The American Clean Energy & Security Act (H.R. 2454)

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EXECUTIVE SUMMARY

The American Clean Energy and Security Act of 2009 (the Bill) addresses the problem of global warming, or, more specifically, the problem of increased anthropogenic greenhouse gas emissions into the atmosphere, which are the cause of global warming. If the Bill is passed, it will direct the United States Environmental Protection Agency to administrate a cap-and-trade system intended to reduce carbon dioxide levels progressively relative to a 2005 benchmark. In its current form, the Bill also modernizes the nation's electric grid, mandates new energy efficiency standards, and initiates a green jobs program. Because of its sweeping mandates, the Bill is the critical piece of environmental legislation being debated in Congress today.

This report will examine the importance of the Bill in both mitigating and confronting the effects of climate change anticipated both nationally and globally. Currently the United States' greenhouse gas emissions are among the highest per capita in the world. The problem of reducing anthropogenic emissions is complex and therefore requires the amalgamation of various technologies and policy strategies. With its mandates for a cap-and-trade program, offsets and other economic and technological methods, the Bill unites greenhouse gas reduction and adaptation strategies, and represents an interconnected approach to reducing the United States' emissions.

Though the Bill is environmentally and politically significant, it does not represent the only attempt in Congress to transition the nation to renewable energy. For this reason, the report focuses on the latter two sections, or titles, of the Bill: these are unique proposals that detail the cap-and-trade emissions allowance programs, as well as federal and state-level adaptation strategies, for reducing greenhouse gas emissions.

As the most recent Intergovernmental Panel on Climate Change reports have shown, the range of likely temperature increases for the twenty-first century is between 1.1 to 6.4 degrees Celsius (Trenberth et al., 2007). Scientific consensus holds that due to the slow response of biological, geological and ecological systems a reduction of greenhouse gas emissions will not have an immediate effect on slowing the Earth's warming temperatures and rising sea levels. Emissions reductions will, however, have critical long-term effects. Thus, the restriction of emissions and the advancement of the renewable energy sector all have significant long-term potential to impact the future global climate trajectory.

INTRODUCTION

While the Bill is extensive (in its current form in Senate committees, it exceeds 1,400 pages), the four titles can be condensed as follows:

TITLE I: Increases future efficiency and addresses current energy production by promoting the future use of electric vehicles; develops Smart Grid electric utility technology; launches eight regional Clean Energy Innovation Centers to further research and collaboration between academia, industry, and state and federal agencies.

TITLE II: Increases the efficiency of buildings, appliances, vehicles and industrial installations by updating building codes to achieve a fifty percent increase in efficiency by 2016; mandates cooperation between states and federal agencies to maximize federal fuel-efficiency standards for light-duty vehicles; sets deadlines to implement stricter emissions standards for heavy-duty vehicles.

TITLE III: Establishes a cap-and-trade program to reduce the emission of greenhouse gases to ninety-seven percent of 2005 levels by 2012, eighty percent by 2020, fifty-eight by 2030 and seventeen percent by 2050; limits industries' greenhouse gas emissions to the level provided by allowances under the cap; establishes banking, borrowing and trading allowances under the cap.

TITLE IV: Mitigates any potential economic damage that may be associated with the mandatory cap-and-trade system; establishes a research program titled the National Climate Change Adaptation Program to develop adaptation strategies.

Because titles I and II of the Bill do not represent the only attempt in the U.S. Congress to transition the economy to renewable energy, this report focuses on titles III and IV, which present the unique cap-and-trade emissions allowance program: market-based mechanisms that have not yet been attempted in the United States as a nationwide comprehensive greenhouse gas reduction strategy.

H.R. 2454 sets renewable energy targets for U.S. power generation, modernizes the nation's electric grid, mandates new energy efficiency standards across sectors, establishes a national cap and trade program to reduce greenhouse gas emissions, initiates a green jobs program, and requires U.S. agencies to begin planning domestic and international adaptation strategies to mitigate the effects of climate change.

H.R. 2454 takes a multisectoral approach of employing a suite of mandates, regulations, market-based strategies, and financial incentives, attempting to set the U.S. on a long-term path towards environmental sustainability and energy security.

Introduction to Global Warming

Global warming is the increase in average global surface

temperature due to a buildup of greenhouse gases in the layer of the atmosphere that lies closest to Earth. The main source of these gases is the combustion of fossil fuels and deforestation. Although the gases occur naturally in the atmosphere and result in the natural greenhouse effect, which allows Earth's temperatures to be habitable, anthropogenic emissions of carbon dioxide and other gases has led to an increase in trapped radiation. The increased concentration of greenhouse gases in the atmosphere results in a partial closure of an atmospheric "window" in the total spectrum of absorbed radiation that otherwise allows radiation to escape. The closed window effectively reduces the amount of heat from escaping through the atmosphere and thus warms Earth's surface.

Global warming can greatly disrupt environmental, social, and economic dynamics. The environmental effects of global warming include melting of Arctic and alpine glaciers and reduced sea ice, acidification of the oceans, changing ranges of both plants and animals, loss of biodiversity, and weather changes such as increased drought, heat waves, and hurricanes (e.g. ACIA, 2005; Trenberth et al., 2007; Houghton, 2009). In addition, global warming will displace communities and increase public health problems, the spread of disease, energy consumption, and property damage. Resulting decreased agricultural output, trade and employment, and tourism will likely also affect the world economy.

The Intergovernmental Panel on Climate Change predicts the warming atmosphere and oceans will cause more extreme events, like wildfires. In this photo a plane is reseeding a burnt New Mexico mountainside to mitigate flooding and erosion. Photo source: K. Wurden.

Why Is Government Action Needed?

Government intervention is required to mitigate detrimental effects of global warming, one of the first truly global environmental problems (e.g. Cohen, 2006). Government regulation has effectively worked in the past to ameliorate large-scale environmental problems, such as water pollution (Clean Water Act) and air pollution (Clean Air Act). The United States Environmental Protection Agency has also administered two other cap-and-trade programs, the NO_x (Nitrous Oxide) Budget Trading Program and the Acid Rain Program. The programs are relatively successful: in 2003, the United States Office of Management and Budget found that the Acid

Rain Program accounted for the largest quantified human health benefits of any federal regulation implemented over the previous decade (Schakenbach et al., 2003). Relying on industry and communities to reduce greenhouse gas emissions voluntarily is not effective because immediate individual economic costs of making changes will outweigh the current benefits of reducing greenhouse gases (Ernst, 2003); the long-term nature of the problem and its observed effects has resulted in delayed concern and response (Cohen, 2006). Policy is needed to overcome this short-term, economic benefit individuals derive from emitting greenhouse gases.

Interconnectedness of the Solution

The global warming problem that the United States faces is a dynamic, intricate, large-scale problem compounded by the economic interests of individuals and businesses. The Tragedy of the Commons, a key environmental studies concept, can be used to describe the global warming dilemma today: industries and individuals acting in their own self-interest are jointly destroying a shared resource needed by all (Hardin, 1968).

Though the problem is intricate, the Bill presents a simplifying solution. By uniting climate change mitigation strategies like carbon capture and sequestration and cap and trade of greenhouse gas emissions, the Bill may mobilize the nation to address global warming problems.

"The Waxman-Markey bill [H.R. 2454] is of extreme importance. The debate over it is, by a wide margin, the most important thing happening in environmental law and policy in the United States today."

- Michael Gerrard, Director, Columbia University Center for Climate Change Law

THE ENVIRONMENTAL DILEMMA: GLOBAL WARMING

Widespread awareness of global warming dates to the mid twentieth century, when first measurements of atmospheric measurements of carbon dioxide concentrations showed an upward trend. Concurrently, paleoclimate work began to suggest that climate has the capacity to fluctuate relatively rapidly, as had occurred many times in the Earth's past (e.g. Emiliani, 1955; Broecker, 1988). The 1988 creation of the Intergovernmental Panel on Climate Change, a scientific body that reviews climate change literature and publishes reports relevant for policy-makers discussing climate-change implications, has greatly furthered the understanding of modern climate changes in the past two decades (Sommerville et al., 2007). Consequently, Intergovernmental Panel on Climate Change reports have become increasingly decisive in describing the impacts of human activities on climate (Hegerl et al., 2007).

At present, there is consensus in the scientific community that Earth's temperatures are increasing, and that the energy-intensive lifestyle valued by the developed world is the primary driver. Furthermore, the science of the mechanisms of warming is undisputable, and the rate of average temperature increases is unprecedented in at least the last 10,000 years (e.g. Houghton, 2009). Uncertainties, however, lie in the projected rates and magnitude of warming and in the future anthropogenic emissions scenarios used to predict future warming.

Natural v. Anthropogenic Greenhouse Effect

Earth's climate can be altered by changes in incoming solar radiation, the reflectivity of the Earth's surface, or the amount of outgoing radiation (which is affected by the concentration of certain gases in the atmosphere) (Sommerville et al., 2007). The last 150 years has defined a new geological time period, called the "Anthropocene," driven by two of those factors: increased atmospheric composition of greenhouse gases (notably carbon dioxide) and changes in global albedo, or surface reflectivity (Houghton, 2009).

Incoming radiation entering the Earth's atmosphere is either scattered before reaching the Earth or reflected back out to space; the planet absorbs the remainder, producing warming. A natural greenhouse effect occurs as the Earth emits radiation and the layer of greenhouse gases, mostly composed of water vapor, traps some of this outgoing heat, producing surface warming without which life could not be sustained (Houghton, 2009).

Climate change is happening more rapidly at the poles than any other place in the world. The higher warming rate is primarily due to rapidly declining polar albedo and the natural Earth processes that redistribute radiation energy from the tropics to the poles. Photo source: C. Wilson

Anthropogenic Sources of Greenhouse Gases

At present mankind is causing an enhanced greenhouse effect by increasing the atmospheric concentration of greenhouse gases. Sources of these greenhouse gases include the burning of fossil fuels, cement production and refrigerant use, as well as agricultural practices such as fertilizer use, biomass burning and land use change (Forster et al., 2007). Another significant source is deforestation, which releases carbon naturally stored in forests and soils, and reduces plants' potential to take up carbon dioxide (Houghton 2009; BASC, 2003).

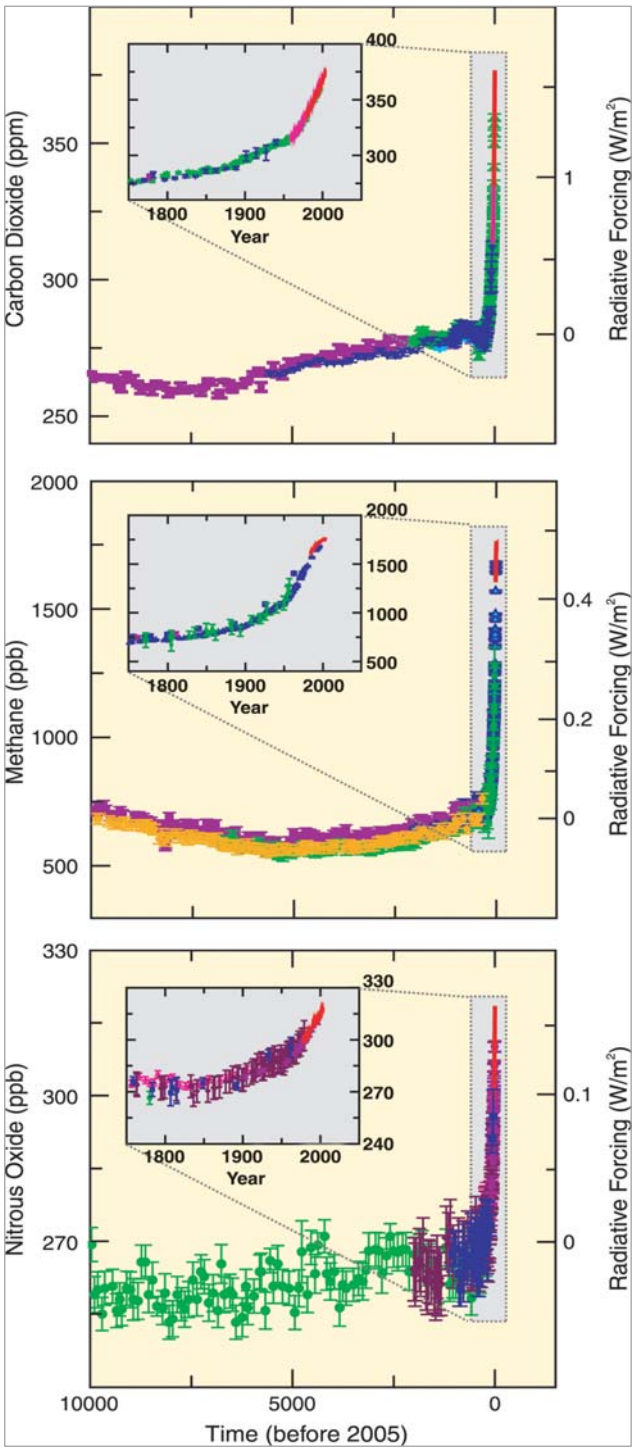
Feedback Cycles: Driver of Climate Change

An important local and global driver of change is feedback cycles, or factors that tend to increase or decrease the rate of a process and are in turn affected by that process. The complexity of feedback cycles and the interaction between the components of the Earth system means that greenhouse gas removal occurs over differing time scales. The speed at which the gases are removed from the atmosphere is also affected by the physical characteristics of each gas (Archer, 2005; Denman et al., 2007; Meehl et al., 2007). Of the projected increase in atmospheric carbon dioxide, fifty percent will be removed within thirty years, a further thirty percent will be removed within a few centuries, and the remaining twenty percent may remain in the atmosphere for many thousands of years (Archer, 2005; Denman et al., 2007).

Even if emissions reductions from implementation of the Bill are effective, temperatures and attendant effects will continue to increase for some time (Meehl et al., 2007). Thus, a one hundred percent reduction of emissions will slow greenhouse gas concentration buildup, but not quickly eliminate them. Meehl et al. (2007) projects that the temperature of the planet is expected to warm approximately 0.2°C per decade for the next two decades regardless of anthropogenic emissions trends.

Why Is Action Needed Now?

If one hundred percent emissions reduction does not immediately eliminate gas concentration buildup, why is action needed? Though Intergovernmental Panel on Climate Change data show immediate action cannot entirely prevent the effects of global warming, some of the most deleterious long-term effects can be prevented by acting quickly. Passage of the Bill may provide the immediate solutions needed.



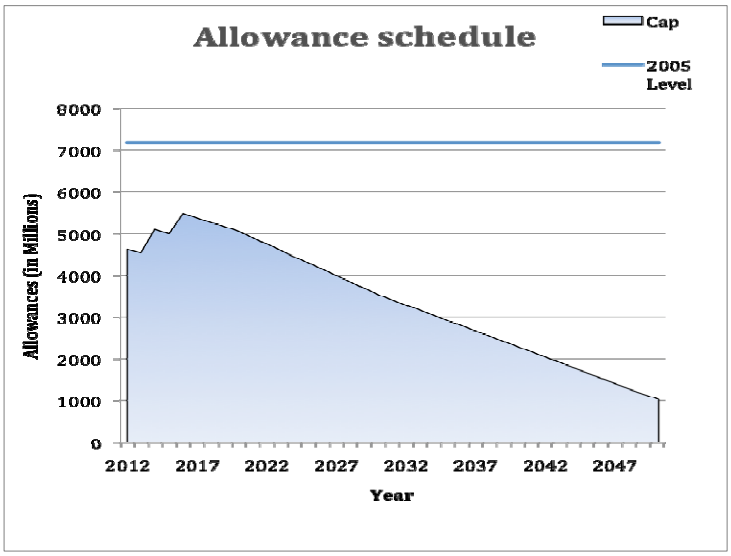
Atmospheric concentrations of carbon dioxide, methane and nitrous oxide are shown over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colors for different studies) and atmospheric samples (red lines). Data and Graphic Source: Intergovernmental Panel on Climate Change.

CAP AND TRADE AS A GLOBAL WARMING STRATEGY

A complex, long-term issue like climate change requires a dynamic program that is capable of adjusting to changing factors over time. Title III of the Bill mandates a cap-and-trade system through several key provisions, including the ability for regulated businesses to choose whether to emit or abate greenhouse gases. Title III also includes a graduated allowance schedule: the Bill projects a seventeen percent reduction in greenhouse gas emissions by 2020 and eighty-three percent by 2050, relative to 2005 levels.

Allowance Schedule

Under the cap-and-trade system, regulated entities (electric utilities, oil refiners, natural gas producers, and other manufacturers that produce energy onsite) can either reduce their emissions or emit above the designated cap by purchasing allowances to comply with the regulation. The cap is to be carried out through the annual issuance of tradable allowances. Each allowance represents the right to emit one ton of carbon dioxide, or an equivalent amount of regulated greenhouse gases (equivalents are based on each gas's global warming potential, or the additional energy retained on Earth through the presence of this gas). At the end of each year, all entities regulated by the cap must deliver a sufficient number of allowances to cover their carbon dioxide emissions that year. The entities can also save their allowances to use in another year. The basis of the cap-and-trade system requires an annual distribution of allowances freely allocated to industries based on historical energy intensity. Additionally, fifteen percent of the allowances will be auctioned initially; the money garnered from the auctions will partially fund the buyback of deforestation offsets.



Title III of the Bill includes a graduated allowance schedule with a projected seventeen percent reduction in greenhouse gas emissions by 2020 and eighty-three percent by 2050, relative to 2005 levels. Data source: HR 2454.

Offset Credits

A provision under the Bill allows regulated industries and utilities to generate offset credits by engaging in projects that reduce emissions elsewhere without actually reducing their own emissions. Projects can be located domestically and internationally, but no more than fifty percent of the total offset allowances may be located internationally. These projects include renewable, energy efficiency, carbon capture and sequestration, and afforestation, reforestation, and deforestation prevention.

Command and Control v. Market Mechanisms

The cap-and-trade program is a market-based solution that has been successfully implemented in the United States for acid rain pollutants since 1995, and by the European Union for greenhouse gases since 2005. Historically, environmental policies have almost exclusively been employed through top-down, command-and-control regulations. Command-and-control methods require polluters to comply with specific performance and technology standards. In the context of climate change, however, command and control may be overly costly (Freeman, 2003).

Due to complexity of the environmental problem as well as the many stakeholders involved, climate change falls under a new generation of environmental concerns, one that requires a more flexible form of policy design and implementation (Hempel, 2003). When compared to traditional regulatory efforts, emissions trading programs are found to be fairly effective and efficient at meeting their goal of improved air quality (Kamieniecki, 1999). Therefore the market-based cap-and-trade system presented in the Bill may provide the flexibility needed to address the problem, as well as provide incentives for technological advancement to reduce emissions further and ultimately lower the cost of compliance.

Drawbacks of Cap and Trade

Although the cap-and-trade system is an efficient method to reduce emissions, industries incur significant costs that may in turn affect the U.S. economy. The Congressional Budget Office (2009) estimates that the cost of purchasing allowances and offset credits will amount to tens of billions of dollars annually, which could be difficult for firms to absorb. Another problem is carbon leakage, in which industries may decide that it is more cost-effective to relocate production facilities to areas where relaxed emission regulations exist or from increased production from industries already located in unregulated areas. For this reason, the Bill contains a provision that allows the Environmental Protection Agency to develop international reserve allowance regulations. If there is a significant amount of carbon leakage (seventy percent of global output) by the year 2020, the President has the option to implement the International Reserve Allowance Program, which would require foreign entities to pay for emission allowances based on goods exported to the U.S.

Industries that emit above the capped emissions level can invest in allowance projects that can be located both domestically and internationally. Photo source: K. Proctor

Science of Cap and Trade: Carbon Capture and Sequestration

The Bill acknowledges that it will be difficult to limit global temperature increases to less than 2°C above preindustrial levels without reducing emissions from deforestation.

Almost one-fifth of carbon dioxide emissions result from deforestation and the associated biomass decay (Houghton, 2009), and therefore avoidance of this type of land-use change has the potential to significantly impact global anthropogenic greenhouse gas emissions. Some land-use changes contribute more emissions than others; for example, the conversion of forest to agricultural land releases more carbon dioxide than forest converted to grazing pastures (Houghton et al., 1983).

In addition to protecting forests from deforestation or replanting removed forests, the processes of carbon capture and sequestration can be used as offsets to reduce overall emissions. Carbon dioxide can be trapped from point-source industrial or energy-production activities at an efficiency of eighty-five to ninety-five percent and transported to a storage location, effectively preventing emission to the atmosphere (Metz et al., 2005). Methods for the storage of captured carbon include deep geological storage in emptied fossil fuel formation or in deep aquifers. The technology for these methods of storage is available and has been implemented on a small scale (Metz et al., 2005). Another proposed storage option is the use of the capacity of the ocean to absorb carbon dioxide; however, pumping carbon dioxide into the oceans will result in acidification, and thus this method remains controversial and is not currently used (Anderson and Newell, 2004).

Regardless of the effectiveness of the cap-and-trade system described in Title III in reducing future greenhouse gas emissions, some level of global warming is unavoidable. Title IV of the Bill outlines adaptation to these environmental consequences through the completion of a National Vulnerability Assessment by the National Climate Change Adaptation Council that will be updated every four years as necessary.

DEBATES OVER CAP AND TRADE & GLOBAL WARMING

The discussion associated with the Bill ranges from policy arguments to scientific discussions about climate change. Though science has reached consensus that climate change is occurring, scientists differ on the magnitude of change and methods of mitigation. Some proponents of the Bill disagree over necessary stringency of the solution. A summary of policy and scientific debates is presented below.

Carbon Dioxide Concentation

Some climate experts debate the level of atmospheric greenhouse gas concentrations that should be considered safe. James Hansen, head of National Aeronautics and Space Administration's Goddard Institute for Space Studies, and Joseph Romm, a Senior Fellow at the Center for American Progress, have debated the acceptable concentration of carbon dioxide in the atmosphere. Whereas Hansen believes that the concentration of carbon dioxide, measured in parts per million, should be lower than the present concentration of approximately 389 parts per million (and therefore more conservative), Romm believes that a concentration of 450 parts per million is acceptable (Hansen et al., 2008; Romm, 2008).

"This first step is critically important to long-term national and international progress on the climate change challenge… It's entirely defensible to both deplore this bill's shortcomings and to hope…it becomes law."

- Bud Ward, Editor, The Yale Forum on Climate Change & The Media

Global Climate Models

"(H.R. 2454) is far weaker and full of loopholes and special breaks than the ideal piece of legislation should have. However, those loopholes and breaks were the cost of getting the narrow majority that passed it in the House."

- Michael Gerrard, Director, Columbia University Center for Climate Change Law

Some argue that the predominant method of predicting the magnitude of future climate change, using global climate models, is fundamentally flawed. Global climate models are based on known physical principles, such as the enhanced greenhouse effect, though most incorporate vast and often incomplete data sets that describe the interacting atmosphere, biosphere, lithosphere and hydrosphere. Furthermore, the data on which the global climate models are based cannot include unforeseen events such as solar activity or volcanic eruptions, and feedback cycles are challenging to incorporate into models (e.g. Houghton, 2009). In addition, cloud albedo creates uncertainty in climate models. However, the most important unknown factor when modeling future climate changes is the trajectory of anthropogenic greenhouse gas emissions; the Intergovernmental Panel on Climate Change therefore

models climate based on multiple future development scenarios (Randall et al., 2007).

Despite uncertainties, global climate models provide useful climate projections (Randall et al., 2007). After the 2001 Third Assessment Report of the Intergovernmental Panel on Climate Change, the mathematical geophysics community has made significant progress in accounting for dynamic geophysical data to predict future climate shifts (Jackson et al., 2003; Randall et al., 2007). Over 20 climate centers in 10 countries are actively developing and using climate models to predict the future climate trajectory (Houghton, 2009). Models presently in use have been shown to robustly reconstruct known past climates as well as correspond to present measured observations (Randall et al., 2007).

Price of Offsetting Emissions Too Cheap?

Some environmental organizations fear the ability to purchase domestic and international offsets under the Bill will delay emissions reductions in the U.S., allowing emissions to continue to rise through to 2030. The organizations argue that the price of offsetting emissions elsewhere remains relatively cheap and easy, and therefore there is little to no incentive for direct abatement from the highest emitting industries (Jenkins, 2009).

The United States Environmental Protection Agency, along with experts like Clinton Administration environmental advisor Joseph Romm, disagree with this analysis and believe the competition for offsets credits in the international market is strong enough to prevent carbon allowance prices from falling too low (EPA, 2009a; Romm, 2007). While passage of the Bill would substantially increase the supply of offset credits, it would also dramatically increase demand, stabilizing prices or even driving them up. Additionally, many of the projects will be domestic emissions reductions; therefore, the use of these offsets would not interfere with the goal of meeting the overall cap (EPA, 2009a).

DETERMINING THE EFFECTIVESS OF CAP AND TRADE

Monitoring emissions across industries and ensuring that these emissions are within the allowance limits will be crucial to determining the overall success of the cap-and-trade program.

Such monitoring can be accomplished using continuous emissions monitoring systems, instruments that constantly measure pollutant emissions levels at stationary sources, such as smoke stacks of power plants. These systems use pollutant gas analyzers to take direct measurements of emissions and which are then transmitted to computer programs that convert emissions to standard units (such as the carbon dioxide equivalents used in the Bill) in order to ensure that emissions are below allowance limits (Jahnke, 2000).

Measuring the Effectiveness of Offsets

Measuring the effectiveness of offsets will provide an indicator of success; however, measuring carbon dioxide removed from the atmosphere through these processes is not a simple or uniform task (Gibbs et al., 2007).

To measure the carbon dioxide removed from the atmosphere by reforestation, estimations would have to be made about how much carbon is captured in a reforested area. Thus far, there is no set method for measuring forest carbon stocks but estimates can be made based on the amount of living biomass of trees and vegetation and dead organic matter (Gibbs et. al., 2007). Different methods can be used to make these estimates, such as biome averages, forest inventory, and optical remote sensing, each of which has benefits and drawbacks.

Carbon dioxide can also be removed from the atmosphere through capture and sequestration. This process captures carbon dioxide at a combustion source (such as a power plant) and injects it either deep underground or into the deep ocean, as previously described. Measuring the amount of carbon dioxide that is prevented from entering the atmosphere is straightforward in this case because the amount can be measured as it is being injected underground or into the ocean (Metz et al., 2005). However, leakage during the injection process is possible, and ocean acidification from leakage of deep aquifer storage is under scientific review.

Once the injection process is complete, the Intergovernmental Panel on Climate Change estimates that over ninety-nine percent of the carbon stored in geological sites will remain sequestered for at least one thousand years (Metz et al., 2005). Monitoring these environmental impacts will be an essential component to determining the benefits of this type of atmospheric carbon dioxide reduction mechanism.

Measuring Performance of Cap-and-trade Programs

As previously mentioned, the United States Environmental Protection Agency has administered two other successful cap-and-trade programs, the Acid Rain and the NO_x (Nitrous Oxide) Budget Trading Programs, which can be used as models for the Bill's cap-and-trade program.

Under these existing programs, the United States Environmental Protection Agency tracks and reports on emissions data and environmental conditions using a variety of monitoring techniques to appraise performance of the programs (Schakenbach et al., 2006). A crucial element of a successful cap-and-trade program is to establish reporting requirements for accurate emissions data through constant monitoring of parameters such as emissions concentrations (Schakenbach et al., 2006). This requires the use of continuous emissions monitoring systems for all regulated emissions; a high compliance rate like that achieved under the existing Acid Rain and NO_x programs (Schakenbach et al., 2006) is crucial to the success of any cap-and-trade program.

Monitoring Agencies Established Under the Bill

The Bill establishes various methodologies and agencies for measuring the cap-and-trade program's effectiveness. For instance, the Bill requires the United States Environmental Protection Agency to establish a greenhouse gas registry at the federal level and to create an emissions reporting system for covered industries. The Administrator of the cap-and-trade program (the United States Environmental Protection Agency) is also required to submit a report to Congress every four years that includes an update of the latest climate change science, an analysis of the Administrator's capacity to monitor emissions, a breakdown of global greenhouse gas inventories, and a progress report of reductions in greenhouse gas emissions. In order to monitor the effectiveness of offsets, an independent Offsets Integrity Advisory Board will be established to determine eligibility of projects, methodologies for measuring the carbon sequestration capacity, uncertainties associated with projects, and finally determining the actual performance of offsets.

Measuring Impacts of Global Warming

Another method of measuring the success of the Bill's emissions reductions program is measuring changes in the environment that result from climate change. By taking baseline measurements of environmental indicators, such as global average sea level, at the start of the program, data collected in the future can be compared to gauge improvement. Furthermore, the Intergovernmental Panel on Climate Change predicts that global warming could lead to a greater number of extreme weather events such as hurricanes, droughts, and tornadoes (Trenberth et al., 2007). Therefore, another possible indicator for measuring success would be changes in the occurrence or degree of severity of these events.

A drawback is that data of this type potentially reveals little concrete information about the success of the program, because changes in sea level and extreme weather events could potentially be attributed to other factors and the continued emissions from other countries. Thus, this type of measurement should not be the sole indicator for the success of the Bill; it should rather be a supplement to more direct indicators such as concentration of greenhouse gases in the atmosphere and global average temperatures.

CONCLUSIONS

Reacting to the Earth's dynamic climate system calls for a flexible political strategy and the use of abatement tools that can be rapidly adjusted with scientific breakthroughs and economic opportunities (Hempel, 2003). The adaptive management strategies in the Bill not only unite the wide range of evolving technologies and strategies for adapting to and mitigating climate change, they may provide the flexibility required to address the problem.

While a world leader in some aspects of environmental protection, the United States has often been viewed as a laggard when it comes to climate issues (Hempel, 2003). The Bill, which represents the first time the federal government has attempted to address climate change, conveys progressive environmental policy to the international community. Moreover, passage would represent a rare application in United States politics of the precautionary principle, an environmental, political and scientific concept advocating the responsibility to intervene and protect the public from harm even when science or evidence is not certain.

Indeed, scientific certainty in climate change is a luxury mankind cannot afford in the short run and quite possibly an unattainable goal in the long run, due to the chaotic properties of climate systems (Hempel, 2003). Through melting ice caps and increased weather anomalies, climate change has already begun to demonstrate to mankind that change must occur, and soon. While action may be costly economically and politically, inaction is costliest of all.

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