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An Assessment of US Progress towards its Pledge on Climate Change Mitigation

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Abstract

In 2009, President Obama pledged that, by 2020, the United States would achieve reductions in greenhouse gas emissions of 17% from 2005 levels. With the failure of Congress to adopt comprehensive climate legislation in 2010, the feasibility of the pledge was put in doubt. However, we find that the United States is near to reaching this goal: the country is currently on course to achieve reductions of 16.3% from 2005 levels in 2020. Three factors contribute to this outcome: greenhouse gas regulations under the Clean Air Act, secular trends including changes in relative fuel prices and energy efficiency and sub-national efforts. Perhaps even more surprising, domestic emissions are probably lower than would have been the case if the Waxman-Markey cap-and-trade proposal had become law in 2010. At this point, however, the United States is expected to fail to meet its financing commitments under the Copenhagen Accord for 2020.

Key Words: greenhouse gases, additionality, emissions cap and trade, Clean Air Act, carbon dioxide

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Contents

An Assessment of US Progress towards its Pledge on Climate Change Mitigation

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Introduction

At the international climate meetings in Copenhagen in December 2009, President Obama pledged that by 2020, the United States would achieve reductions in greenhouse gas (GHG) emissions of 17% from 2005 levels.[1] Following the failure of the United States to adopt comprehensive climate policy through legislation in the 111th Congress (2009–10), most observers anticipated that the pledge would not be met. This paper presents a forecast for US emissions in 2020. Although substantial uncertainty remains because important pieces of regulations are still pending, our central estimate indicates that the United States is near to reaching this goal. The country is currently on course to achieve reductions of 16.3% from 2005 levels in 2020.

Three factors contribute to this emissions projection. First is regulation under the Clean Air Act. The US Environmental Protection Agency (EPA) has already finalised fuel efficiency standards for mobile sources and rules for preconstruction permitting under the Act. The most important regulation from EPA will be the expected operating performance standards for new and existing stationary sources, and the design and stringency of these standards is the most important source of uncertainty in our estimate. A second factor is the secular trends in fuel prices and energy efficiency. The advantageous change in relative fuel prices has led to a substantial shift toward the use of natural gas and away from coal for electricity generation. Meanwhile, a discernible reduction in the energy intensity of economic activity is stemming from the expanded role of energy efficiency. The economic recession has also had an overall influence on reducing current emissions, but this will have less of an influence by 2020. The third factor is the effect of sub-national efforts to reduce emissions, including cap and trade in California and nine north-eastern states, renewable portfolio standards for electricity generation in 29 states and energy efficiency resource standards in 24 states.

The United States is about on track to achieve President Obama's Copenhagen pledge with respect to mitigation goals. Perhaps even more surprisingly, emissions in the domestic US economy under the current status quo, which we label the 'Clean Air Act regime', will probably be less in 2020 than would have occurred if the Waxman–Markey cap-and-trade proposal (H.R. 2454) had become law in 2010. That legislation would have achieved a roughly 30% reduction in emissions by 2020, but two-thirds of those reductions would have come from international and domestic offsets and many of those emissions reductions would have contributed to a bank of emissions allowances that would have reappeared as emissions in later years. The legislation also would have pre-empted many of the

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[1] The President's pledge did not specify whether the reductions would apply to the entire economy or onlyto a set of covered sectors within the economy. We assume that the reductions would apply only to emissions produced by the sectors covered by the Waxman–Markey cap-and-trade bill (H.R. 2454). These covered sectors – including electric generators, fossil-fueled transportation, and industrial sources, as well as other large emitters – composed approximately 84.5% of US greenhouse gas emissions in 2005. All references to 2005 emissions levels count only emissions from these covered sectors.

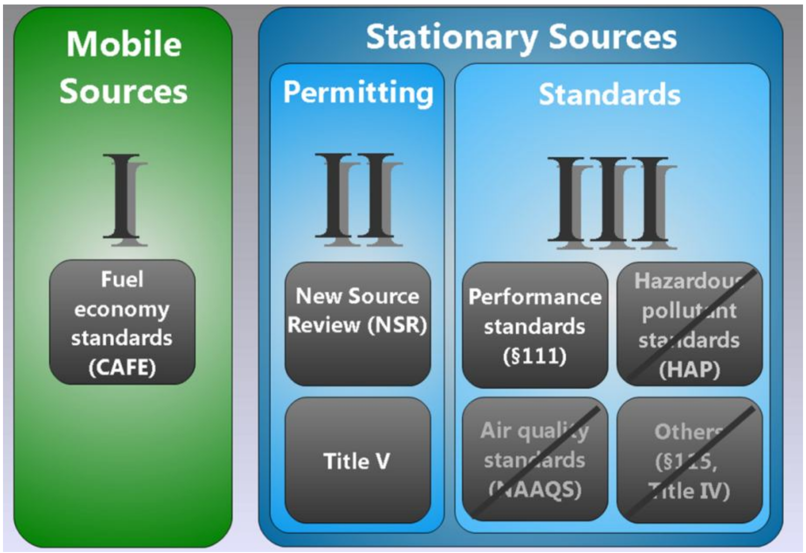
activities that are responsible for emissions reductions under the Clean Air Act regime. On the other hand, the legislation also would have offered a greater element of certainty with respect to the US emissions profile and presumably a lower cost, even if the expected level of emissions reductions would have been less.

Although the United States is close to meeting its pledge regarding domestic emissions, one must be less optimistic about the ability of the country to fulfil its pledge for international financing. The United States joined other developed countries in committing to support emissions mitigation and adaptation in developing countries through financing that would grow to $100 billion per year from public and private sources by 2020. However, the United States has not put a plan in place to achieve its share of this commitment (Purvis, 2012). The public contribution to the financing goals in future years appears to be insufficient. The contribution of private capital, including payments for international offsets, was expected to fulfil the lion's share of the US financing commitment but international offsets play no role in meeting regulations under the Clean Air Act (Richardson, 2012). Private investment capital in energy resource development already substantially exceeds the $100 billion target, but this cannot be seen as an additional source of funding, as implied by the Copenhagen Accord. At this point, the United States is expected to fail to meet its financing commitments for 2020.

Greenhouse Gas Regulation under the Clean Air Act

The modern Clean Air Act, passed in 1970, conveys broad authority to the EPA to develop regulations to mitigate harm from air pollution. In 2007, the Supreme Court confirmed that this authority applies to the regulation of GHGs.[2] Subsequently, the agency made a formal, science-based determination that GHGs are dangerous to human health and the environment, which compels the agency to develop regulations to mitigate the harm. Those regulations will take shape in three ways (Figure 1).

Figure 1. Three pathways to GHG regulation under the US Clean Air Act



Source: Richardson et al. (2011).

At the time of President Obama's pledge in Copenhagen in 2009, modelling by the US Energy Information Administration (EIA) forecast emissions in the United States under a business as usual

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[2] *Massachusetts v. EPA,* 549 U.S. 497 (2007).

baseline to be 6,689 million tonnes in 2020 from sources covered by Waxman-Markey.[3] The EIA reports that emissions in 2005 were 6,741 million tonnes (EIA, 2009a). The target identified in Copenhagen would have reduced emissions by 2020 to 17% below 2005 levels, resulting in emissions of 5,595 million tonnes in 2020. In this section we review actions and trends in place and in progress that have an effect on the expected level of emissions in 2020 with a special focus on changes that were not included in EIA's forecast in 2009.

Mobile Sources

More stringent vehicle fuel economy standards mandated by the Energy Independence and Security Act of 2007 were proposed in 2009 and finalised in May 2010. The standards, which took effect in January 2011, affect cars and trucks beginning with the 2012 model year. The standards impose annual improvements in fuel efficiency of 5% per year, raising the fleet average fuel efficiency for light trucks and sport utility vehicles to 30 miles per gallon by 2016, and to 39 miles per gallon for cars, resulting in a combined fleet average of 35.5 miles per gallon. Over the next decade, these standards are expected to roughly offset increases in vehicle miles travelled; over the life of the programme, they are expected to reduce GHG emissions from these vehicles by 990 million tonnes compared to business as usual. Because of these increased fuel economy standards, as well as changing consumer preferences, emissions per driver of newly purchased vehicles fell by 20% from October 2007 to July 2012 (Sivak & Schoettle, 2012).

Even stricter standards that have since been developed and finalised are expected to require additional fuel efficiency improvements of 40%, to be phased in beginning in 2017 and ultimately raising the combined fleet average equivalent to 54.5 miles per gallon by 2025. These standards are expected to reduce GHG emissions by roughly 2 billion tonnes over the lifetime of 2017–25 model year vehicles. Complementary regulations addressing medium- and heavy-duty vehicles will take effect in 2014.

Permitting for Stationary Sources

In January 2011, the EPA also adopted regulations for preconstruction permitting for major new and modified sources, such as power plants and industrial facilities. Permitting requires site-specific, technology-based review of control technology. Permitting is implemented at the state level, although the technological inquiry is national in scope and subject to EPA oversight. Under current EPA guidelines, this permitting process applies to about 900 construction projects per year at sources that emit large quantities of GHGs.

Performance Standards for Stationary Sources

The third regulatory action still anticipated by EPA will be the implementation of operating performance standards affecting new and, in particular, existing stationary facilities.[4] The first proposed standards, issued in April 2012 for new fossil-steam power plants, require these plants to achieve a carbon dioxide (CO_2) emissions rate of 1,000 pounds per megawatt-hour; this is based on the performance of a new natural gas combined-cycle plant. A new coal-fired plant would be required to install carbon capture and sequestration (CCS) to achieve this emissions rate. However, the standard includes a provision that allows a coal plant to operate for up to 10 years without CCS if it then installs CCS so that it achieves a 30-year average emissions rate that meets the standard of 1,000 pounds per megawatt-hour. Similar new source performance standards for other source categories –including

[3] All tonnage measures are reported in short tonnes.

[4] Standards under §111(b) of the Clean Air Act apply to new sources (these are termed 'new source performance standards'), and those under §111(d) to existing sources.

refineries, pulp and paper, iron and steel, and other emitting sources –are expected to roll out over time.

Once EPA has finalised its standards for new sources in a particular source category, the Clean Air Act requires that the agency begin to develop standards for existing sources in that category. Existing stationary facilities are the source of the largest share of GHG emissions and provide the greatest opportunity for cost-effective reductions in emissions, according to economy-wide modelling (EIA, 2009a). Existing steam boilers at power plants fuelled with coal, oil and natural gas, along with petroleum refineries, account for more than one-third of GHG emissions in the United States. Conceivably, the EPA could issue standards that mandate large-scale substitution away from coal to natural gas or non-emitting technologies. However, indications are that the EPA will not issue standards that require a major substitution away from coal. Instead, the agency is looking initially at improving the operating efficiency of power plants and refineries while rewarding, but not requiring, the substitution from coal to natural gas.

In its preliminary notice of a proposed rulemaking, the agency indicated that operating efficiency at existing facilities might be improved by 2–5%, resulting in a comparable reduction in emissions without changing the electricity output from these facilities (EPA, 2008). A 5% reduction in emissions from existing coal-fired power plants would amount to over 90 million tonnes per year, or about 1.4% of total US emissions. The agency identified the possibility of additional emissions reductions of 2–5% if coal-fired facilities co-fired with biomass. Larger emissions reductions may result if the regulations explicitly enable co-firing with or substitution to natural gas at existing coal-fired facilities as a way to achieve an emissions rate reduction on average.

Across all the stationary source categories identified in the EPA's technical documents, emissions total 62% of domestic emissions (Burtraw et al., 2011). Existing studies identified by the EPA uncover opportunities to reduce emissions from these sectors by up to 10%, or 6.2% of total US emissions. These short-term measures, which include energy and process efficiency improvements, the beneficial use of process gases, and limited material and product changes, have been identified by various authors as "cost-effective," meaning that they are zero-cost options for a firm after accounting for the cost of energy saved. These calculations apply engineering costs based on case studies, but have been validated in one econometric study of operating efficiency in the electricity sector (Linn et al., 2012).

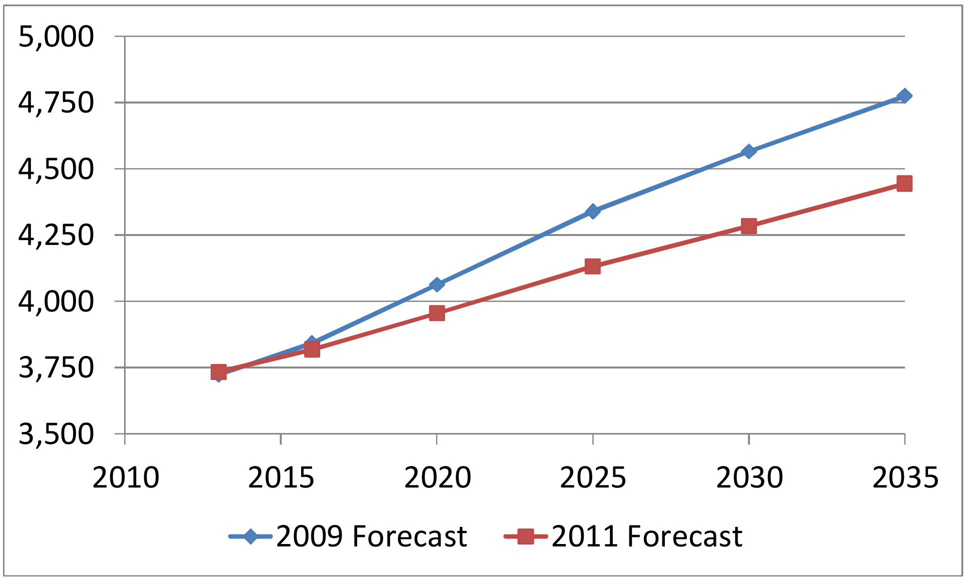
Perhaps more important than the stringency of the regulations in the long run is how the EPA chooses to structure regulations, because this will identify a pathway for ongoing regulatory activity. Figure 1 illustrates that a performance standard approach was chosen over other potential sources of authority under the Act.[5] The primary responsibility for implementation and enforcement resides with state governments, which will submit plans indicating how they will implement and achieve the EPA's environmental goals. Many authors have encouraged the EPA to issue a strong model rule that could be adopted by each state and that would implement a uniform, cost-effective national trading program. However, this raises a dilemma in the potential transfers of wealth across regions. The EPA could choose to develop subcategories within a sector based on technology type or region of the country. Departure from a uniform national programme would allow emissions rate averaging or trading, for example through regional programs, but the greater the degree of sub-categorisation, the higher total national costs are likely to be (Burtraw & Woerman, 2012). An alternative to a process driven by the EPA is one that embraces a variety of approaches proposed by the states, each calibrated to meet or exceed the EPA standard. The structure, timing, and stringency of this regulation are the major sources of uncertainty in US emissions profile.

[5] Richardson et al. (2011) outline the alternatives and the advantages of a performance standard approach.

Secular Trends in Natural Gas Supply and Energy Efficiency

Over the past three years, expectations about future prices of natural gas and future demand for electricity have evolved substantially, as reflected in adjustments to the energy forecasts produced by EIA in its Annual Energy Outlook (EIA, 2009b; EIA, 2011). Between 2009 and 2011, forecasts of future natural gas supply expanded multiple times, and the expected level of future natural gas prices fell significantly. Coincidentally, forecasts of demand levels and growth are also lower because of the current economic downturn as well as expanded investments in energy efficiency that accumulate over time.

Figure 2. Electricity consumption (terawatt-hours)

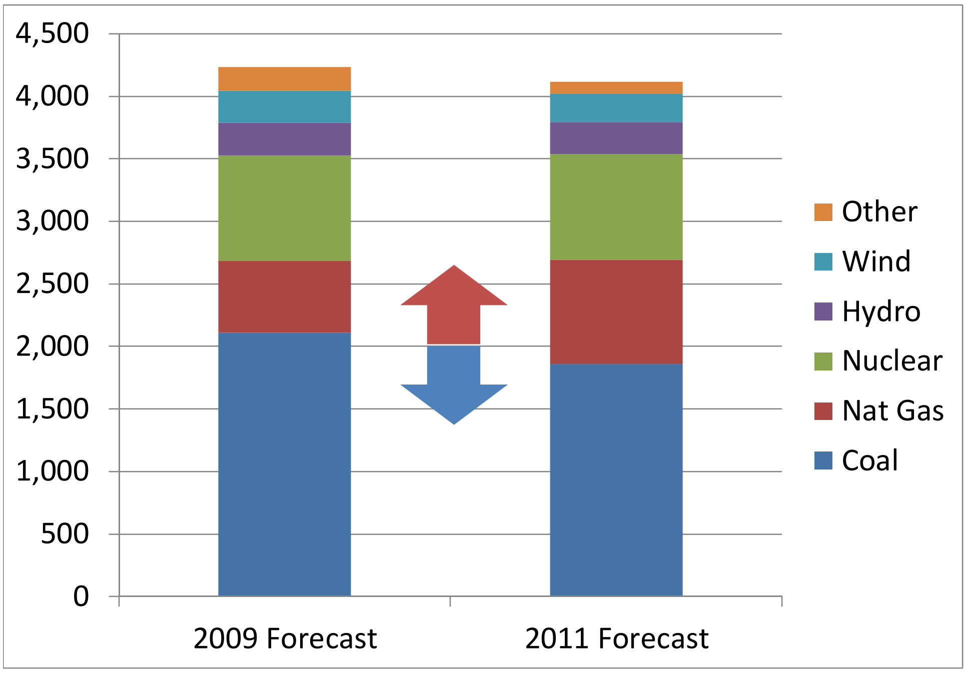


Source: Adapted from Burtraw et al. (2012).

To observe how these secular trends affect the electricity sector, we solve Resources for the Future's Haiku electricity market model two times, once calibrated to EIA's 2009 forecast and once calibrated to EIA's 2011 forecast.[6] The change in electricity demand due to these differing forecasts is illustrated in Figure 2. Reduced demand for electricity leads to a reduction in the amount of electricity generated, yielding CO_2 emissions reductions. The increased supply of natural gas also reduces CO_2 emissions as coal-fired generation is replaced by natural gas generation that is less carbon intensive. The change in generation mix expected in the year 2020 is shown in Figure 3. The combined effect of these secular trends in the electricity sector is expected to reduce CO_2 emissions in 2020 by 240 million tonnes (Burtraw et al., 2012).

[6] See Paul et al. (2009) for documentation on the Haiku electricity market model.

Figure 3. Electricity generation mix in 2020 (terawatt hours)



Source: Adapted from Burtraw et al. (2012).

Sub-National Policy

Many recent efforts at the state and regional level have sought to reduce emissions of GHGs, either directly, through a cap-and-trade policy, or indirectly, by mandating the increased use of renewables in generating electricity or the displacement of electricity demand with energy efficiency. Significant attention is currently focused on California, which will launch a cap-and-trade programme affecting the electricity and industrial sectors in 2013; the programme will expand to include the transportation sector, covering 85% of GHG emissions in 2015. This programme is part of the implementation of California's 2006 law that requires the state to reduce its GHG emissions (including emissions associated with imported electricity) to 1990 levels by 2020. Implementation of the law is expected to yield emissions reductions of 88 million tonnes per year from business as usual. Regulatory standards and measures are already in place to achieve 78% of this emissions target (Burtraw & Szambelan, 2012).

Another sub-national cap-and-trade program is the Regional Greenhouse Gas Initiative (RGGI), which comprises nine states in the north-east. The RGGI covers emissions from fossil-fuelled electric generators and seeks to reduce emissions by 10% by 2018 relative to levels observed in 2009, which was the first year of compliance under this programme. For several reasons, including secular trends within the electricity sector, the price of RGGI allowances is currently at the programme's price floor, resulting in emissions below the level required by the cap. For example, in 2011, emissions covered by the RGGI program were 44 million tonnes below the policy's cap. Nonetheless, the price floor in the programme auction has returned nearly $1 billion in revenue, which has been directed in large part towards energy efficiency investments in the region (Hibbard et al., 2011).

Policies to reduce GHG emissions have also been enacted at the state level. In 29 states plus the District of Columbia, renewable portfolio standards mandate that a specified percentage of electricity must be generated by renewable sources. In 24 states, fully-funded energy-efficiency resource standards establish specific, long-term targets for energy savings that must be met through electricity or natural gas energy efficiency programmes. Although these policies do not directly reduce GHG emissions, the increased use of renewable generators and the reduction in energy demand decreases the use of carbon-intensive fossil fuels. In most states, the percentage of electricity that is required to be renewable and the amount of demand displaced by energy efficiency will increase over the next decade, with many policies reaching the maximum stringency around the year 2020.

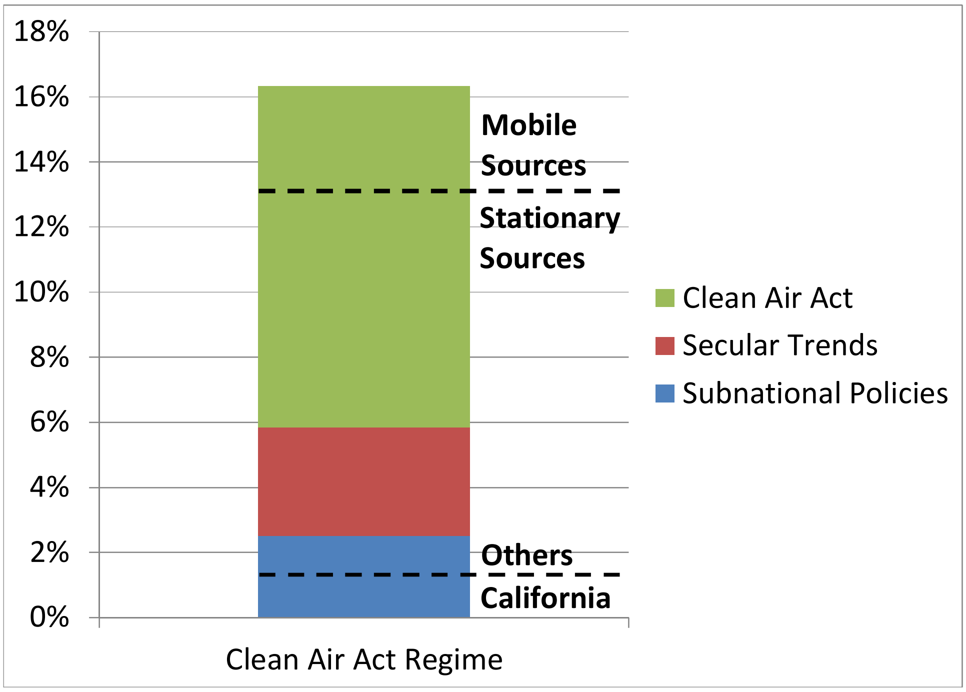
Adding up the Pieces: Projected US Emissions in 2020

We have identified three factors that contribute to emissions reductions in the United States. First, under the Clean Air Act, EPA has produced GHG regulations affecting mobile sources and preconstruction permitting. Regulations governing the operation of stationary sources are in development, although at a slow pace. Taken together, these initiatives are expected to achieve emissions reductions of 10.5% by 2020 compared to a 2005 baseline. It is uncertain whether these reductions will be fully realised, but the legal and institutional dominoes are in place for this to occur.

Second, secular trends in the economy, including changing relative fuel prices and the expanded influence of energy efficiency, will lead to additional reductions in the electricity sector that we measure to be 3.3%, compared to 2005 levels.

Third, sub-national policies are increasingly important. California's goal, embedded in state law; cap and trade in the Northeast (RGGI); and state renewable electricity and energy efficiency programmes should contribute additional emissions reductions. These sub-national policies alone, without the effects of secular trends in the electricity sector or any new regulations under the Clean Air Act, put the United States on target to have emissions 2.5% below 2005 levels. Total reductions by 2020, accounting for all three factors, are on track to yield emissions reductions of 16.3%, relative to 2005 levels. The contribution from each of these three factors is displayed in Figure 4.

Figure 4. Components of emissions reductions below 2005 levels (%) under the Clean Air Act regime



Emissions May Be Lower than under Cap and Trade

Comprehensive climate legislation proposed in the 111th Congress, known as Waxman–Markey, would have introduced an emissions cap-and-trade system covering over 84.5% of emissions in the US economy. The cap in 2020 was calibrated to be 17% below 2005 levels and in alignment with President Obama's Copenhagen pledge. In fact, the emissions reductions by 2020 were expected by EIA to be substantially greater than that, with the excess accumulating in an emissions bank that would reappear in later years (EIA, 2009a). However, the lion's share of the emissions reductions was expected to occur through offsets; less than half were expected to occur at sources covered by the emissions cap. Further, the legislation would have explicitly or implicitly pre-empted most of the emissions reductions that are expected to occur under its alternative, the Clean Air Act regime. In Table 1 we report that expected total reductions by 2020 of 16.3% relative to 2005 levels within the covered sectors of the US economy will be greater under the Clean Air Act than would have occurred under cap and trade.

EIA's modelling of Waxman–Markey in 2009 anticipated that the United States would achieve emissions reductions, including offsets, of 33.6% by 2020. However, emissions reductions at covered domestic sources were expected to total 10.2%. Of the 33.6%, 4.7 percentage points were expected to come from domestic offsets, and more than 15 percentage points were expected to come from international offsets—a policy tool unlikely to be available under the Clean Air Act (Richardson 2012). These estimates are presented in the first row under the Cap and Trade Implementation section in Table 1. Further, about 45% of these reductions would have contributed to the emissions bank. If one considers the contribution to the emissions bank ephemeral and likely to appear as actual emissions in a later year, then the permanent emissions reductions from sources regulated under the emissions cap in the US economy would have been 5.6%. Counting emissions from domestic offsets, this number would be 8.2%.

Some of the factors contributing emissions reductions under the status quo Clean Air Act regime, including changes in the economy since 2009, also would have had an effect under the cap-and-trade program. For example, the change in relative fuel prices—and especially the expanded supply of natural gas—would have occurred with or without cap and trade. However, the emissions reductions that would have been achieved with or without cap and trade are actually quite different because an *emissions cap* also serves as an *emissions floor*; that is, it specifies not only the maximum but also the minimum emissions that can occur. Under an emissions cap, because maximum emissions are fixed at the national level, the actions of agents within the economy cannot affect the overall level of emissions. Any effort to reduce emissions by one entity, including state and local governments or private parties, does not affect the overall level of emissions (Shobe & Burtraw, 2009; Goulder & Stavins, 2011). With an emissions cap, efforts to reduce emissions by one party make possible additional emissions by another party. The emissions floor undermines the contribution of emissions reductions through a number of venues—including aspects of the Clean Air Act or actions by state and local governments to adopt measures unilaterally that may contribute to local emissions reductions—because leakage of emissions to other jurisdictions would be 100%. In effect, a cap-and-trade program at the national level pre-empts efforts to achieve additional emissions reductions through other means.

Although total emissions may not change under a national cap, agents may undertake actions that shift emissions reductions between different sources under the cap. When additional domestic reductions are achieved within one sector or geographic region, either due to changing trends in the economy or additional policies at the national or sub-national level, the marginal cost of reductions decreases. The lower marginal cost leads to a rebound effect with fewer domestic reductions in other sectors or regions and fewer purchases of emissions offsets. For example, a policy that reduces emissions within the electricity sector would yield emissions below what would otherwise be required to attain the cap, which results in a lower allowance price. This reduced allowance price causes emitters in other sectors to increase their emissions and purchase fewer offsets. The net effect is an increase in domestic reductions, but the additional emissions reductions are less than 100% of what would have occurred in the absence of the cap.

In the absence of cap and trade, the first factor we identified that would yield emissions reductions is the Clean Air Act. The 2007 vehicle standards that took effect in 2011 were included in EIA's baseline projections for Waxman–Markey. However, new standards proposed in 2011, which take effect in 2017, could very well have been effectively pre-empted by the passage of Waxman–Markey because the cap would have introduced a price on carbon, resulting in a strong policy argument to let the price substitute for other regulatory efforts. In our central estimate of the cap-and-trade program, we assume that these additional fuel economy standards would not have been finalised, but we do estimate a sensitivity case with the standards in place. Under the Clean Air Act regime, these vehicle standards are projected to achieve additional reductions of approximately 220 million tonnes in 2020, or 3% of benchmark emissions. If they were to occur under the Waxman–Markey cap-and-trade programme, however, we estimate that about one-fifth of the emissions reductions would have been partially crowded out by emissions increases elsewhere, resulting in a smaller change in domestic emissions of 175 million tonnes. Other aspects of EPA's authority to regulate GHGs under the Act, including permitting and performance standards for stationary sources, would have been explicitly pre-empted.

The second factor yielding emissions reductions under the Clean Air Act regime is secular trends in the economy. Reductions in the electricity sector arising from greater use of natural gas and an expanded role for energy efficiency also would have occurred with Waxman–Markey, but because of the emissions cap, they would not have directly resulted in equivalent emissions reductions. Instead, as described above, some of these reductions would have been crowded out by increased emissions in other sectors of the domestic economy, resulting in approximately four-fifths of the reductions being additional under a national cap.

The third factor yielding emissions reductions in the absence of cap and trade is the sub-national effort by state and local governments. Waxman–Markey would not have pre-empted the ability of California or other states to set their own emissions reduction goals or to pursue related goals, such as renewable energy targets or efficiency standards. These policies might still have emerged even if Waxman–Markey had become law, although arguments to rescind them would have been strong. If they were not rescinded, then under the cap-and-trade system many of these sub-national efforts would have become non-binding, and therefore would have provided no additional emissions reductions. For sub-national policies that remained binding, again these emissions reductions would have been partially crowded out by emissions increases elsewhere, resulting in a smaller change in domestic emissions given the overall national cap.

To estimate that portion of the emissions reductions from the three factors we outline that would have been additional under cap and trade, we solve Resources for the Future's Haiku electricity market model with a reduced-form representation of emissions reduction opportunities for the rest of the US economy, and for the availability of offsets, that is calibrated to EIA's National Energy Modeling System. Haiku includes projections of electricity demand and natural gas prices that correspond to the secular trends discussed above, as well as the sub-national policies. These results are reported as the 2012 RFF Forecast under the Cap and Trade Implementation section in Table 1.

We estimate the comprehensive cap-and-trade program proposed for the United States in 2009–2010 would have yielded emissions reductions in the domestic economy of 13.6% in 2020, compared to 2005 levels. Total emissions reductions accounting for offsets would total 32.4%. This estimate is slightly smaller than that anticipated in the EIA analysis of Waxman-Markey because we use RFF's electricity model and because of other changes in the economy that are accounted for. As with the EIA analysis of Waxman–Markey, a large portion of these reductions would have contributed to the allowance bank and would have reappeared in later years as emissions. Accounting for the ephemeral nature of these reductions, the cap-and-trade program would have achieved domestic emissions reductions of only 7.9% in 2020. In contrast, the anticipated emissions reductions under the Clean Air Act regime total 16.3%, exceeding those reductions within the United States that would have occurred under cap and trade. Table 1 displays the reductions achieved by these different policies, as well as the portion of reductions achieved by domestic reductions, domestic offsets, international offsets, and non-market offsets.[7] Below, we examine several sensitivity cases with different assumptions about reductions under a national cap, which are also included in Table 1.

[7] The Waxman-Markey proposal included 3% of additional reductions that would be achieved by the purchase of international offsets outside of the cap-and-trade system, which we denote as "non-market offsets."

It is especially noteworthy that the comparison ignores the contribution of emissions reductions, both domestically and abroad, through the purchase of offsets. Global emissions may have been lower with the passage of Waxman–Markey, but surprisingly, in the sectors of the domestic economy covered by the emissions cap, they likely would have been more than will occur under the Clean Air Act regime.

Table 1. Emissions reductions below 2005 levels (%) in 2020

Scenario	Domestic reductions	Domestic offsets	International offsets	Non-market offsets	Total reductions
Clean Air Act regime					
RFF forecast	16.3	0.0	0.0	0.0	16.3
Cap and trade implementation:					
2009 EIA forecast	10.2	4.7	15.8	3.0	33.6
Adjusted for banking	*5.6*	*2.6*	*8.8*	*3.0*	*20.0*
2012 RFF forecast (Secular trends)	13.6	4.2	11.6	3.0	32.4
Adjusted for banking	*7.9*	*2.4*	*6.7*	*3.0*	*20.0*
2012 RFF w/ fuel Economy standards	15.9	3.8	10.4	3.0	33.0
Adjusted for banking	*9.0*	*2.1*	*5.9*	*3.0*	*20.0*
2012 RFF w/ risk-adjusted (10%) discount rate	12.3	3.7	7.9	3.0	26.9
Adjusted for banking	*8.7*	*2.6*	*5.6*	*3.0*	*20.0*
2012 RFF w/ bank ending in 2035	10.9	3.1	3.0	3.0	20.0
Adjusted for banking	10.9	3.1	3.0	3.0	20.0

Domestic Offsets

Our central estimate of reductions under Waxman–Markey includes 282 million tonnes of emissions offsets purchased domestically, or 4.2% of 2005 emissions. Although these reductions would not have occurred within the covered sectors of the policy, they would have occurred within the domestic economy. Consequently, one may choose to include these offsets when estimating the amount of emissions reductions that would have been achieved domestically. If we include domestic offsets, we find that Waxman–Markey would have achieved domestic reductions in 2020 of 17.8% compared to 2005 levels. Again, these emissions reductions can be adjusted to account for reductions that are banked and will reappear as emissions in a later year. If this is done, we find that Waxman–Markey yields domestic reductions of 10.3%, relative to 2005 levels.

It is important to note that the 2005 levels, to which these reductions are compared, count only the emissions from the covered sectors and do not include the sectors in which the offsets would occur. Thus the comparison does not have sectoral equivalence, but that is precisely the intent of offsets, to allow for reductions outside of the covered sectors.

Fuel Economy Standards

In our central estimate of Waxman–Markey, we assume that the fuel economy standards proposed in 2011, and set to take effect in 2017, would not have occurred if Waxman–Markey had been enacted. However, it is possible these increased standards would have been finalised even with the passage of Waxman-Markey. In this case, the standards would provide additional emissions reductions within the transportation sector, although some of these reductions would be crowded out by increased emissions in other sectors and the purchase of fewer emissions offsets. We estimate the inclusion of these fuel economy standards would result in domestic emissions reductions in 2020 of 15.9% compared to 2005 levels. If these emissions reductions are adjusted to account for reductions that are banked and will appear in later years, we find domestic reductions in 2020 of 9.0%, relative to 2005 levels.

Banking Sensitivities

The Waxman-Markey cap-and-trade program allows for the banking of emissions allowances to be used in later years. However, future session of Congress or regulators could pass additional legislation or rules to weaken or completely abolish the cap-and-trade program, which would have a considerable effect on the value of banked allowances. The evolution of regulations for sulphur dioxide and nitrogen oxides culminating in the proposed Cross State Air Pollution Rule is a precedent for how subsequent regulation can affect the value of banked allowances (Fraas & Richardson, 2012). Consequently one would expect firms to anticipate the risk of regulatory change in their banking behaviour in future market-based programmes.

In our central estimate of Waxman-Markey, we use a discount rate of 7.4% to calculate the return on holding allowances; this is the same rate used by EIA in their 2009 analysis of the Waxman-Markey legislation. However, with the risk that banked allowances could become less valuable in the future, investors would likely require a greater annual return in order to hold the allowances (Salant & Henderson, 1978). To represent this risk premium, we also modelled Waxman-Markey with a 10% risk-adjusted discount rate for allowances, which yields a lower allowance price in the early years of the program and consequently fewer emissions reductions and a smaller purchase of offsets. This 10% discount rate results in domestic emissions reductions in 2020 of 12.3% compared to 2005 levels. If these reductions are adjusted to account for allowances that are banked in 2020 and will reappear as emissions in later years, we find Waxman-Markey, with a 10% discount rate for banking, yields domestic reductions in 2020 of 8.7%, relative to 2005 levels.

Another possible result of the risk of banking allowances is that investors may choose to hold allowances for a shorter period of time. In our central estimate of Waxman-Markey we assume banking persists throughout the life of the program until 2050. However, one might expect that investors will hold a smaller portfolio of allowances with a shorter planning horizon in mind due to the risk of future legislation or rules changing their value. We model this outcome using a 15-year planning horizon so that looking forward from 2020 the bank of allowances would be exhausted in 2035. This results in a lower allowance price through 2035 (and a higher price after 2035), which yields fewer emissions reductions and a smaller purchase of offsets in the early years of the programme. With this banking outcome, we estimate domestic emissions reductions in 2020 of 10.9% compared to 2005 levels. Coincidentally, we find no incremental contribution to the bank occurs in 2020 in this sensitivity case; allowances are banked in earlier years, and these banked allowances are used in later years, but in 2020 the number of allowances allocated equals the number surrendered for compliance with the policy. Thus no adjustment is needed to account for allowances banked in 2020 in this case.

Conclusion

In sum, we estimate that the United States is on track to achieve emissions reductions of 16.3% by 2020 relative to 2005 levels.

Important uncertainties are associated with the current path of US emissions reduction efforts that would have been lessened with the passage of comprehensive climate legislation. To forecast what will happen next in the United States, one must consider two key touchstones. One is the California program. If the first planned auction happens in November 2012, then the programme will almost certainly begin in January 2013, with big implications for the nation. It is likely to face various legal challenges, but for the most part it is expected to survive intact.

Second is the finalisation of the new source performance standard for electric steam boilers, which is expected early next year, and the EPA's posture in the development of existing source standards. The existing source standards may be more stringent than the technical documents have identified. That is because it is a state-driven process in which states develop implementation plans for the EPA's approval. Many states view this as an opportunity to strengthen and broaden the regional trading programs. The uncertainty about the issuance of these standards is a concern, but the legal requirements of the Clean Air Act are clear. A new administration could "slow walk" the regulatory development and delay it for years, but is unlikely to stop it altogether.

Another possibility is the reversal of the Clean Air Act, or at least the removal of authority for enforcing the GHG rules. This seems far-fetched because it would require an unbalanced legislature and administration. However, a less-extreme outcome could be for a new legislature and administration to defund the activities of the EPA in developing these rules. This would delay the rules indefinitely.

If the eventualities play out as they currently are aligned, we find that not only is President Obama's pledge in Copenhagen within reach, but emissions reductions within the domestic economy could actually be greater than would have occurred under comprehensive climate policy with cap and trade, as proposed by Waxman–Markey. The reason is that a large portion of the emissions reductions that were expected under cap and trade would have been offsets, whereas many of the factors driving emissions reductions under the current Clean Air Act regime would have been effectively or explicitly pre-empted under cap and trade.

One might conjecture that advantageous changes in the economy that lead to emissions reductions under the Clean Air Act could have gone the other way, that is, they could have been disadvantageous changes that led to greater use of fossil fuel and greater GHG emissions. The inability of an emissions cap to capture emissions reductions from secular changes has the corollary that it prevents emissions increases resulting from economic growth or the greater use of fossil fuels. However, the course of history is not equally likely in this regard. Throughout developed economies the long-run trend is toward lower emissions intensity of economic activity. Since 1990 the GHG intensity of economic activity in the United States has fallen by 33%, along with the intensity of most other forms of pollution, even as overall economic activity and emissions have increased. Harrington et al. (2000) document that *ex-post* assessments of the cost of regulations tend to be less than anticipated, especially for incentive-based policies like cap and trade, often due to mistakes in forecasting the baseline against which necessary emissions reductions would be measured. In other words, an emissions cap set in statute is more likely to end up less stringent than more stringent compared to what was initially anticipated. Incentive-based approaches would have a better environmental performance if they accommodate this fact by including rules to adjust their stringency in response to changing costs (Burtraw et al., 2010). Regulatory approaches do so inherently.

In the short run, to the surprise of many, the United States appears able to meet its mitigation obligations under the Copenhagen agreement. In contrast, however, the United States seems off-course with respect to meeting its financing obligations under the agreement. Cap and trade provided a vehicle and incentive to direct private capital toward investment in developing countries through the purchase of emissions offsets. It also provided a source of funds for the federal government that could have supported the public fund contribution to the financing obligation. In contrast, under a regulatory approach, these avenues are not available. In particular, international offsets appear to be unavailable as a legal compliance instrument by which to meet GHG reduction standards under the Clean Air Act.

The sub-national cap-and-trade policies allow for international offsets, but their supply in those programmes is limited. Private financing of energy development internationally is already extensive but generally could not be seen as an additional contribution to the outcome of US climate policy. In the absence of cap-and-trade policies in general, and an active offset market in particular, the United States is likely to have difficulty meeting its commitment to finance international investments.

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ECP Steering Group

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The ECP is a joint initiative of the Climate Policy Research Programme (Indigo) of the Swedish Foundation for Strategic Environmental Research (Mistra) in Stockholm and the Centre for European Policy Studies (CEPS) in Brussels. Established in 2005, the ECP aims to facilitate interaction within the policy research community, mainly but not exclusively in Europe. Its working methods consist of bringing together a select number of policy-makers, negotiators and experts to vigorously debate key topics in the area of international climate change policy and to widely disseminate its conclusions. The ECP actively seeks dialogue with policy-makers and other stakeholders while being dedicated to academic excellence, unqualified independence and policy relevance. The ECP is governed by a steering group, drawn from government and academia. For further information, see http://new.ceps.eu/content/european-climate-platform.

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The Mistra Indigo programme is aimed at developing tools and instruments that in an internationally coordinated, cost-effective way can support climate efforts from the 'bottom up', i.e. independent of international frameworks. Mistra Indigo is financed by the Swedish Foundation for Strategic Environmental Research (Mistra). http://indigo.ivl.se

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