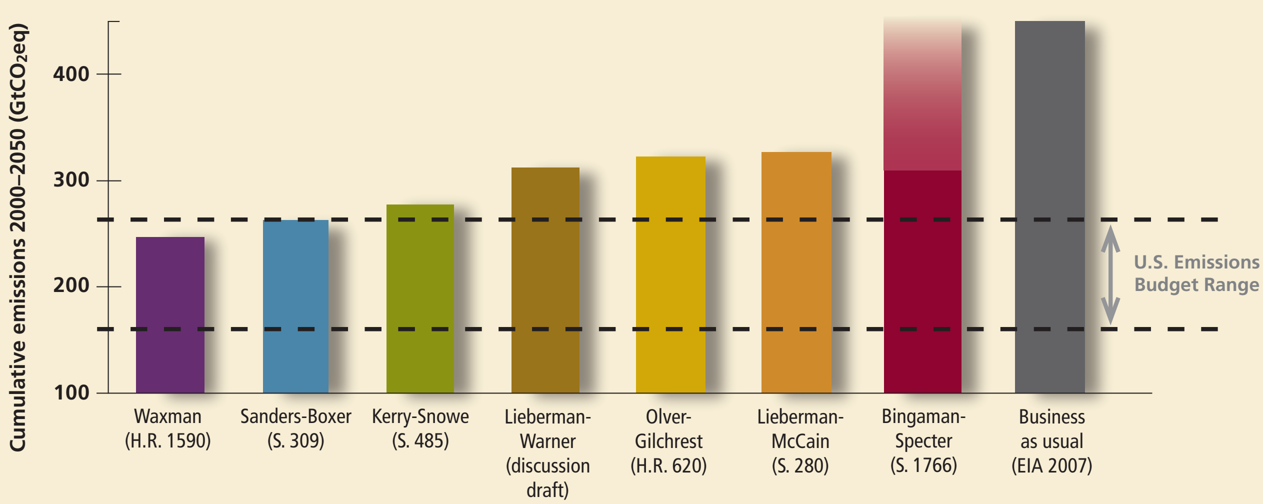


FIGURE 3b. Cumulative U.S. Emissions in 2050 under Federal Proposals



Only two current climate policy proposals (H.R. 1590 and S. 309) would stay within the emissions budget of 160 to 265 GtCO_2eq defined in this analysis, and even these proposals would result in emissions well above the low end of the range. For S. 1766, the potential range of cumulative emissions for 2000–2050 is provided.*

*The lower portion of the bar indicates cumulative emissions for S. 1766 under the best-case scenario, in which the bill's price ceiling is never triggered, all emissions reduction targets out to 2030 are met, and all of the conditions needed to achieve the 2050 target are met, including international action, a recommendation by the president to Congress, and additional congressional legislation. This scenario also assumes that the 2050 target reduces total (economy-wide) U.S. emissions 60 percent below 2006 levels, even though earlier targets reduce emissions for only 85 percent of the economy. The color gradient in the upper portion of the bar represents the uncertainty in the additional cumulative emissions that would occur if the bill's price ceiling were triggered. (The darker the color, the more likely it is that total cumulative emissions would reach that level.) The gradient is for illustrative purposes only and does not represent explicit modeling of the price ceiling's effect on emissions decisions. The range depicted here assumes that if the price cap is triggered, the total cumulative emissions could approach those projected by the EIA under a low-growth "business as usual" scenario.

†Equivalent to an average absolute reduction of 0.16 GtCO_2eq per year (or about 2 percent of current levels).

Evaluating Existing Proposals

Of the current climate policy proposals before the U.S. Congress, only the Global Warming Pollution Reduction Act (S. 309) and the Safe Climate Act (H.R. 1590) would require reductions consistent with staying below *the upper limit* of the U.S. cumulative emissions budget (265 $GtCO_2eq$) (Figure 3). All of the other bills under consideration—the Lieberman-Warner proposal, the Global Warming Reduction Act (S. 485), the Climate Stewardship Act (H.R. 620), and the Low Carbon Economy Act (S. 1766)—would exceed that limit. The amounts by which these bills would go over the budget may not appear to be great, but if every nation went over its budget by a similar amount, the result would be a greatly increased risk of dangerous climate change.

Furthermore, no proposal currently before Congress would come close to the proposed lower end of the U.S. emissions budget (160 $GtCO_2eq$). Several of the proposals do provide for congressional review and periodic reports by the National Academy of Sciences to ensure U.S. targets remain consistent with the goal of preventing the global average temperature from rising 2°C above pre-industrial levels. These periodic reviews are an essential element of any robust federal climate policy.

Increased use of renewable energy is one of many existing solutions that can help achieve the proposed emissions reduction target.

CIELO WIND POWER, NREL

The Way Forward

It is clear that the United States must quickly overcome its current impasse on climate policy if we are to avoid the risks of dangerous climate change. Many solutions are already available, including greater energy efficiency, increased use of renewable energy, and reductions in deforestation. These changes can be encouraged by a wide range of market-based and complementary policies including cap-and-trade programs, renewable electricity standards, efficiency standards for electricity and vehicles, and incentives for cleaner technologies and international cooperation on emissions reductions.

For the United States to be fully engaged in the fight against global warming, however, Congress must support legislation that requires the deep reductions in heat-trapping emissions needed to stay within the emissions budget described here and preserve a climate safe for future generations.

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This summary was prepared by the Union of Concerned Scientists (UCS) based on the report *How to Avoid Dangerous Climate Change: A Target for U.S. Emissions Reductions* by Amy L. Luers (UCS), Michael D. Mastrandrea (Stanford University), Katharine Hayhoe (Texas Tech University), and Peter C. Frumhoff (UCS).

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

To read the fully referenced report, including an appendix comparing details of the climate-related bills and proposals currently before Congress, visit:

www.ucsusa.org/emissionstarget.html