

Greenhouse Gas Emissions Mitigation in the United States of America



MAJOR ECONOMIES AND CLIMATE CHANGE RESEARCH GROUP

Carson Stones
Stephanie Redfern
Edited by: Sarang Shidore

Supervised by Dr. Joshua Busby
busbyj@utexas.edu
<http://blogs.utexas.edu/mecc>

TABLE OF CONTENTS

Table of Contents	1
Executive Summary	2
<i>BARRIERS</i>	2
<i>RECOMMENDATIONS</i>	3
Introduction to Greenhouse Gas Emissions in the United States	4
Current U.S. Climate Policies & the History of Legislation	8
State & Regional Level Climate Policies	8
Federal Climate Policies	11
U.S. Participation in International Climate Action	17
Current Policy Issues.....	20
Federal Regulation of Power Plant Emissions with the Clean Air Act	20
Reducing Methane and VOC Emissions in the Oil and Gas Sector.....	22
<i>Federal Air Standards for Oil and Gas</i>	23
<i>Reduced Emission Completions</i>	23
<i>Measurements of Methane Emissions at Natural Gas Production Sites in the US</i>	24
The Keystone XL Pipeline	24
The Energy Savings and Industrial Competitiveness Act	26
Barriers to Effective Climate Change Action	26
Informational and Cultural Barriers	26
Political Barriers.....	28
Recommendations for the United States	30
<i>Energy Production</i>	30
<i>Transportation</i>	30
<i>Short-Lived Gases</i>	30
<i>General Recommendations</i>	30
Conclusions	32
References.....	33
Appendix A: US GHG Mitigation Policies	39
Appendix B: New Power Plant Regulations Timeline	40

EXECUTIVE SUMMARY

This report examines the United States of America's greenhouse gas emissions profile and climate policies, identifies the barriers currently preventing effective action, and proposes recommendations to overcome these barriers.

The United States is one the world's primary greenhouse gas emitters, having produced over 6.5 gigatonnes of CO₂e in 2012. Cumulatively, the U.S. has released the largest amount of greenhouse gases of any country into the atmosphere; the nation is responsible for nearly 30% of the world's present carbon dioxide levels. While the nation's emissions are declining, there is still much that can be done to cut them more quickly.

The nation's transport and energy production sectors are the key sources of emissions. Together they produce well over one half of the nation's greenhouse gases. As a result, the main focus of this paper is on these two sectors.

BARRIERS

The report found that the United States' barriers can be divided into three categories - informational, cultural, and political as follows:

- **Informational Barriers:** The scientific community has found it extremely difficult to successfully communicate to the general public the risks and uncertainties associated with findings produced from climate models.
- **Cultural Barriers:** A widespread climate change countermovement has gained major momentum and funding through support from organizations and individuals who deny human-induced climate change. This has sparked a false debate over the validity of climate change as a real phenomenon, massively distracting the public from debating the optimum mitigation actions that are urgently needed.
- **Political Barriers:** A divided Congress makes it extremely difficult to pass any type of climate legislation, making the nation reliant upon much less powerful executive actions.

RECOMMENDATIONS

Based on an analysis of current policy issues and barriers in the United States, the paper lays out the following recommendations for successfully moving forward with climate mitigation action in the United States:

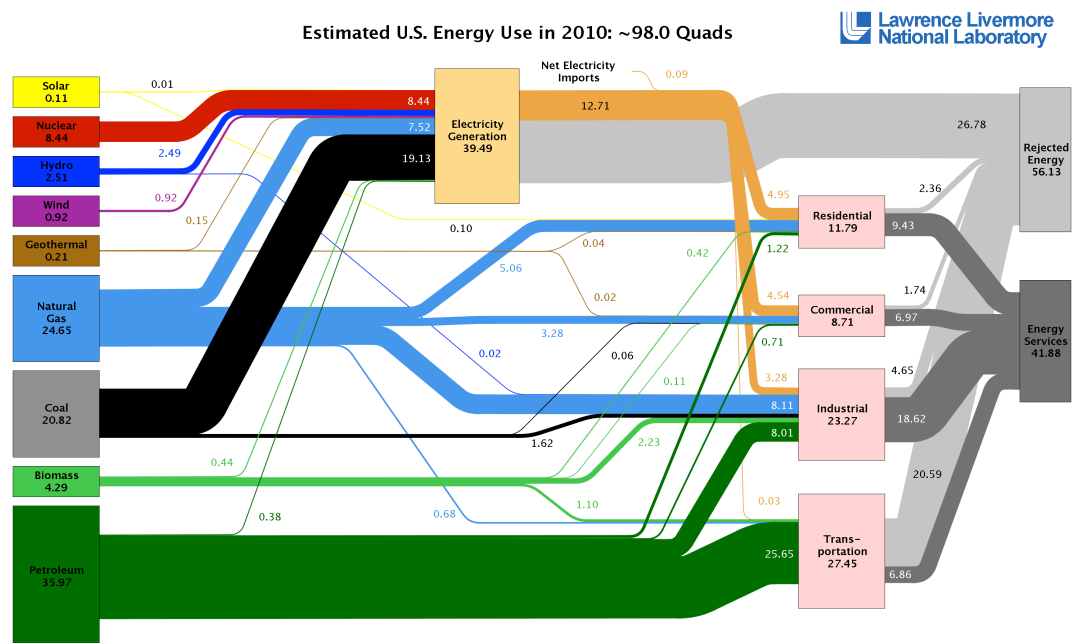
1. **Federal Carbon Legislation:** While President Obama has used executive authority available to him to advance a climate mitigation agenda, more robust action will inevitably be required. While building a domestic working majority may be problematic with the composition of the U.S. Congress circa 2014-2015, within a reasonable timeframe, the U.S. needs to move away from the Clean Air Act as a CO₂ emissions regulation vehicle and write legislation specifically targeting greenhouse gas production in the electricity sector. It must be flexible, attentive to states' specific needs, and the cap must be easily moved to stricter allowances.
2. **Packaged Keystone Deal:** The President should couple a Keystone XL approval with trade-offs that work in favor of environmental action. While a number of environmental groups opposing the pipeline will never accept such a trade, the president could drive a hard bargain and extract significant climate-friendly concessions. The pipeline has sufficient votes in the new 2015 Congress (though not enough to override a presidential veto), but the president could lock-in more significant changes in heavy vehicles, methane leakage, renewables tax credits, or possibly something even more ambitious with such a deal.
3. **Regional Climate Change Communication Initiatives:** Communication of climate change must take place on a regional level. Funding of state-level research efforts and marketing campaigns could have a greater impact on public engagement on the issue than reliance on national media outlets for communication.
4. **Targeted Methane Legislation:** The EPA should limit methane emissions in the oil and gas sector by mandating Reduced Emissions Completions on new rigs where it is technologically feasible. Additionally, the EPA should work with state commissions on environmental quality to significantly restrict flaring within the borders of the United States.
5. **Continued Multilateral Climate Negotiations through the UNFCCC:** The bilateral agreement with China in late 2014 to restrain greenhouse gas emissions was a welcome development that put pressure on other states like India. However, while China and the US are the biggest emitters in the world today, bilateral agreements are no substitute for effective multilateral engagement through the UNFCCC for any significant long term global reductions. The Obama administration should strive to secure an agreement in Paris in 2015 that commits other countries with significant emissions like India to embrace a multilateral agreement based on national actions to reduce greenhouse gases.

INTRODUCTION TO GREENHOUSE GAS EMISSIONS IN THE UNITED STATES

In 2010, the United States was responsible for emitting over 5,429 million metric tons of CO₂e (carbon dioxide equivalent) into the earth's atmosphere.¹ That number comprised 17.8% of the world's total amount of greenhouse gas emissions, putting the U.S. as the second highest emitter—still trailing China by a sizeable amount. Of the OECD nations, the United States was the second highest emitter per capita, at 17.6 metric tons, following Luxemburg (21.5 metric tons).²

The U.S. consumed about 98 Quads of energy in 2010,³ with the majority of it going toward electricity generation and transportation (see Figure 1). With the addition of industry—a sector whose emissions primarily originate through the burning of fossil fuels⁴—these three areas account for 80% of the United States' emissions (figure 2).

Figure 1: U.S. Energy Use by Sector and Source, 2010



Source: Lawrence Livermore National Laboratory, 2010

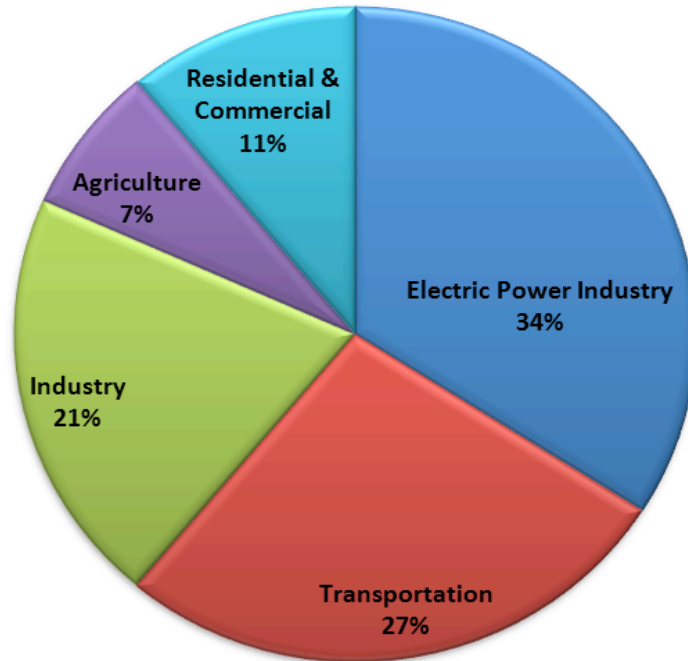
¹ World Bank, 2010a.

² World Bank, 2010b.

³ 1 Quad = 1.055 Exajoules.

⁴ U.S. EPA, 2014d.

Figure 2: U.S. GHG Emissions by Sector, 2010
U.S. Greenhouse Gas Emissions by Sector 2010



Source: Center for Climate and Energy Solutions, 2010

As has been laid out in previous sectoral reports, the United States is a significant world contributor to greenhouse gas emissions through energy production, transport, energy efficiency, LULUCF and short-lived gas production. The exact contribution of the country to these sectors is presented below, in Table I. In each area (except Land Use Change and Forestry), the US ranks very high in sector emissions when compared with other nations around the world.

Table 1: U.S. Greenhouse Gas Emissions, 2010

Sector	2010 US Emissions	2010 World Emissions	US as % of World Total by Sector	US Ranking in Sector Emissions
Energy Production ⁵	2309.7 MMT CO ₂	12480.6 MMT CO ₂	17.9%	2
Transport ⁶	1621.7 MMT CO ₂	6755.8 MMT CO ₂	24%	1
Energy Efficiency ⁷	6481 GtCO ₂ e	49406 GtCO ₂ e	13.1%	2
Short-Lived Gases: Methane ⁸	503.7 MtCO ₂ e	7195.56 MtCO ₂ e	7%	4
Short-Lived Gases: HFCs ⁹	289 MtCO ₂ e	727 MtCO ₂ e	39.7%	1
LULUCF: Agriculture ⁹	.353 GtCO ₂ e	4.68 GtCO ₂ e	7.5%	4

As the third most populated nation in the world¹⁰ and one that enjoys the many benefits of high per capita energy consumption, the U.S. holds a great deal of potential for greenhouse gas emissions reduction. As the companion sectoral reports have detailed, there are a number of interventions in each of the areas mentioned above that would serve to reduce the country's impact on the atmosphere at a relatively low cost. A review of the U.S. greenhouse gas abatement potential by sector and the major interventions that would enable such reductions (table 2) indicates that energy production and transportation are the two areas best suited for policy interventions.

For the U.S. to successfully implement these interventions, a number of barriers—informational, cultural, and political barriers—must be addressed. The following sections outline the United States' current approach to climate policy and discuss the main issues preventing the nation from taking effective action.

⁵ IEA, 2012.

⁶ Transport Sector Paper, Busby PRP, 2013-2014.

⁷ Energy Efficiency Sector Paper, Busby, PRP 2013-2014.

⁸ Short-Lived Gases Sector Paper, Busby PRP, 2013-2014.

⁹ LULUCF Sector Paper, Busby PRP, 2013-2014.

¹⁰ U.S. Census, 2014.

Table 2: U.S. Emissions Abatement Potential by Sector and Intervention

Sector	Abatement Potential by 2030	Major Interventions
Energy Production	1580 MtCO ₂ /yr	<ul style="list-style-type: none"> • CCS • Increased Renewables • Fuel Switching
Transport ¹¹	759 MtCO ₂ e/yr	<ul style="list-style-type: none"> • Develop LEED Standards for Transportation • Multi-modal National Transport System • Continue Developing Aggressive Fuel Standards for Various Auto Types
Energy Efficiency: Buildings	669 MtCO ₂ e/yr	<ul style="list-style-type: none"> • Lighting/Appliance Upgrades • Commercial Building Retrofits • Upgraded Building Codes
Energy Efficiency: Industry	425 MtCO ₂ e/yr	<ul style="list-style-type: none"> • Feedstock Switching • Process Integration (CHP) • Investments in Best-Practice Technology (Including CCS)
Energy Efficiency: Smart Grid	Up to 2100 MtCO ₂ /yr ¹²	<ul style="list-style-type: none"> • Smart grid rollout coupled with dynamic pricing schemes
Short-Lived Gases: Methane	25 – 90 MtCO ₂ e/yr ^{13,14}	<ul style="list-style-type: none"> • VRU Installations • Degasification of Coal Mines • Anaerobic Digestion Facilities • Municipal Waste Treatment
Short-Lived Gases: HCFs	100 – 135 TgCO ₂ e/yr ^{8,9}	<ul style="list-style-type: none"> • HFC Amendment to the Montreal Protocol • CGF Regulation
LULUCF: Agriculture	275.88 MtCO ₂ e/yr	<ul style="list-style-type: none"> • Grassland Management • Degraded Land Restoration

Source: McKinsey & Company, 2014

¹¹ McKinsey & Company, 2014.

¹² By 2050.

¹³ U.S. Department of State, 2014a.

¹⁴ By 2020.

CURRENT U.S. CLIMATE POLICIES & THE HISTORY OF LEGISLATION

The United States has a number of initiatives as well as local, state, and federal policies, established to regulate the nation's greenhouse gas emissions. Due to the nature of the country's governmental structure, efforts at mitigation tend to vary in number, level of aggressiveness, and structure, depending on the state or region. This section examines the state and national-level actions that the United States currently has established or is pursuing.

STATE & REGIONAL LEVEL CLIMATE POLICIES

One common criticism of the United States' approach to climate policy is its current reliance on executive orders and centralized actions. Arguably, the nation's primary efforts may be summed up through presidential direction of federal agencies like the EPA to target anthropogenic climate forcers, albeit using existing legislative authority. However, there are also a great number of state-level efforts to reduce local greenhouse gas emissions—many of which are focused on energy production and energy efficiency.

RENEWABLE PORTFOLIO STANDARDS

One of the most prevalent state-level climate initiatives is the renewable portfolio standard (RPS). States that participate in this type of effort set a fixed percentage of their energy production that must be derived from renewable energy sources. Depending on the state, any of the following may qualify as an “eligible” renewable:¹⁵

- Wind
- CSP
- Distributed PV
- Centralized PV
- Biomass
- Hydroelectric
- Geothermal
- Landfill Gas
- Ocean/Tidal

Utilities have the responsibility of ensuring that their assigned percentages of an RPS are met through the sale of these resources. Alternatively, some utilities must not meet their portion of the RPS through retail sales, but rather through a certain amount of renewable generation capacity (e.g., customer-owned distributed PV may count as such, in this situation).¹⁶

¹⁵ DSIRE, 2013c.

¹⁶ DSIRE, 2013b.

CALIFORNIA AB 32

California is one of the most progressive states regarding climate change. Boasting policies targeting greenhouse gas emissions on the whole (a statewide cap), establishing a cap-and-trade system, setting renewable portfolio standards, and enforcing strict building efficiency codes, the state has given itself a name for being environmentally aware and forward-thinking with regards to greenhouse gas emissions.¹⁷ In particular, California's Assembly Bill 32 (AB 32), which was passed by governor Arnold Schwarzenegger in 2006, mandated that the state reach 1990 emissions levels by 2020. As part of the actions taken to meet this goal, the government established a cap-and-trade program that went into effect in 2012. Despite political opposition regarding federal legislation (as demonstrated by, for example, the failed Waxman-Markey bill), this program was rolled out successfully and continues to function effectively today.¹⁸

On a regional level, California has recently engaged with Oregon, Washington, and the Canadian province British Columbia, on the Pacific Coast Collaborative, an initiative to address the need for sustainability in the area. Together, these actors have released the Pacific Coast Action Plan on Climate and Energy. This document outlines unique state strategies targeting greenhouse gas emissions. For example, each player has agreed to initiate or, if already established, maintain, a carbon-pricing plan to disincentivize high levels of fossil fuel consumption and encourage efficiency, the use of renewable energy, and conservation.¹⁹

REGIONAL GREENHOUSE GAS INITIATIVE

The Regional Greenhouse Gas Initiative (RGGI) is the first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI (table 7) is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO₂ emissions from the power sector.²⁰

RGGI was established in 2005 and held its first auction in 2008. RGGI requires fossil fuel power plants in participating states that produce more than 25 megawatts to obtain an allowance for each ton of CO₂ emitted annually. States can then sell these emissions allowances through auctions and invest the proceeds into energy efficiency, renewable energy, and other consumer benefit programs.²¹ According to C2ES, "By 2020, the RGGI CO₂ cap is projected to contribute to a 45 percent reduction in the region's annual power-sector CO₂ emissions from 2005 levels, or between 80 and 90 million short tons (tons) of CO₂."²²

¹⁷ DSIRE, 2013e.

¹⁸ Environmental Defense Fund, 2014.

¹⁹ Pacific Coast Collaborative, 2013.

²⁰ RGGI.org, 2014.

²¹ Ibid.

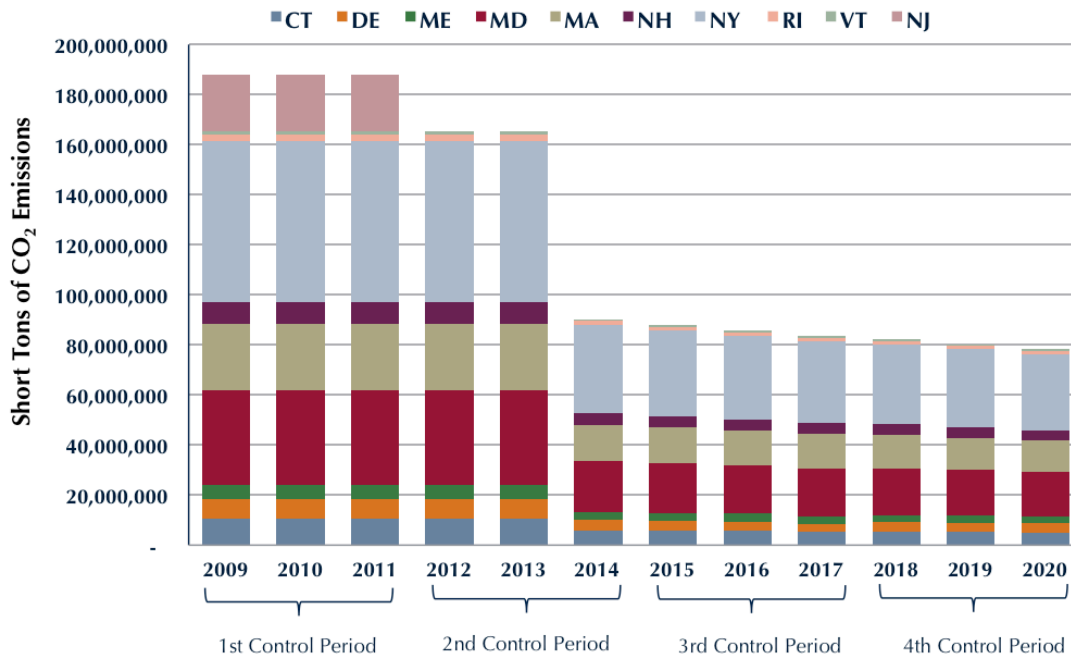
²² Center for Climate and Energy Solutions, 2013b.

Table 7: Timeline of RGGI

2005	Memorandum of Understanding Issued between Connecticut, Delaware, Maine, New Hampshire, New York, and Vermont
2007	Maryland, Massachusetts, and Rhode Island join RGGI
2008	Original Model Rule adopted; first Allowance Auction held
2009	1st Control Period Begins: CO ₂ emissions capped at 188 million short-tons
2011	New Jersey withdraws from RGGI
2012	2nd Control Period Begins: CO ₂ emissions capped at 165 million short-tons
2013	Updated Model Rule adopted
2014	New Cap Compliance Begins: CO ₂ emissions capped at 91 million short-tons

Source: Center for Climate and Energy Solutions, 2013b

Two major developments have occurred in the last three years. In 2011, Governor Chris Christie (R-NJ) withdrew New Jersey from the Initiative. Many environmentalists were disappointed by this move and worried about the fate of the initiative, the first of its kind in the United States. Then, following a comprehensive Program Review in 2012, the RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO₂ cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO₂ cap represents a regional budget for CO₂ emissions from the power sector.²³

Figure 9: RGGI Annual CO₂ Emissions Cap

Source: Center for Climate and Energy Solutions, 2013b

²³ RGGI.org, 2014.

Currently, the RGGI states and California are the only market-based cap and trade programs in the United States for CO₂ emissions. Perhaps the most important result of these initiatives has been the development of sophisticated and transparent CO₂ mechanisms to quantify and track GHG emissions. Since the U.S. Congress has been sharply divided over the idea of cap-and-trade since 2008, these state and regional initiatives have thus far been the best approach to capping domestic GHG emissions.

OTHER REGIONAL EFFORTS

Apart from RGGI, other regional efforts in the United States include the Western Climate Initiative (California, British Columbia, Quebec—down from its original list of 24 participant states/provinces), the Midwest Greenhouse Gas Reduction Accord, and the Transportation and Climate Initiative (housed in the Northeast/Mid-Atlantic).²⁴ Each of these organizations has set out an ambitious mission statement asserting the recognized need and will to reduce its participants' greenhouse gas emissions.

FEDERAL CLIMATE POLICIES

In addition to state and regional initiatives, the United States federal government has engaged in a number of centralized actions targeting climate change mitigation and adaptation. The key federal initiatives of the last decade include: renewable energy tax credits, vehicle emissions standards, an executive climate action plan, and attempts at passing legislation to implement a nation-wide cap and trade program.

MCCAIN-LIEBERMAN CLIMATE STEWARDSHIP ACT

In October 30, 2003, Senators Joseph Lieberman (D-CT) and John McCain (R-AZ) brought the Climate Stewardship act to a vote in the United States Senate. This bill was noteworthy because it called for EPA regulations to limit greenhouse gas emissions from electricity generation, transportation, industrial, and commercial sectors while also allowing for the trading of emission allowances.²⁵ This bill received bipartisan support, which reflected congressional thinking on climate change in the early 2000s.

WAXMAN-MARKEY BILL

²⁴ Center for Climate and Energy Solutions, 2014g.

²⁵ Center for Climate and Energy Solutions, 2014f.

In November 2008, President-elect Barack Obama addressed the first ever Governor's Global Climate Summit and promised to show leadership on the issue.²⁶ The event was noteworthy because governors from different parties and regions parties were in attendance. In May 2009, encouraged by President Obama's commitment, Representative Henry Waxman and Representative Edward Markey introduced the American Clean Energy and Security Act of 2009 (H.R. 2454) on the floor of the U.S. House of Representatives after it passed the House Energy and Commerce Committee by a vote of 33-25. On June 26, 2009, the ACES, or "Waxman-Markey" bill as it would come to be known, passed the U.S. House of Representatives by a vote of 219-212.²⁷ The vote was split largely along party lines with the exception of 44 "Blue Dog" Democrats who voted against it and Republicans unanimously opposing. The goal of the bill was "to create clean energy jobs, achieve energy independence, reduce global warming pollution, and transition to a clean energy economy."²⁸ The Bill included provisions for a federal cap-and-trade system, set increasingly stringent emission reduction targets beyond 2020, and created incentives for renewable energy investment, electric vehicles, and energy efficiency.

Following the lead of the House, in September 2009 Senator John Kerry and Senator Barbara Boxer introduced the Clean Energy Jobs and American Power Act in the U.S. Senate. The bill emerged from the Senate Environmental and Public Works Committee despite opposition votes by all seven Republican members.²⁹ However, despite a narrow victory in the House, the Senate Bill never received enough votes to make it to the floor for a vote.

In October 2009, Senators John Kerry, Lindsay Graham, and Joseph Lieberman jointly introduced a bill titled the "Framework for Climate Action and Energy Independence in the U.S. Senate" which included: a market-based solution to reduce emissions by 17% of 2005 levels by 2020, investments in nuclear and renewable energy, clean coal, energy efficiency, and "a strong, international agreement with real, measureable, reportable, verifiable and enforceable actions by all nations."³⁰ Despite these efforts, by July 2010 Senate majority leader Harry Reid did not have a single Republican vote (not even Graham) and realized that, without bipartisan support, the Senate could not pass comprehensive climate change reform.

Since that time, Congress has been gridlocked over the issue of climate change, almost strictly along party lines. As a result, the Executive Branch, and particularly the EPA has taken the lead in regulating greenhouse gases from all sectors.

²⁶ Rochelson, 2008.

²⁷ Center for Climate and Energy Solutions, 2014h.

²⁸ American Clean Energy and Security Act, 2009.

²⁹ Center for Climate and Energy Solutions, 2014a.

³⁰ Center for Climate and Energy Solutions, 2014e.

PRESIDENT OBAMA’S CLIMATE ACTION PLAN

In June 2013, President Barack Obama outlined his Climate Action Plan. The plan includes detailed plans for cutting carbon from power plants, increasing fuel economy standards, curbing emissions of HFCs, increasing renewable energy investment, and reducing methane emissions.³¹ In this section, we examine the existing domestic policies that the federal government has already employed to mitigate greenhouse gas emissions.

CAFE STANDARDS

In April 2010, the EPA and the Department of Transportation’s National Highway Traffic Safety Administration (NHTSA) finalized rules for the most aggressive fuel standards in U.S. history. These rules were developed in response to the Obama Administration’s call for stricter emissions controls. Interpreting the Clean Air Act broadly to cover greenhouse gases as pollutants, the EPA issued the first-ever greenhouse gas emission standards for light-duty vehicles.³²

Additionally, using the Energy Policy and Conservation Act, the NHTSA finalized Corporate Average Fuel Economy (CAFE) standards for light-duty vehicles in August 2012.³³ These rules required all passenger cars, light-duty trucks, and medium-duty passenger vehicles for model year 2017-2020 to achieve fuel economy standards of 54.5 miles per gallon.³⁴ The second phase of the plan involves targeting medium and heavy-duty vehicles. These standards will be introduced for model years 2014 through 2018. Phase 2 aims to build upon that progress of Phase I. According to the EPA, “Phase 2 may include more stringent engine and vehicle greenhouse gas emission and fuel efficiency standards, and may also include a new regulatory standard for new trailers pulled by semi-tractors.”³⁵

However, these standards are currently subject to Small Business Advocacy Review for qualifying “small” businesses.³⁶ According to C2ES, if adopted, these standards “are projected to save a combined \$50 billion in fuel costs, 530 million barrels of oil, and 270 million metric tons of carbon emissions over the lifetime of vehicles for model years 2014 to 2018.”³⁷

³¹ Whitehouse.gov, 2013.

³² U.S. EPA and Department of Transportation, 2010.

³³ Ibid. For more information on this topic, see the Transportation Sector paper in the PRP by Bartlett, Clark, and Zbeida.

³⁴ US EPA and Department of Transportation, 2012.

³⁵ Ibid.

³⁶ Ibid.

³⁷ Center for Climate and Energy Solutions, 2014d.

RENEWABLE ELECTRICITY PRODUCTION TAX CREDIT (PTC)

The Renewable Electricity Production Tax Credit (PTC) was a corporate tax credit originally enacted in 1992 and renewed by the American Recovery and Reinvestment Act of 2009 and later by the American Taxpayer Relief Act of 2012. According to the Database of State Incentives for Renewables and Efficiency (DSIRE), the PTC was “a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year” up to 10% of the amount paid for the renewable installation.³⁸ The PTC however expired on December 31, 2013 and was only renewed with two remaining in the calendar year in 2014 retroactively for 2014, not enough time for many producers to take advantage of it.

Table 3: Renewable Electricity Production Tax Credit

Resource Type	Begin Construction Deadline	Credit Amount
Wind	December 31, 2013	2.3¢/kWh
Closed-Loop Biomass	December 31, 2013	2.3¢/kWh
Open-Loop Biomass	December 31, 2013	1.1¢/kWh
Geothermal Energy	December 31, 2013	2.3¢/kWh
Landfill Gas	December 31, 2013	1.1¢/kWh
Municipal Solid Waste	December 31, 2013	1.1¢/kWh
Qualified Hydroelectric	December 31, 2013	1.1¢/kWh
Marine and Hydrokinetic (150 kW or larger)	December 31, 2013	1.1¢/kWh

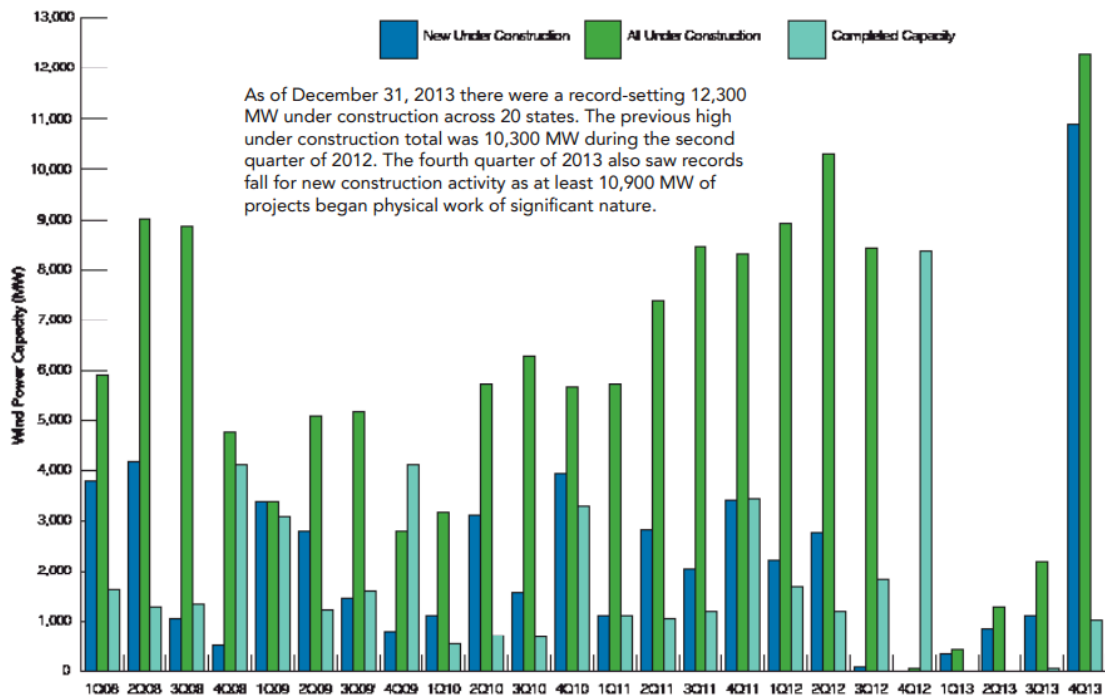
Source: DSIRE, 2013d

The PTC is credited with fueling the explosive growth in wind installations in the United States (figure 3).³⁹ By one estimate, since 2009, wind accounted for 36% of all new electricity generation installed in the U.S. and now supplies more than 4% of the country's electricity. One key indicator that the PTC is largely responsible for recent U.S. wind development is the drastic uptick in the number of projects started before the expiration of the PTC.

³⁸ DSIRE, 2013d.

³⁹ Phillips, 2014.

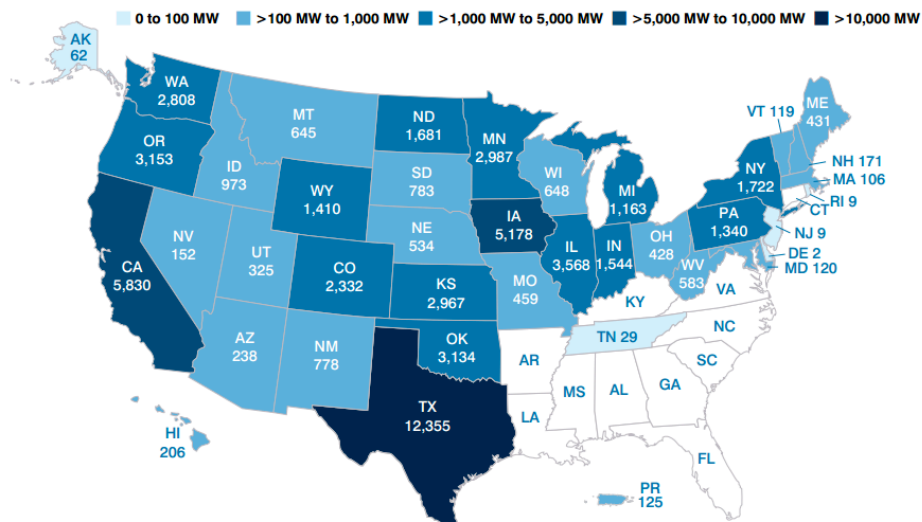
Figure 3: Wind Power Capacity under Construction



Source: American Wind Energy Association, 2014

According to an analysis by the American Wind Energy Association, renewable developers installed over 5 GW of wind capacity in Iowa and California and over 12 GW of wind capacity in Texas under the PTC.

Figure 4: U.S. Wind Power Capacity Installations by State

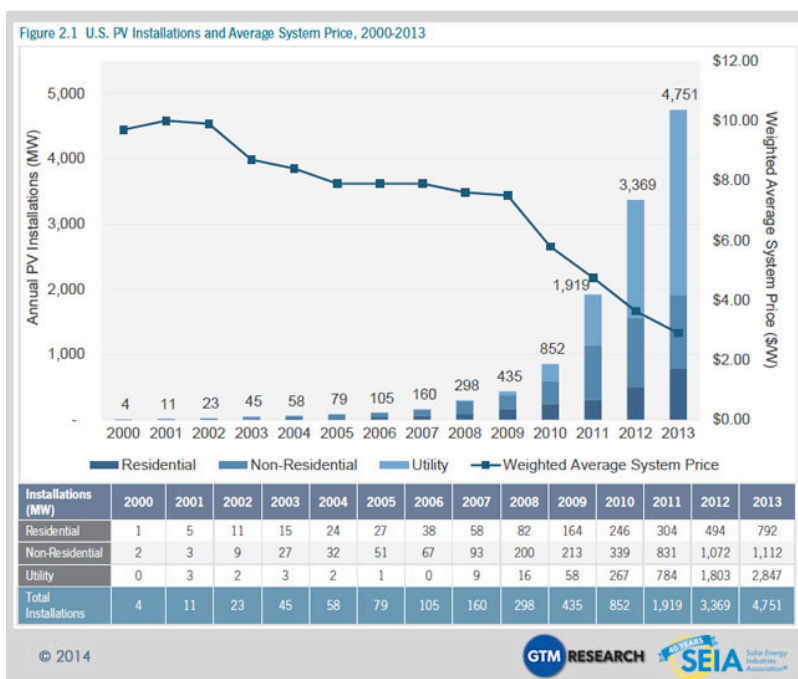


Source: American Wind Energy Association, 2014

The Business Energy Investment Tax Credit is a 30% corporate tax credit for solar systems on residential and commercial properties, fuel cells, small wind, and PTC-eligible technologies.⁴⁰ It also offers a 10% rebate for geothermal, microturbines, and CHP installations. The ITC was originally implemented in 2006 and expanded under the American Recovery and Reinvestment Act of 2009 to all taxpayers who were eligible for the PTC.⁴¹

The Solar Energy Industries Association (SEIA) credits the ITC with fueling dramatic growth in domestic solar installations, increasing domestic solar manufacturing capacity, and reducing the costs of solar PV systems for residential, commercial, and utility customers⁴² (figure 5).

Figure 5: U.S. PV Installations and Average System Price, 2000-2013



Source: Solar Energy Industries Association, 2014

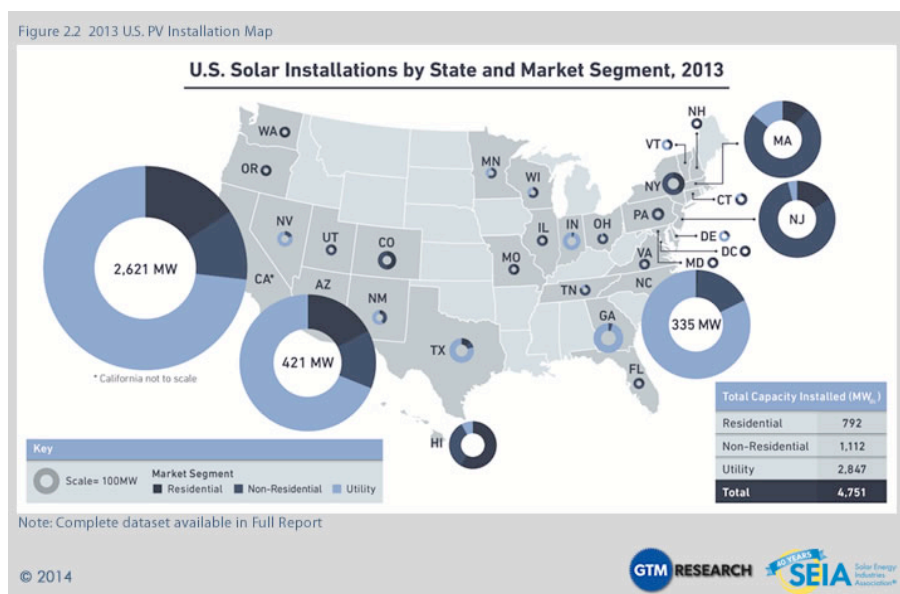
Arizona and California remain leaders in solar installation capacity due to their abundant solar radiation endowment. With the help of the federal ITC and state level policies, but in spite of their poor solar resources, the northeastern states of Massachusetts, New Jersey, and Maryland have witnessed impressive growth in installed solar capacities (figure 6).

⁴⁰ Solar Energy Industries Association, 2014.

⁴¹ DSIRE, 2013a.

⁴² Solar Energy Industries Association, 2014.

Figure 6: U.S. Solar Installations by State and Market Segment, 2013



Source: Solar Energy Industries Association, 2014

Overall, the ITC and PTC accomplished what they were intended to do: encourage the growth of the nascent renewable energy industries in the United States. These subsidies were not intended to last indefinitely. For this reason, the PTC was phased out in 2013 (though perhaps revived in 2014) and the ITC will likely expire in 2017.

U.S. PARTICIPATION IN INTERNATIONAL CLIMATE ACTION

The United States has had a long tradition of involvement with international climate negotiations, though the country's ability to lead on this issue has been hindered by domestic political opposition. Despite the Clinton administration's support for this issue, the high treaty ratification requirements prevented it from submitting the 1997 Kyoto Protocol for ratification. The successor George W. Bush administration was hostile to the issue.

In the face of recalcitrant Republican opposition to action on climate change, President Obama has sought to guide new international approaches to climate change that build on domestic action rather than top-down international treaty commitments. In addition, President Obama's Climate Action Plan calls for enhanced multilateral engagement with major economies, expanded bilateral cooperation with emerging economies, an international effort to phase out short-lived climate pollutants, an eventual phase-out of fossil fuel subsidies, and robust mechanisms for climate finance as detailed below.⁴³

THE MAJOR ECONOMIES FORUM

⁴³ Whitehouse.gov, 2013.

The Major Economies Forum on Energy and Climate, launched by President Obama in April 2009, facilitates a candid dialogue among major developed and developing economies to make progress in meeting the climate change and clean energy challenge. The 17 major economies which are members of the Major Economies Forum are: Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, South Africa, the United Kingdom, and the United States.⁴⁴

THE CLEAN ENERGY MINISTERIAL

The Clean Energy Ministerial is a high-level global forum of energy ministers to promote policies and programs that advance clean energy technologies, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. It is focused on three main goals: improve energy efficiency worldwide, enhance clean energy supply, and expand clean energy access.⁴⁵ Twenty-three countries are currently a part of this effort. Energy Secretary Ernest Moniz leads the U.S. initiative.

CLIMATE AND CLEAN AIR COALITION

In February 2012, U.S. Secretary of State Hillary Clinton launched the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollution. This global initiative seeks to reduce short-lived pollutants in the atmosphere such as methane, black carbon, and hydrofluorocarbons (HFCs). Together these gases account for one-third of current global warming, and limiting them can prevent more than 2 million premature deaths a year, avoid the annual loss of over 30 million tons of crops, increase energy security, and address climate change. Since its launch, the Partnership has expanded beyond the original founding partners (Bangladesh, Canada, Ghana, Mexico, Sweden, and the UN Environment Program) to include over 30 countries and the European Commission.⁴⁶

APEC SUMMIT

At the 2011 Asia-Pacific Economic Cooperation (APEC) Summit, leaders agreed to eliminate non-tariff barriers to environmental goods and services. Under the chairmanship of President Barack Obama, leaders further committed to reduce fossil fuel subsidies of APEC economies by 45 percent by 2035.⁴⁷

At the 2013 Summit, Secretary of State John Kerry, speaking on behalf of President Obama, warned of the dangers posed by climate change and encouraged further cooperation between the APEC members. The 2014 APEC meeting was also the occasion that brought President Obama and President Xi of China together for a landmark bilateral climate change agreement.

⁴⁴ Whitehouse.gov, 2014.

⁴⁵ Clean Energy Ministerial, 2014.

⁴⁶ Whitehouse.gov, 2014.

⁴⁷ Whitehouse.gov, 2014.

MONTREAL PROTOCOL

The Montreal Protocol was established in 1987 to facilitate a global approach to combat depletion of the stratospheric ozone layer. Every country in the world is currently a member of the protocol. Over the past four years, the United States has led international efforts to amend the Montreal Protocol to phase out global production and consumption of hydrofluorocarbons (HFCs), a potent greenhouse gas. A global phase down of HFCs could potentially reduce some 90 gigatons of greenhouse gases by 2050, equal to roughly two years worth of current global greenhouse gas emissions.⁴⁸ In June 2013, President Obama and Chinese President Xi agreed to work together and with other countries to use the Montreal Protocol to phasedown HFCs, a critical step forward toward a global agreement.⁴⁹ The United States is currently engaged in persuading the few remaining holdout states, such as India, to extend this bilateral initiative into a multilateral, global effort.

⁴⁸ Ibid.

⁴⁹ Ibid.

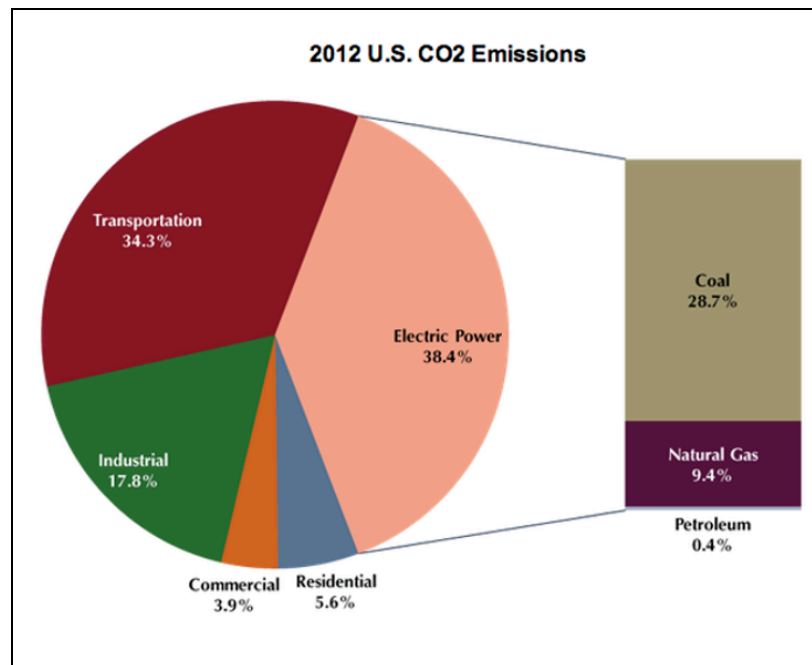
CURRENT POLICY ISSUES

The United States is currently host to several climate issues that are either pending legislation or are under heated debate. The EPA is developing regulation standards for existing power plants, the Keystone XL pipeline's future is contested and uncertain, and the relatively new practice of hydraulic fracturing or fracking has sparked much controversy. Each of these issues holds significance regarding the United States' future climate policies; therefore, in this section, they are each be examined in turn.

FEDERAL REGULATION OF POWER PLANT EMISSIONS WITH THE CLEAN AIR ACT

Because over a third of carbon dioxide emissions in the United States stem from the electric power industry, this sector has been targeted as one with significant greenhouse gas mitigation potential—especially in light of new and cleaner power generation technologies. The majority of emissions from this area are released through the burning of coal (figure 7).

Figure 7: U.S. CO₂ Emissions by Sector, Power Sector by Source, 2012



Source: Center for Climate and Energy Solutions, 2013a

After the failure of legislative approaches to climate mitigation, President Obama turned to executive action, mandating the EPA to develop a solution for setting power plant greenhouse gas emission standards in the United States. The EPA turned to sections 111 (b) and 111 (d) of the Clean Air Act (established in 1970⁵⁰) as the framework and justification for establishing hard caps on new and existing power plant emissions. While the use of this law is somewhat controversial, given that it was originally developed to address acute air pollutants that pose a direct public health risk, it provides a surprisingly flexible basis for states to regulate their plants as they best see fit.⁵¹

Section 111 (b) of the Clean Air Act was used as the basis for an EPA proposal to regulate emissions from new gas- and coal-fired power plants. On September 20, 2013, the EPA announced this proposal and it remained open for comment through October 2014.⁵² The proposal requires newly constructed power plants to adhere to defined emission caps (table 5).

Table 4: Clean Air Act Section 111 (b) Restrictions for New Power Plants

Type of Power Plant	Emissions Cap
Coal	1,100 lb CO ₂ /MWh
Natural Gas Combined Cycle – Large ⁵³	1,000 lb CO ₂ /MWh
Natural Gas Combined Cycle – Small	1,100 lb CO ₂ /MWh

Source: Federal Register, 2014

Under these regulations, coal plants would need to install Carbon Capture and Sequestration technology. The timeline for installation, given that such equipment is near-prohibitively expensive, may follow one of two paths. New coal plants may be constructed with CCS installed immediately, so that they meet the 1,100 lb CO₂/MWh goal over their first 12-month average, and then maintain it moving forward. Alternatively, new coal plant owners may install CCS anytime within seven years after startup, but must then achieve between 1,000 and 1,050 lb CO₂/MWh for that initial seven-year average.⁵⁴

Section 111 (d) of the Clean Air Act will be used as the basis for the upcoming EPA proposal to regulate emissions from existing power plants. Proposed standards and methods of regulation for existing power plants will be released by June 1, 2015. States then have until June 30, 2016 to develop their own unique plans for meeting the new federal emissions caps. It is anticipated

⁵⁰ U.S. EPA, 2014a.

⁵¹ Center for Climate and Energy Solutions, 2013a.

⁵² Will be closing on May 9, 2014.

⁵³ Rated at over 100 MW.

⁵⁴ U.S. EPA, 2013.

that the new standards will not have an excessively detrimental impact on the power industry due to the shale gas revolution and fuel-switching to cleaner natural gas already underway.⁵⁵

REDUCING METHANE AND VOC EMISSIONS IN THE OIL AND GAS SECTOR

GHG emission from energy extraction and exploration activities is a major concern in the climate arena. On April 15, 2014, EPA released five technical white papers on potentially significant sources of emissions in the oil and gas sector (table 6). This effort was part of the Obama Administration's Strategy to Reduce Methane Emissions as part of the overall Climate Action Plan. These papers focus on technical issues covering emissions and mitigation techniques that target methane and volatile organic compounds (VOCs).⁵⁶ Unless otherwise stated, all five white papers present data and mitigation techniques for emissions from each source as well as issues not addressed in the EPA's 2012 New Source Performance Standards (NSPS) for VOCs. These proposed rules, if enforced, will yield a 95% reduction in VOC emissions from more than 11,000 new hydraulically fractured gas wells each year.⁵⁷

Table 5: White Papers on Emissions in the Oil and Natural Gas Sector

Compressors	Mechanical devices that increase the pressure of natural gas and allow the natural gas to be transported along a pipeline.
Emissions from completions and ongoing production of hydraulically fractured oil wells	Completion is the processes of preparing a well for production, which can be a source of methane and VOC emissions since gas is often vented during production.
Leaks	Onshore natural gas leak emissions can occur from natural gas production (from unconventional formations such as shale deposits), processing, transmission, and storage.
Liquids and unloading	Liquids unloading refers to a number of processes used to remove accumulated liquids that can impede the flow of gas from a well to the surface.
Pneumatic devices	Controllers and pumps powered by high-pressure natural gas are widespread in the oil and natural gas industry. These pneumatic devices may release gas - including methane and VOCs - with every valve movement, or continuously in many cases.

Source: U.S. EPA, 2014e

⁵⁵ Center for Climate and Energy Solutions, 2013a.

⁵⁶ U.S. EPA, 2014e.

⁵⁷ Ibid.

FEDERAL AIR STANDARDS FOR OIL AND GAS

On April 17, 2012 the EPA issued cost-effective regulations, required by the Clean Air Act, to reduce harmful air pollution from the oil and natural gas industry while allowing continued, responsible growth in U.S. oil and natural gas production. Among these new rules include the first federal air standards for hydraulic fracturing wells based upon cost-effective technology and practices such as those in the EPA's Natural Gas STAR Program. These rules also included several other sources of pollution for which there are currently no federal standards.⁵⁸

REDUCED EMISSION COMPLETIONS

According to the EPA, Reduced Emission Completions (RECs), also known as “green” completions, “use specially designed equipment at the well site to capture and treat gas so it can be directed to the sales line. This process prevents some natural gas from venting and results in additional economic benefit from the sale of captured gas and, if present, gas condensate.”⁵⁹ The EPA has identified a transition period (until January 1, 2015) to ensure green completion equipment is broadly available. During this transition period, fractured and refractured wells must reduce their emissions through combustion devices (flares).⁶⁰

The EPA summarized their findings on green completions in a 2014 report based upon case studies in the Permian Basin, and the Bakken and Eagle Ford Shales. Their preliminary conclusion was that limited information is available on both controlled and uncontrolled emissions from hydraulically fractured oil well completions and recompletions. They also identified studies in which the level of uncontrolled methane emissions ranged from 44,306 tons per year to as much as 247,000 tons per year. Finally, they referenced a study by the University of Texas which found that RECs, in certain situations, can be an effective emissions control technique for oil well completions when gas is co-produced, but due to dangers such as well pressure and gas content below the surface, RECs may not always be technically feasible at co-producing wells.⁶¹

Another practice that could potentially undermine the efficacy of natural gas over coal is methane flaring. Flaring is the act of igniting excess natural gas that bubbles to the surface of drilled wells. From an engineering standpoint, flaring is an egregious waste of resources, especially when considering the effort spent to extract the resources in the first place. But from a business standpoint, drilling companies do not have the luxury of time when searching for oil and must make the most of their leases (typically 3 years). When oil is (or when it was) priced around \$100/bbl and natural gas is only worth \$2/thousand cubic foot, if the cheap gas reaches the surface before the well has access to a pre-existing pipeline, and it may not be profitable for

⁵⁸ U.S. EPA, 2014e.

⁵⁹ U.S. EPA, 2014f.

⁶⁰ U.S. EPA, 2014e.

⁶¹ U.S. EPA, 2014f.

them to build a pipeline, then they will flare the gas instead.⁶² This process releases excess carbon dioxide and methane into the atmosphere without displacing a single watt of coal-fired electricity.

MEASUREMENTS OF METHANE EMISSIONS AT NATURAL GAS PRODUCTION SITES IN THE US

Methane leakage can occur at various stages of the extraction process. In a landmark study, a University of Texas team led by Dr. David Allen, partnered with experts from the Environmental Defense Fund, Andarko Petroleum corporation, BG Group PLC., Chevron, and others to measure exactly how much methane leaks from a typical hydraulic fracturing well in the United States of America.⁶³ The team went to 190 pre-selected production sites throughout the United States at times pre-determined by the nine participating companies. They found that the majority of well completions with modern equipment reduced emissions by 99%.⁶⁴ These methane emissions levels were 97% lower than 2011 national emissions estimates released from the U.S. Environmental Protection Agency in April 2013.⁶⁵

These findings have been widely criticized by opponents of hydraulic fracturing who claim that the study is deeply flawed because the industry pre-selected the wells before the researchers tested them and thus, do not represent typical industry practices.⁶⁶ These findings also contradicted another study, published by the National Academy of Sciences in 2013, which found that methane emissions in certain regions of the United States may be 50% higher than originally thought due to oil and gas drilling.⁶⁷ These contradictory studies and others have led to methane leakage being a highly contested terrain for policy action.

THE KEYSTONE XL PIPELINE

The Keystone XL Pipeline has been an issue of intense debate for the past several years since it was proposed in 2005. The pipeline would transport oil extracted from oil sands in Alberta, Canada, with a number of significant destinations in the United States—including Cushing, OK (a major oil hub) and the dense cluster of refineries located along the Gulf Coast (figure 8). The extraction process is known to produce high GHG emissions.

The project has therefore triggered major opposition from many environmentalists who are pitted against the oil and gas industry in a head-to-head conflict over whether or not the

⁶² Krauss, 2013. *These sections were taken, with permission, from the Energy Production Sector Paper by Jones, Stephenson-Reynolds, and Stones. Available online: http://blogs.utexas.edu/mecc/files/2013/10/Energy-Production_Formatted.pdf

⁶³ Allen, 2013.

⁶⁴ Ibid.

⁶⁵ Ibid.

⁶⁶ Ingraffea, 2013.

⁶⁷ Miller, 2013.

project deserves approval.⁶⁸ Over the past few years, the entire pipeline has been analyzed in an environmental impact statement, rerouted around highly sensitive environmental lands in Nebraska, and sections of it have already received regional approval. Currently, however, the project remains on hold, awaiting presidential approval.⁶⁹

Figure 8: Keystone Pipeline Proposed and Built Routes



The final environmental impact statement for Keystone—released in January of 2014—indicates little impact to overall anticipated greenhouse gas emissions in the United States.⁷⁰ This conclusion was reached in light of the fact that regardless of whether or not the Keystone Pipeline is in place, the oil from the Canadian sands will be extracted and consumed. In fact, many conclude, it may actually be less damaging to the climate to construct the pipeline because alternative methods of transporting the oil include the use of heavy-duty vehicles which can cause major accidental fires and destruction of communities during transport.⁷¹

In 2014, Secretary of State John Kerry decided to delay the construction of the pipeline indefinitely awaiting the outcome of legal wrangling over the proposed route of the pipeline through Nebraska. This effectively punted the issue until after the 2014 mid-term elections.⁷² While declining gas prices in late 2014 made the necessity and even financial feasibility of the

⁶⁸ New York Times. 2014.

⁶⁹ Al Jazeera, 2013.

⁷⁰ U.S. Department of State, 2014b.

⁷¹ Eilperin and Mufson, 2014.

⁷² Davenport, 2014.

project more suspect, Congressional Republicans were pressing the Administration to approve the pipeline in early 2015.

THE ENERGY SAVINGS AND INDUSTRIAL COMPETITIVENESS ACT

In May 2013, the Energy Savings and Industrial Competitiveness Act, co-sponsored by Senators Jeanne Shaheen and Rob Portman, passed to the Senate floor from the Senate Committee on Energy and Natural Resources with a vote of 19-3. The bill aims to “spur the use of energy efficiency technologies in the residential, commercial, and industrial sectors of our economy.”⁷³ If this bill passes the Senate, it would strengthen national building codes to encourage energy efficiency, create an initiative for financing commercial building energy efficiency, and establish training centers where students and practitioners could study efficient commercial design. It would also establish a DOE program to help make companies’ supply chains more efficient.⁷⁴ Regardless of whether this bill passes the Senate, it shows that energy efficiency can be a bipartisan issue, which is a promising development for the next Congress.

BARRIERS TO EFFECTIVE CLIMATE CHANGE ACTION

While the U.S. has shown significant promise in the steps it has taken to reduce greenhouse gas emissions and prepare for the risks that will accompany climate change, there remain a number of barriers preventing the nation from assuming a stronger leadership role in these areas. With the world’s highest GDP and one of the highest GDP’s per capita,⁷⁵ the U.S. does not face the types of financial barriers a number of other countries do. The barriers are rather primarily informational, cultural, and political in nature.

INFORMATIONAL AND CULTURAL BARRIERS

As a democratic nation, the United States requires the support of the people to back any major legislation that may be passed. Citizen sentiment is currently divided on climate change. Polling has shown that Americans do not view climate change as a matter of great concern (figure 10).

⁷³ Energy Savings and Industrial Competitiveness Act, 2013.

⁷⁴ Ibid.

⁷⁵ World Bank, 2012.

Figure 10: Primary Concerns of Americans as Ranked by a 2014 Poll

	Great deal	Fair amount	A little/ not at all
	%	%	%
The economy	59	29	11
Federal spending and the budget deficit	58	22	20
The availability and affordability of healthcare	57	20	23
Unemployment	49	28	23
The size and power of the federal government	48	20	31
The Social Security system	46	29	24
Hunger and homelessness	43	33	23
Crime and violence	39	31	29
The possibility of future terrorist attacks in the U.S.	39	24	37
The availability and affordability of energy	37	30	33
Drug use	34	29	37
Illegal immigration	33	24	42
The quality of the environment	31	35	34
Climate change	24	25	51
Race relations	17	26	56

Question asked of a half sample
March 6-9, 2014

Source: Gallup 2014

A major reason for this lack of support is that the major risks of inaction on climate change have not been communicated well to Americans. The media has repeatedly shied away from covering this issue, and when it does turn its attention to climate change, it is usually driven by special interests.⁷⁶ This deficiency in appropriate issue consideration has become increasingly dangerous over time, as the risks associated with continued greenhouse gas emissions have only been growing in size and significance as action is delayed. Without a reliable, unbiased forum for information delivery, United States citizens cannot make educated decisions about their nation's climate actions. As one of the largest greenhouse gas emitters in the world, the country has the responsibility of taking well-informed climate action. To do so, however, information must be disseminated responsibly—and, currently, this is not happening.⁷⁷

Similarly, the communication of the science itself to the general public is inherently difficult (as is the case with relaying any type of specialized information to the masses). Because climate change is such a large and complex issue, and because forecasting models are essentially attempting to predict the longer-term future, there is a level of uncertainty in the scientific predictions. To properly assess risk one must consider not only the probability of a scenario

⁷⁶ Boykoff and Rajan, 2007.

⁷⁷ Freudenburg and Muselli, 2010.

playing out but also the “outcome function” and cost of mitigating this outcome.⁷⁸ With so many variables factoring into the equation, it is easy for one to emphasize certain factors while disregarding others—and this, in turn, presents biased causes for action (or inaction).

Discussing the catastrophic risks that accompany the “tail” scenarios will obviously raise in one a sense of fear or even alarm. This reaction has been exploited by climate deniers who claim that discussing such situations is a scare tactic used to frighten the audience into backing climate change mitigation policies. The deniers twist the low-probability argument to bend in their favor, by focusing on how little a chance these devastating events have of occurring. Again, because the science behind climate change can be so variable, deniers can gloss over the macro-scale trends (e.g. warming will occur) aside and use model-based uncertainty to drive anti-climate policy agendas. This is a very large barrier to moving U.S. climate policy forward.

POLITICAL BARRIERS

Up through April of 2014, 176 climate change-related bills had been introduced in Congress. The majority of them propose methods to curb greenhouse gas emissions or strengthen adaptation efforts, but 68 are designed to stand in the way of progressive climate efforts.⁷⁹ The nature and division of these bills are, in and of themselves, indicative of the deep wedge driven between partisan lines in today’s Congress.

The partisan divide in Congress over energy and environmental policy predates the current administration. There was a moment after Hurricane Katrina in 2005 when Republican governors felt pressure to do something about climate change. But after the election of Barack Obama and the rise of Tea Party in 2009, the issue was effectively dead in the Republican Party. This was evident during the Waxman-Markey debate of 2010.

No issue is more indicative of this divide today than the Keystone XL pipeline decision. As was described earlier, despite Keystone’s limited effects on GHG emissions, this issue has been framed as one of the defining environmental issues for this administration and thus, has become a political lightning-rod for the Executive Branch. Decisions to delay action on it until after the midterm elections show how delicate environmental issues were in the 113th Congress.

In spite of the current divide in Congress, the Executive Branch, and especially the EPA, has taken the lead on efforts to mitigate domestic GHG emissions. The EPA’s use of the Clean Air Act’s Section 111 (d), and the President’s Climate Action Plan are two such initiatives which show the way towards substantive emissions reductions. However, without Congressional support, the effects of these initiatives will be limited. Ultimately, the power to craft long-term solutions to limit and reduce GHG emission in the U.S. beyond 2020 resides with the U.S. Congress.

⁷⁸ Emanuel, 2014.

⁷⁹ Center for Climate and Energy Solutions, 2014c.

Despite the fact that climate change has been near universal recognition by climate scientists, the issue remains politically contested in the United States.⁸⁰ As previously mentioned, countermovement organizations highlight model uncertainty in order to introduce doubt about climate change. Those unfamiliar with statistical modeling or the science behind atmospheric chemistry and dynamics may then process this uncertainty as evidence against the phenomenon's existence. Denial tactics such as this have been used by certain political groups, whose ideologies do not align with the types of changes that would accompany a commitment to aggressive greenhouse gas reduction strategies.

In late 2013, a report was released that detailed the amount of money being invested in the propagation of climate change denial.⁸¹ The breakdown of funding—both to recipients and from donors—showed that the effort is primarily supported by money from conservative foundations/organizations. Clearly, the intentional miscommunication of information regarding climate change is coming from a source with a clear external agenda in mind, and this culturally (politically)-fueled movement has had a significant negative effect, as we have seen, on climate change perceptions in the United States.

⁸⁰ Webber, 2013.

⁸¹ Brulle, 2013.

RECOMMENDATIONS FOR THE UNITED STATES

Based on the current trends and barriers surrounding climate policy in the United States, the following recommendations for more effective action may be considered:

ENERGY PRODUCTION

While the Clean Air Act allows the federal government to take immediate action toward regulating power plant emissions, it was not designed for this purpose. Legislation that is targeted specifically toward carbon dioxide and other greenhouse gases (like methane, which can be released through leakages) needs to be written and passed. It must be flexible and attentive to states' specific needs, but also set an overall hard cap on emissions consistent with the IEA's low-emissions scenario.

The power to regulate emissions from oil and gas production historically lies with the EPA, and the Courts have upheld this interpretation. The EPA should use this power to limit methane emissions in the sector by mandating Reduced Emissions Completions on new rigs where it is technologically feasible. Additionally, the EPA should work with state commissions on environmental quality to significantly restrict flaring within the borders of the United States.

Fuel-switching to natural gas represents an opportunity for mitigation, but only if the coal that is not consumed in U.S. power plants is also not exported to other nations. This indicates that restrictions on exporting coal ought to be a part of the debate on overall mitigation policy in the United States.

Enhancing the current policy of incentivizing renewable energy investments is also an important tool in the hands of executive authority. Ways and means to achieve this after the expiration of all such incentives mandated by Congress (the PTC and ITC, see above) need to be explored seriously by the White House.

TRANSPORTATION

The President should package the Keystone XL approval with trade-offs that work in favor of environmental action. Examples of trade-offs include even tougher emissions standards for heavy vehicles in the United States, new rules on methane leakage, a renewed tax credit for renewable energy and energy efficiency, or possibly something even more ambitious. This pipeline could be re-imagined as a negotiation tool, one that brings with it sizeable wins for climate action.

SHORT-LIVED GASES

The bilateral agreement with China limiting HFCs within the bounds of the Montreal Protocol was a good step forward for international action on GHG emissions. However, while China and

the U.S. are the biggest emitters in the world today, a global agreement that brings HFCs within the purview of the Montreal Protocol would be a significant step forward in global mitigation efforts. The U.S. can do more to persuade and incentivize recalcitrant states to agree to such a measure.

GENERAL RECOMMENDATIONS

Processing the sheer implications of an enormous phenomenon such as climate change is an extremely difficult thing to do, especially when the matter is presented in a global context. Humans better relate to issues with which they can personally empathize; therefore, communication of climate change on a regional level—e.g., how these risks affect one's hometown—would likely have more influence.⁸² Enhancing state-level communication campaigns could have a greater impact on public engagement on the issue than reliance on national media outlets for communication. Nevertheless, strong federal leadership is needed on climate mitigation.

Considering the reality of political gridlock in the U.S. Congress, the onus is on the executive arm to take further action. Apart from the sector-specific recommendations outlined above, the White House could exercise more vigorous leadership by calling a summit of major business houses and pressing for hard commitments from America's leading corporations to achieve major emissions reductions.

Again, the United States does not face the same types of financial barriers that many developing nations do, with regards to greenhouse gas mitigation. While costs to mitigate and adapt will be high, they are not insurmountable. Therefore, a number of recommendations posed do not target financial barriers; rather, they aim to bring down the obstacles that exist within the nation's government and governmental structure, information communication, and international negotiation tactics.

⁸² Swim, 2009.

CONCLUSIONS

The United States, as the nation with the highest GDP, is a significant emitter of greenhouse gases into the atmosphere. The country is the number one contributor of transport-related greenhouse gas emissions, and falls within the top five for energy production, energy efficiency, methane and HFCs, and agriculture-related emissions. As a nation that maintains an overall high standard of living and high HDI ranking,⁸³ there is a very logical reason for this level of consumption—the country’s fossil fuel-based infrastructure and its ability to continue purchasing primary fuel sources.

The previous sectoral papers have pinpointed various interventions that hold the most potential to reduce greenhouse gas emissions in the United States. However, for these actions to be taken, policies must first be established to either encourage or mandate their adoption. This paper has examined the current U.S. political structure as it applies to climate change by highlighting current policies either in place or under debate, under both state and federal lenses. The conclusions reached primarily focus on setting a centralized cap on greenhouse gas emissions—therefore ensuring that the nation makes its contribution to international mitigation efforts—and allowing states to then use appropriate interventions as they see fit (i.e. with regards to their specific economies). Additionally, effective communication of climate change threats is imperative—and it must be done on a regional level in order for populations to fully understand the risks.

⁸³ United Nations Development Program, 2013.

REFERENCES

350.org (2014), “Stop the Keystone XL Pipeline”. Available at: <<http://350.org/campaigns/stop-keystone-xl/>>

Al Jazeera America (2013), “A History of Keystone [Timeline],” Available at: <<http://america.aljazeera.com/watch/shows/the-stream/multimedia/2013/multimedia/2013/12/a-history-of-keystonetimeline.html>>.

Allen, David et al. (2013), “Measurements of methane emissions at natural gas production sites in the United States,” *Proceedings of the National Academy of Sciences of the United States of America*, v. 110, no. 44.

American Clean Energy and Security Act of 2009 (2009), H.R. 2998, 111th Congress. Available at: <<https://www.govtrack.us/congress/bills/111/hr2998>>

American Wind Energy Association (2014), “U.S. Wind Industry Fourth Quarter 2013 Market Report,” Available at: <http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA%204Q2013%20Wind%20Energy%20Industry%20Market%20Report_Public%20Version.pdf>

Boykoff, Maxwell T. and S. Ravi Rajan (2007), “Signals and Noise: Mass Media Coverage of Climate Change in the U.S. and the UK,” *EMBO Report*, vol. 8 no. 3.

Brulle, Robert J. (2013), “Institutionalizing delay: foundation funding and the creation of U.S. climate change counter-movement organizations,” *Climatic Change*, vol. 122, 682-698. Available at: <<http://link.springer.com/article/10.1007/s10584-013-1018-7>>

Center for Climate and Energy Solutions (2014a), “111th Congress Climate Change Legislation,” Available at: <<http://www.c2es.org/federal/congress/111>>

Center for Climate and Energy Solutions (2014b), “Carbon Pollution Standards for Existing Power Plants: Issues and Options,” Available at: <<http://www.c2es.org/publications/carbon-pollution-standards-existing-power-plants-issues-options>>.

Center for Climate and Energy Solutions (2014c), “Climate Debate in Congress,” Available at: <<http://www.c2es.org/federal/congress>>

Center for Climate and Energy Solutions (2013a), “EPA Regulation of Greenhouse Gas Emissions from New Power Plants,” Available at: <<http://www.c2es.org/federal/executive/epa/ghg-standards-for-new-power-plants>>

Center for Climate and Energy Solutions (2014d), “Federal Vehicle Standards,” Available at: <http://www.c2es.org/federal/executive/vehicle-standards#hdv_2014_to_2018>

Center for Climate and Energy Solutions (2014e), “Framework for Climate Action and Energy Independence in the U.S. Senate,” Available at:

<http://www.c2es.org/docUploads/Framework_for_Climate_Action_and_Energy_Independence.pdf>

Center for Climate and Energy Solutions (2014f), “Lieberman-McCain Climate Stewardship Act of 2003,” Available at: <<http://www.c2es.org/federal/congress/108/summary-mccain-lieberman-climate-stewardship-act-2003>>

Center for Climate and Energy Solutions (2014g), “Multi-State Climate Initiatives,” Available at: <<http://www.c2es.org/us-states-regions/regional-climate-initiatives>>

Center for Climate and Energy Solutions (2014h), “The American Clean Energy and Security Act (Waxman-Markey Bill),” Available at: <<http://www.c2es.org/federal/congress/111/acesa>>

Center for Climate and Energy Solutions (2010), “U.S. Greenhouse Gas Emissions by Sector 2010,” Available at: <<http://www.c2es.org/facts-figures/us-emissions/sector>>

Clean Energy Ministerial (2014), “About the Clean Energy Ministerial,” Available online: <<http://www.cleanenergyministerial.org/About>>

CNN (2009), The Situation Room, Interview by Wolf Blitzer and James Inhofe, 7 Dec. 2009, Available at: <<http://transcripts.cnn.com/TRANSCRIPTS/0912/07/sitroom.03.html>>

DSIRE - Database of State Incentives for Renewables & Efficiency (2013a), “Business Energy Investment Tax Credit (ITC),” North Carolina Solar Center and the U.S. Department of Energy, Available at: <http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F&re=1&ee=1>

DSIRE - Database of State Incentives for Renewables & Efficiency (2013b), “Glossary,” North Carolina Solar Center and the U.S. Department of Energy, Available at: <<http://www.dsireusa.org/glossary/>>

DSIRE - Database of State Incentives for Renewables & Efficiency (2013c), “Quantitative RPS Data Project Database,” North Carolina Solar Center and the U.S. Department of Energy, Available at: <<http://www.dsireusa.org/rpsdata/index.cfm>>

DSIRE - Database of State Incentives for Renewables & Efficiency (2013d), “Renewable Electricity Production Tax Credit (PTC),” North Carolina Solar Center and the U.S. Department of Energy, Available at: <http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F&re=1&ee=1>

DSIRE - Database of State Incentives for Renewables & Efficiency (2013e), “Rules, Regulations & Policies for Renewable Energy,” North Carolina Solar Center and the U.S. Department of Energy, Available at: <<http://www.dsireusa.org/summarytables/rrpre.cfm>>

Davenport, Coral (2014), “U.S. Delays Final Call on Keystone XL Pipeline,” *The New York Times*, Apr. 14, 2014, Available at: <<http://www.nytimes.com/2014/04/19/us/politics/us-delays-decision-on-keystone-xl-pipeline.html>>

Eilperin, Juliet and Mufson, Steven (2014), "State Department releases Keystone XL final environmental impact statement." *The Washington Post*, Available at:
<http://www.washingtonpost.com/business/economy/state-to-release-keystones-final-environmental-impact-statement-friday/2014/01/31/3a9bb25c-8a83-11e3-a5bd-844629433ba3_story.html>

Emanuel, Kerry (2014), "MIT Scientist: An Obligation to Take on 'Tail Risk' vs. Alarmism," *The Yale Forum on Climate Change & the Media*, Available at:
<<http://www.yaleclimatemediaforum.org/2014/04/mit-scientist-an-obligation-to-take-on-tail-risk-vs-alarmism/>>

Energy Savings and Industrial Competitiveness Act 2013 (2013), S. 761, 113th Congress, Available at: <<https://www.govtrack.us/congress/bills/113/s761>>

Environmental Defense Fund (2014), "California Cap-and-Trade Updates," Available at:
<<https://www.edf.org/california-cap-and-trade-updates>>

Federal Register (2014), "Noda: Standards of Performance for Greenhouse Gas Emissions Sources: Electric Utility Generating Units," Available at:
<<https://www.federalregister.gov/articles/2014/02/26/2014-03115/standards-of-performance-for-greenhouse-gas-emissions-from-new-stationary-sources-electric-utility>>

Freudenburg, William R. and Muselli, Violetta (2010), "Global warming estimates, media expectations, and the asymmetry of scientific challenge," *Global Environmental Change*, vol. 20 no. 3, Available at: <<http://www.sciencedirect.com/science/article/pii/S0959378010000300>>

Gallup (2014), "Climate Change Not a Top Worry in the U.S.," Available at:
<<http://www.gallup.com/poll/167843/climate-change-not-top-worry.aspx>>

GLOBE International (2014), "The GLOBE Climate Legislation Study," Available at:
<<http://www.globeinternational.org/studies/legislation/climate>>

IEA- International Energy Agency (2012), "CO2 Emissions from Fuel Combustion: Highlights," Available at: <<https://www.iea.org/co2highlights/co2highlights.pdf>>

Krauss, Clifford (2013), "Applying Creativity to a Byproduct of Oil Drilling," *The New York Times*, December 17, 2013, Available at: <http://www.nytimes.com/2013/12/18/business/energy-environment/applying-creativity-to-a-byproduct-of-oil-drilling-in-north-dakota.html?pagewanted=all>

Lawrence Livermore National Laboratory (2010), "Estimated U.S. Energy Use in 2010," Available at:
<https://flowcharts.llnl.gov/content/energy/energy_archive/energy_flow_2010/LLNLUSEnergy2010.png>

McKinsey & Company (2014), Climate Desk, Available at:
<http://solutions.mckinsey.com/climatedesk>

Miller, Scot et al. (2013), "Anthropogenic Emissions of Methane in the United States," *Proceedings of the National Academy of Sciences of the United States of America*, v. 110, no. 50.

The New York Times (2014), "Times Topics: Keystone XL Pipeline," Available at: http://topics.nytimes.com/top/reference/timestopics/subjects/k/keystone_pipeline/index.html

Pacific Coast Collaborative (2013), "Pacific Coast Action Plan on Climate & Energy," Available at: <http://www.pacificcoastcollaborative.org/Documents/Pacific%20Coast%20Climate%20Action%20Plan.pdf>

Philips, Matthew (2014), "Wind Energy Companies Prepare for Tax Credit's End," *Bloomberg Business Week*, 9 January 2014, Available at: <http://www.businessweek.com/articles/2014-01-09/wind-energy-companies-prepare-for-tax-credits-end>

RGGI.org (2014), CO2 Budget Trading Program, Regional Greenhouse Gas Initiative, Available at: <http://www.rggi.org/>

Rochelson, Dave (2008) "President-elect Obama Promises 'New Chapter' on Climate Change," Change.gov - The Official Web Site of the U.S. Presidential Transition, Available at: http://change.gov/newsroom/entry/president_elect_obama_promises_new_chapter_on_climate_change/

Solar Energy Industries Association (2014), "Solar Investment Tax Credit (ITC) Issues and Policies," Available at: <http://www.seia.org/policy/finance-tax/solar-investment-tax-credit>

Swim, Janet et al. (2009), "Psychology and Global Climate Change: Addressing a Multi-Faceted Phenomenon and Set of Challenges," American Psychological Association, Available at: <http://www.apa.org/science/about/publications/climate-change.aspx>

United Nations Development Program (2013), "Table 2: Human Development Index Trends," Available at: <https://data.undp.org/dataset/Table-2-Human-Development-Index-trends/efc4-gjvq>

United Nations Framework Convention on Climate Change (2014), "Background on the UNFCCC: The International Response to Climate Change," Available at: https://unfccc.int/essential_background/items/6031.php

U.S. Census (2014), "U.S. and World Population Clock," Available at: <http://www.census.gov/popclock/>

U.S. Department of the Interior, Minerals Management Service (2010), "Moratorium Notice to Lessees and Operators on the Outer Continental Shelf," Available at: <http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=33716>

U.S. Department of State (2014a), "Biennial Report Appendix – With Additional Measures Methodologies," Available at: <http://www.state.gov/documents/organization/214950.pdf>

U.S. Department of State (2014b), "Final Supplemental Environmental Impact Statement (SEIS) for the Keystone XL Project," Available at: <<http://keystonepipeline-xl.state.gov/finaiseis/index.htm>>

U.S. Department of State (2014c), "Keystone XL Project," Available at: <<http://www.keystonepipeline-xl.state.gov/>>

U.S. Environmental Protection Agency (2014a), "Clean Air Act Requirements and History," Available at: <<http://www.epa.gov/air/caa/requirements.html>>

U.S. Environmental Protection Agency (2014b), "Climate Change," Available at: <<http://www.epa.gov/climatechange/>>

U.S. Environmental Protection Agency (2014c), "Potential SBAR Panel: Greenhouse Gas Emissions Standards for Medium and Heavy-Duty Vehicles," Available at: <<http://www.epa.gov/rfa/heavy-duty-phase2.html>>

U.S. Environmental Protection Agency (2014d), "Sources of Greenhouse Gas Emissions: Industry," Available at: <http://epa.gov/climatechange/ghgemissions/sources/industry.html>

U.S. Environmental Protection Agency (2014e), "Summary of key changes to the New Source Performance Standards," Available at: <http://www.epa.gov/airquality/oilandgas/pdfs/20120417changes.pdf>

U.S. Environmental Protection Agency (2014f), "Oil and Natural Gas Sector Hydraulically Fractured Oil Well Completions and Associated Gas during Ongoing Production," Available at: <http://www.epa.gov/airquality/oilandgas/2014papers/20140415completions.pdf>

U.S. Environmental Protection Agency (2013), "Fact Sheet: Reducing Carbon Pollution From Power Plants," Available at: <<http://www2.epa.gov/sites/production/files/2013-09/documents/20130920technicalfactsheet.pdf>>

U.S. Environmental Protection Agency and the Department of Transportation (2010), "EPA and NHTSA Finalize Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks," Available at: <<http://www.epa.gov/oms/climate/regulations/420f10014.pdf>>

U.S. Environmental Protection Agency and the Department of Transportation (2012), "EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model years 2017-2025 Cars and Light Trucks," Available at: <<http://www.epa.gov/oms/climate/documents/420f12051.pdf>>

Webber, Michael (2013), Energy Technology Policy Class Lecture, University of Texas at Austin.

Whitehouse.gov (2013), "The President's Climate Action Plan," The United States of America, Executive Office of the President, Available at: <<http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>>

World Bank (2012), "GDP Per Capita," Available at:
<http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?order=wbapi_data_value_2012+wbapi_data_value+wbapi_data_value-last&sort=desc>

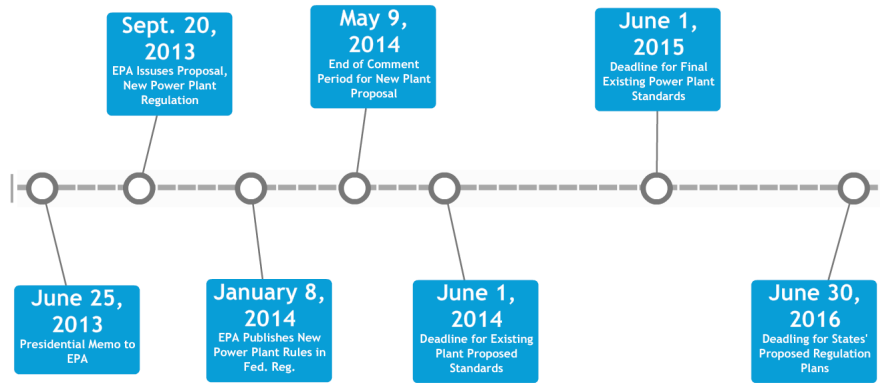
World Bank (2010a), "CO2 emissions (kt)," Available at:
http://data.worldbank.org/indicator/EN.ATM.CO2E.KT/countries?order=wbapi_data_value_2010+wbapi_data_value+wbapi_data_value-last&sort=desc

World Bank (2010b), "CO2 Emissions (metric tons per capita)," Available at:
<http://data.worldbank.org/indicator/EN.ATM.CO2E.PC?order=wbapi_data_value_2010+wbapi_data_value+wbapi_data_value-last&sort=desc>

APPENDIX A: US GHG MITIGATION POLICIES

Established or Under Debate?	Sector	Name
Established	Transport	CAFE Standards
Established	Energy Production	Renewable Electricity PTC
Established	Energy Production	Business Electricity ITC
Established	Energy Production	State-Level Policies (e.g. RPS)
Established	Energy Production	Regional Collaborations
Under Debate	Energy Production	Clean Air Act to Regulate Power Plants
Under Debate	Energy Production	Reduction of Methane in the Oil/Gas Sector
Under Debate	Energy Production	Keystone XL Pipeline
Under Debate	Energy Efficiency	Energy Savings and Industrial Competitiveness Act
Under Debate	Energy Production	Regional Greenhouse Gas Initiative

APPENDIX B: NEW POWER PLANT REGULATIONS TIMELINE



Date	Task Required
June 25, 2013	President Obama directs the EPA to complete carbon pollution standards for domestic power plants, and also outlines a timeline for completion.
Sept. 20, 2013	EPA announces its preliminary plans to limit greenhouse gas emissions from new coal and natural gas power plants through the establishment of New Performance Source Standards (NSPS).
Jan. 8, 2014	EPA publishes its proposed rules for new plant emissions in the Federal Register.
May 9, 2014	Comments on the EPA's proposed new power plant emissions standards close on this extended deadline—60 days after the original close date.
June 1, 2014	EPA must issue a proposed plan for regulating existing power plant emissions in the U.S.
June 1 2015	EPA must issue final standards and guidelines for existing power plant emissions.
June 30, 2016	Deadline for states to submit to the EPA their action plans for enforcing reduced emissions standards.