policy brief

NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS
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An Analysis of the Carbon Limits and Energy for America's Renewal (CLEAR) Act and Comparison to Waxman-Markey

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Key Points

The CLEAR Act, introduced by Senators Maria Cantwell and Susan Collins, is an upstream CO_2 cap-and-trade program with an allowance price collar and a 100% auction. The Nicholas Institute for Environmental Policy Solutions at Duke University analyzed the CLEAR Act and compared the results to the Energy Information Administration's (EIA's) analysis of the Waxman-Markey bill, specifically the 5% discount rate scenario.

CLEAR Results	Waxman-Markey Results*
• Allowance prices are $21 per ton CO_2 in 2012 and grow 5.5% per year to $55 in 2030.	• Allowance prices are $23 per ton CO_2 in 2012 and grow 5% per year to $55 in 2030.
• Allowance prices are equal to the CLEAR price ceiling in all years modeled (2012–2030); in early years, the incentive to bank allowances drives allowance prices up to the ceiling, and in later years, the price ceiling becomes an overriding constraint that prevents the cap from being binding.	• Waxman-Markey does not have a price ceiling, but does have a strategic reserve that releases extra allowances if prices are much higher than expected; the strategic reserve was not triggered in EIA's modeling. The Waxman-Markey cap is binding.
• CLEAR covers only CO_2.	• Waxman-Markey includes all GHGs.
• Direct CO_2 emissions in 2030 are 14% below 2005 levels.	• Direct CO_2 emissions in 2030 are 18% below 2005 levels.
• Cumulative GHG emissions (2012–2030) are 132.8 $GtCO_2e$.	• Cumulative GHG emissions (2012–2030) are 131.1 $GtCO_2e$.
• Offset-like activities (OLAs), representing reductions from sources outside the cap, are separate from the CLEAR cap-and-trade system and are funded via safety valve revenue and potentially via the Clean Energy Reinvestment Trust Fund (CERT).	• Offsets, and their contribution toward net GHG reductions, are an intrinsic part of the Waxman-Markey cap-and-trade system.
• Cumulative net GHG emissions (2012–2030) after OLAs are around 129 $GtCO_2e$. With additional CERT funding, net GHG emissions are 123.4 $GtCO_2e$.	• Cumulative net GHG emissions (2012–2030) after offsets are 106.1 $GtCO_2e$.
• Net GHG emissions after OLAs in 2030 are 14% to 17% below 2005 GHG levels. With CERT funding, the reduction is 18%.	• Net GHG emissions after offsets in 2030 are 34% below 2005 levels.

* Based on EIA's Waxman-Markey analysis with a 5% discount rate found at http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html.

Through additional review of this policy brief, it has come to our attention that the CBO rules regarding budget neutrality may be interpreted differently than in the original version of this brief. We have revised the brief accordingly.

1 The author would like to thank Tim Profeta and Brian Murray of the Nicholas Institute, John Larsen of World Resources Institute, and Senate and EIA staff for their exceptionally helpful comments and suggestions.

Summary for Policymakers

The most direct measure of the cost of a cap-and-trade bill is the allowance price. CLEAR allowance prices are estimated at $21 in 2012 and projected to grow 5.5% per year to $55 in 2030. Waxman-Markey allowance prices are $23 in 2012 and projected to grow 5% per year to $55 in 2030.

The ability to bank allowances in CLEAR drives the allowance price all the way up to the legislated price ceiling at the outset of the program. Allowances are banked in the early years while reductions exceed what is required by the cap. In later years, these banked allowances are used, but they are insufficient to meet compliance. After 2023, the price ceiling holds prices below what is needed to meet the cap, so the government then issues extra allowances at the price ceiling and thus makes the cap aspirational rather than binding during this period.

CLEAR cumulative CO_2 emissions are higher than Waxman-Markey over the modeled period from 2012 to 2030. Cumulative CLEAR CO_2 emissions are 102.5 $GtCO_2$, whereas the CLEAR cap would result in 100.2 $GtCO_2$ had the price ceiling not been constraining. Waxman-Markey cumulative CO_2 emissions during the same period are 101.4 $GtCO_2$.

CLEAR CO_2 and GHG emissions are higher than Waxman-Markey in 2030. CLEAR CO_2 emissions are 14% below 2005 levels, and Waxman-Markey emissions are 18% below 2005 levels. CLEAR greenhouse gas (GHG) emissions in 2030 are 5% below 2005 GHG levels. Waxman-Markey GHG emissions in 2030 are 8% below 2005 GHG levels.

CLEAR does not allow offsets to be used for compliance with the cap, but does allow for the purchase of emission reductions outside the cap (offset-like activities, or OLAs) through safety valve revenue.[2] These purchased uncapped reductions do help the CLEAR Act achieve greater net GHG reductions than the capped sectors alone can provide starting in 2024, but they fall well short of the emission reductions achieved by offsets under Waxman-Markey.

The electric power sector is the source for most CO_2 reductions in CLEAR and Waxman-Markey. The majority of reductions in the electricity sector come from a shift from coal and natural gas generation to renewable and nuclear generation. The biggest difference in the power sector results between CLEAR and Waxman-Markey is the relatively high penetration of CCS capacity in Waxman-Markey compared to CLEAR, which is a result of higher allowance prices and direct CCS incentives under Waxman-Markey. This additional CCS capacity in Waxman-Markey not only leads to the capture and storage of hundreds of millions of tons of carbon, it also drives higher-emitting conventional coal plants that stay in the system under CLEAR into retirement. If CLEAR were coupled with additional technology policies, such as direct incentives for carbon capture and storage, energy efficiency, and renewables, the resulting emissions would likely be lower.

The analysis does not cover the years 2030 to 2050 due to limitations in the model used for the study. The CLEAR cap becomes increasingly stringent beyond 2030, and if no price ceiling were in place, the cap would lead to significant reductions, and the resulting price signal after 2030 may be sufficient to drive considerable technological change. But because of the price ceiling, even if we were able to model beyond 2030, the emissions cap would become increasingly less relevant. Barring a breakthrough in technology, we would expect results beyond 2030 to be largely a continuation of trends in the 2020s that widen the gap between intended and actual emission reductions.

Introduction

This policy brief outlines the Nicholas Institute's recent analysis of the Carbon Limits and Energy for America's Renewal (CLEAR) Act, introduced by Senators Maria Cantwell (D-WA) and Susan Collins (R-ME) on December 9, 2009. The CLEAR Act is a straightforward upstream cap-and-trade program with an allowance price collar and a 100% auction. The cap on fossil carbon—7% below 2005 levels in 2020—is relatively modest in the early years. The cap becomes increasingly stringent over time and is 31% below 2005 levels in 2030 and 82% below in 2050. The price floor starts at $7 per ton[3] of CO_2 and rises at 6.5% per year, and the ceiling starts at $21 and rises at 5.5% per year.

2 CLEAR creates a Clean Energy Reinvestment Trust (CERT) fund, which is given 25% of allowance auction revenue. One of the many functions of the CERT fund is to purchase additional OLAs. Congressional Budget Office (CBO) rules regarding budget neutrality suggest that, at best, Congress must appropriate funds for the CERT annually from the general treasury, and any dollar spent from the CERT would be offset by a reduction in spending elsewhere in the budget. The CBO rules would likely effectively eliminate the CERT fund altogether. Therefore, our default scenarios do not reflect any provisions based on CERT funding. We did include one sensitivity scenario for additional OLA purchases with 10% of CERT funding (assuming CERT is funded at 25% of auction revenue).

3 The term *ton* (abbreviated t) as used in this brief refers to the metric ton (1 ton [or *tonne*] = 1,000 kg = 2,204.62 lbs). Hence, the abbreviations *Mt* and *Gt* refer to the megaton (1 million metric tons) and the gigaton (1 billion metric tons), respectively.

Additional allowances beyond the cap can be sold at the ceiling, or "safety valve," price, and the revenue generated from the sale of these allowances is designated to purchase offset-like activities (OLAs) intended to reduce net GHG emissions.

Seventy-five percent of auction revenue goes back to consumers, and the remaining 25% is dedicated to a Clean Energy Reinvestment Trust (CERT) fund. However, Congressional Budget Office (CBO) rules would require that 25% of all allowance revenue be set aside to make the bill budget-neutral. Because 75% of revenue is designated to be given to consumers, the entire amount intended for the CERT fund would instead be required to go to the general budget. Congress could opt to appropriate money for the CERT fund each year, but only at the expense of other programs in the federal budget. The full cost of the CERT fund as outlined in the CLEAR Act would be about $30 billion each year starting in 2012 and would grow to about $60 billion per year in 2030. We do not model any of the CERT fund provisions in our default scenarios, but we do model one sensitivity scenario with additional OLA purchases equal to 10% of a fully funded CERT fund, which amounts to $3 billion annually starting in 2012 and growing to $6 billion annually in 2030. OLAs do not provide any cost relief by satisfying complance obligations, but they do contribute to additional GHG reductions. CLEAR also has an aspirational goal for economy-wide GHG emissions of 20% below 2005 in 2020 and 42% below 2005 in 2030, but this goal is nonbinding and does not affect the cap on fossil carbon. One of the purposes of the CERT fund is to generate additional emission reductions in order to achieve the GHG reduction goals, although the bill lacks a mechanism to ensure that the goals would be achieved, and the likelihood of full appropriations for the CERT fund is low. For the remainder of the brief, we will focus primarily on the binding fossil cap-and-trade system rather than the nonbinding GHG goals, though we do estimate the supplemental reductions achievable with OLA purchases.

We used the Nicholas Institute's version of the National Energy Modeling System (NI-NEMS) to evaluate CLEAR's core cap-and-trade provisions. We focused on the core provisions of CLEAR in an effort to expedite the analysis. As such, this analysis should be considered preliminary to gain initial insights to the differences in CLEAR and Waxman-Markey. Specifically, we did not model the distributional impact of allocating 75% of auction revenues back to consumers as called for under CLEAR. Because this distribution is on a lump-sum basis rather than through reducing electricity rates or changing other prices, the impact on allowance prices, emission outcomes, and other results reported in this paper would be relatively small had we modeled the distribution to consumers. Also, in our sensitivity scenario, which includes CERT funding, we only modeled funding for OLAs; we did not model other aspects of CERT funding, such as energy efficiency and renewable energy. The bill does not specify funding percentages for the many programs outlined in CERT, and as suggested above, is it unlikely that the CERT will be fully funded.

The NI-NEMS model stops in 2030, so, as with EIA's analyses of other cap-and-trade bills, we were unable to model the bill's full period out to 2050, but instead focus on the initial 2012–2030 period for insights. Because of the way we handle banking, and the role that the price cap plays, the lack of explicit post-2030 modeling does not substantially affect our projections out to 2030. Because the price ceiling acts as a constraint in our modeling through 2030, we believe that, barring a technological breakthrough, the trends in the results in the 2020s would largely continue through 2050.

We combined our NI-NEMS modeling with a separate spreadsheet analysis for CLEAR's OLA purchases. We based our analysis of domestic and international OLA purchases on marginal abatement cost curves (MAC) derived from EPA offset data.[4] Because the CLEAR Act has a cap only on CO_2, all domestic projects that can reduce non-CO_2 GHG emissions would potentially be eligible as OLAs. Therefore, the MAC curves we used for domestic OLAs include some opportunities for reduction that would be included under the Waxman-Markey cap and would not be available as offsets under Waxman-Markey. We assumed that all potential international GHG reductions are included in the international GHG curves. Because other countries have or will have climate policies that allow for international offset purchases, we accounted for the international demand for offsets in estimating the price of international OLAs.[5]

Our CLEAR scenarios are compared to a no-policy reference case based on the stimulus version of NEMS09 distributed by the Energy Information Administration (EIA). We also compare CLEAR results with EIA's analysis of

4 EPA domestic offsets data found at http://www.epa.gov/climatechange/economics/downloads/HR2454_SupplementalAnalysis_DataAnnex.zip. EPA international offset data are from a file sent to the Nicholas Institute by Allen Fawcett of EPA titled "Offset MACs for CEA v1 5."

5 Assumptions about international demand are taken from an EPA spreadsheet titled "Intl derived abatement demand (G8 Assumptions).xls" that can be found at the web location in the previous footnote. This assumption is based on the G8 agreement to reduce emissions 80% or more by 2050 as its share of a global goal to lower emissions 50% by 2050.

H.R. 2454, commonly known as the Waxman-Markey bill.[6] Both analyses use a common reference case, and the only differences in the inputs for the policy cases are related to the provisions in each climate bill.

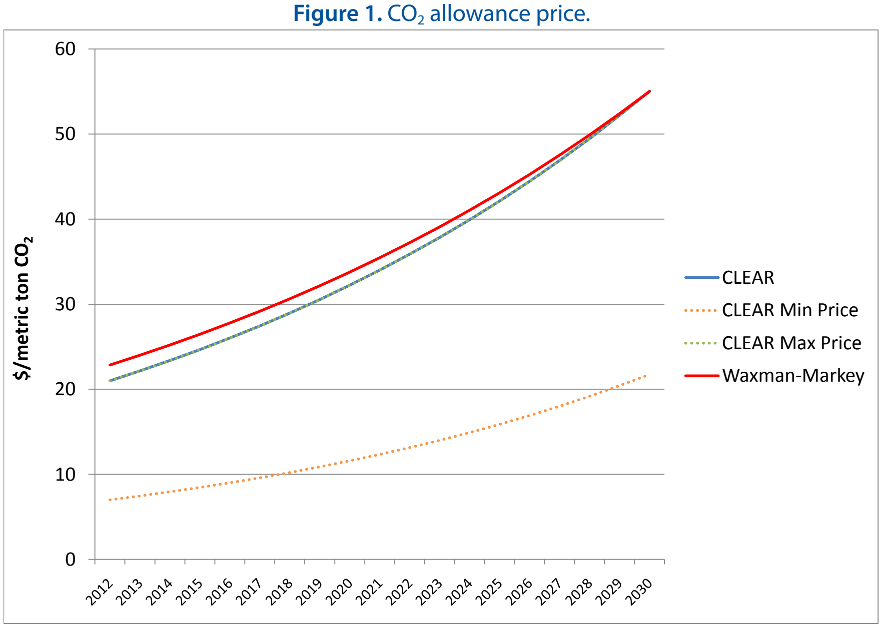
Although the CLEAR Act allows for limited banking over a 10-year period (and no borrowing[7]), as long as the banked allowance balance never exceeds annual compliance, an allowance bank can be rolled forward indefinitely by using any expiring allowances and replacing them with current allowances. Therefore, we assumed that banking is, in effect, unlimited since the bank balance never exceeds annual compliance in our analysis.

CO_2 Allowance Prices

The results of our modeling suggest that CLEAR allowance prices follow the maximum CO_2 price path designated in CLEAR, which is higher than EIA's Waxman-Markey allowance price estimates in the early years and lower in the later years. As discussed below, CLEAR direct emissions are slightly lower than Waxman-Markey emissions in the early ears and higher in the later years, consistent with relative allowance prices.

At the outset of the program in 2012, the ability to bank encourages companies to purchase more allowances than necessary to comply with the cap in the early years of the program in order to bank them for later use. Companies will purchase additional allowances up to the point that allowance prices hit the price ceiling. Because allowance prices are at the price ceiling from 2012 on, the maximum number of allowances is banked. Furthermore, because the price ceiling rises at a rate consistent with a long-term discount rate, companies holding banked allowances will be indifferent about when they use them. A company can opt to sell banked allowances and invest the proceeds in another project that would be as good as the return expected from holding allowances to use later. Therefore, the timing of when banked allowances are used is somewhat arbitrary.

Figure 1. CO_2 allowance price.



Note: the CLEAR allowance price line in blue is on top of the green dotted CLEAR max price line.

CO_2 Compliance

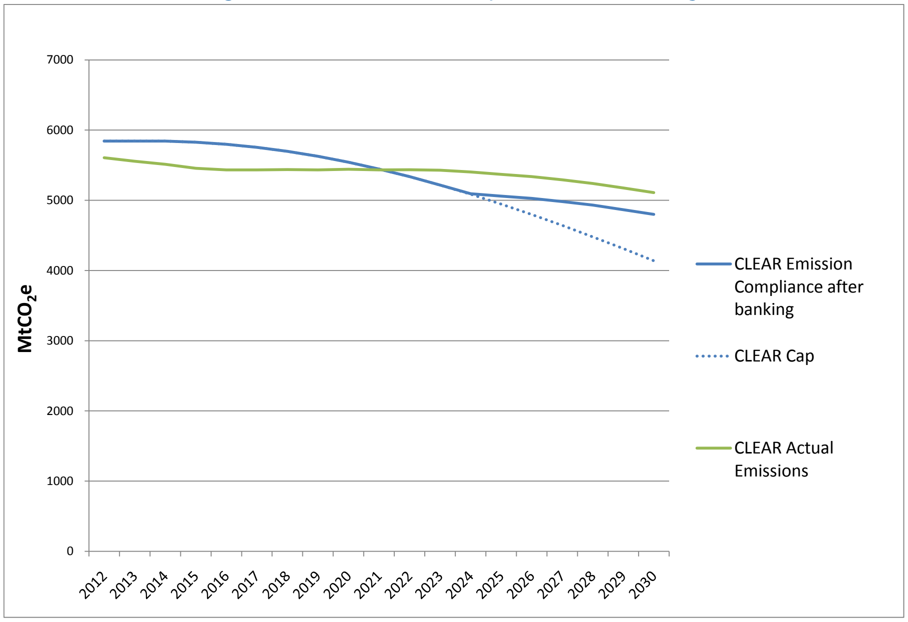
The maximum CLEAR price path is sufficient to meet the cap with banking until 2023, after which the price cap is an overriding constraint that prevents CLEAR from reaching the cap target. Actual CO_2 emissions do not follow the path of the cap because additional reductions are made and banked in the years prior to 2021. After 2021, actual emissions exceed the cap, and we assume the bank is drawn down so that the cap is met through 2023, after which we assume that the remaining bank is divided evenly among the last seven years until exhausted in 2030. After

6 We compared CLEAR results to EIA's 5% discount rate scenario for Waxman-Markey. EIA's Waxman-Markey analysis can be found at http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html.

7 CLEAR allows for a two-year rolling compliance period, which is equivalent to a two-year, interest-free borrowing period.

2023, banked allowances are insufficient to meet the cap requirement, and additional allowances are purchased for emissions exceeding the cap at CLEAR's maximum price.

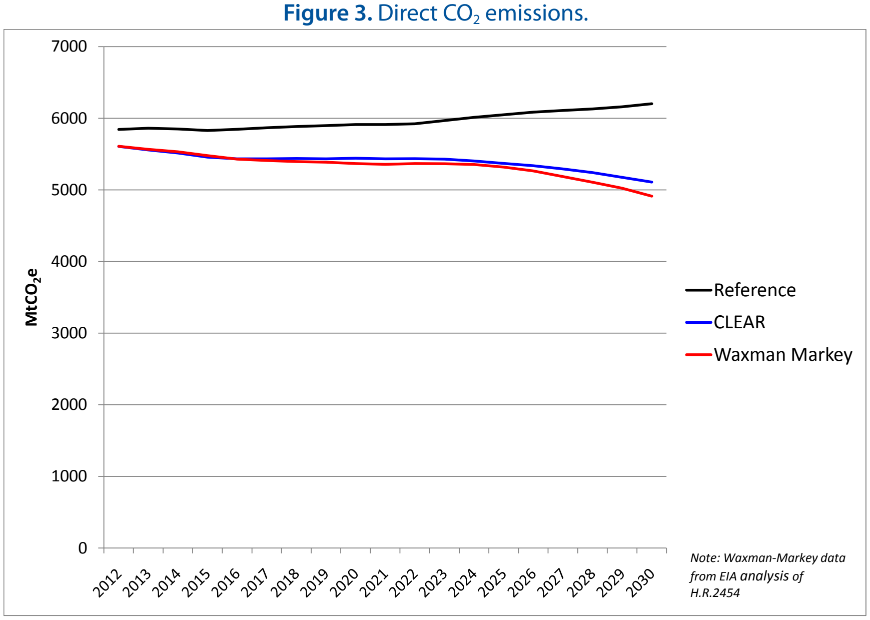
Figure 2. CO_2 emissions compliance after banking.



Direct CO_2 Emissions

Direct CO_2 emissions[8] resulting from the CLEAR Act are slightly below the path of Waxman-Markey emissions until 2018. After 2018, CLEAR emissions continue to decline, but at a slower rate than Waxman-Markey emissions.

Figure 3. Direct CO_2 emissions.



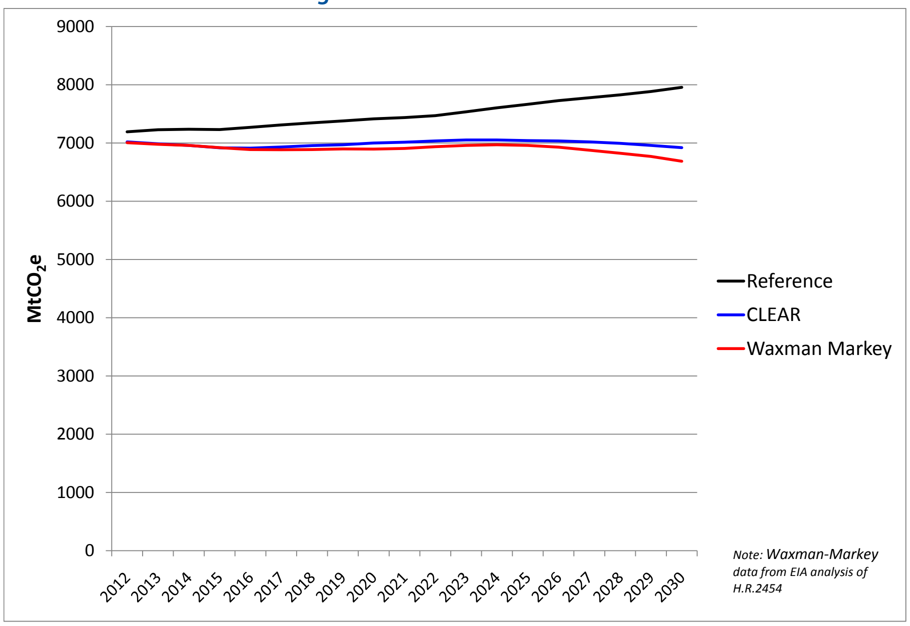
8 Direct CO_2 emissions include all sources of CO_2 emitted. In the case of CLEAR, direct CO_2 emissions are equivalent to the covered sectors under the fossil cap. Because the Waxman-Markey cap includes other GHG emissions, direct CO_2 emissions are not equivalent to the cap in Waxman-Markey. Rather than report covered or uncovered emissions, we have opted to simply report total CO_2 or GHG emissions that result from the two bills. When we refer to net GHG emissions, we are taking into account the reduction made possible by OLAs or offsets.

Differences in direct CO_2 emissions between CLEAR and Waxman-Markey stem primarily from specific provisions in Waxman-Markey that encourage carbon capture and storage (CCS). This CCS capacity in Waxman-Markey also leads to less conventional coal capacity (15 GW) than CLEAR. If CLEAR contained specific technology provisions comparable to those in Waxman-Markey, the resulting emissions from CLEAR would likely be closer to Waxman-Markey emissions.

Greenhouse Gas (GHG) Emissions

Figure 4 shows direct total GHG emissions (CO_2 and other) for CLEAR and Waxman-Markey, which follows a similar pathway as CO_2 emissions shown above. We report total GHG emissions and therefore capture some uncapped emissions in both CLEAR and Waxman-Markey by using this measure.

Figure 4. Direct GHG emissions.



Net GHG Emissions after OLAs and Offsets

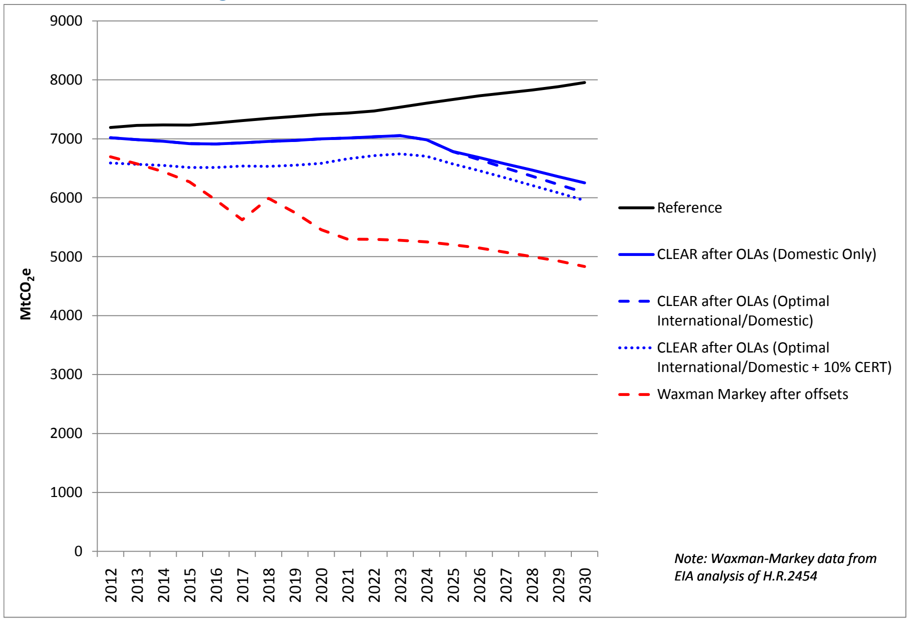
The CLEAR Act allows for the purchase of OLAs through safety valve revenue. If Congress appropriates money for the CERT fund, additional OLAs can be purchased via the CERT. We examined two OLA scenarios funded by safety valve revenue: domestic-only OLAs (i.e., only those reductions produced in the United States) and an optimal mix of domestic and international OLAs. We also evaluated a sensitivity scenario, which adds to the safety valve revenue funding equal to 10% of the maximum value of the CERT fund with an optimal mix of domestic and international OLAs.

We estimate OLA costs based on offset cost curves derived from the EPA analyses of Waxman-Markey and other climate bills. Because the federal government would purchase OLAs, as opposed to individual companies purchasing offsets, we implicitly assume that the government is as efficient in acquiring OLAs as the private sector is in securing offsets. Whether the government purchases OLAs or the private sector purchases offsets, administrative costs would be incurred. Some observers may believe that the federal government would incur higher administrative costs than the private sector in these transactions. These observers may believe that we are overstating the efficacy of our OLA-funding scenarios in generating the estimated quantities of OLAs and in contributing toward reducing emissions. CBO methodology would also require that 25% of the safety valve revenue be set aside for budget neutrality; therefore, we modeled OLA funding at 75% of the generated safety valve revenue.

Figure 5 shows net GHG emissions for the CLEAR OLA scenarios as well as Waxman-Markey net GHG emissions after offsets. The optimal mix of international and domestic OLAs results in slightly more OLAs than the domestic-only scenario due to the lower cost of international OLAs. If CERT funding is available to purchase OLAs, the net

GHG result improves modestly, particularly in the years preceding the start of safety valve revenue. Nevertheless, the net GHG result for Waxman-Markey is substantially lower emissions than any of the OLA scenarios modeled for CLEAR.

Figure 5. Net GHG emissions after OLAs and offsets.



Emissions Below 2005 Levels

The CLEAR Act pegs progress in emission reductions relative to 2005 emissions. The following tables show the percent change from 2005 CO_2 and GHG emissions for scenarios discussed above.

Table 1. Percent change in CO_2 from 2005 CO_2 levels.

	2012	2016	2020	2025	2030
Reference	2%	–2%	–1%	1%	4%
CLEAR fossil cap	–2%	–3%	–7%	–17%	–31%
CLEAR	–6%	–9%	–9%	–10%	–14%
Waxman-Markey	–6%	–9%	–10%	–11%	–18%

Table 2. Percent change in GHG from 2005 GHG levels.

	2012	2016	2020	2025	2030
Reference	–2%	0%	2%	5%	9%
CLEAR	–4%	–5%	–4%	–4%	–5%
Waxman-Markey	–4%	–6%	–6%	–5%	–8%
CLEAR after OLAs (100% domestic)	–4%	–5%	–4%	–7%	–14%
CLEAR after OLAs (optimal international/domestic mix)	–4%	–5%	–4%	–7%	–17%
Sensitivity: CLEAR after OLAs (optimal international/domestic mix + 10% of CERT fund)	–10%	–11%	–10%	–10%	–18%
Waxman-Markey after offsets	–8%	–18%	–25%	–29%	–34%

In 2030, Waxman-Markey, before counting offsets, leads to GHG reductions from 2005 levels that are 1.6 times the GHG reduction of CLEAR without OLAs. Waxman-Markey, after counting offsets, results in reductions between 2 and 2.4 times greater than CLEAR with OLAs in 2030. Looking only at 2030 does not give the full picture, however, because OLAs begin in 2024 in our default scenarios. For example, Waxman-Markey, after counting offsets, results in net GHG reductions that are 4 times greater than CLEAR with OLAs in 2025. With CERT funding, the results for CLEAR improve somewhat, but are still far behind Waxman-Markey in net GHG reduction.

Cumulative CO_2 and GHG Emissions

Cumulative emissions are most important for addressing climate change, and the following table shows cumulative emissions for all of the scenarios mentioned above from 2012 through 2030. Cumulative direct CO_2 emissions from CLEAR exceed the CLEAR cap by 2.3 $GtCO_2$. Cumulative CLEAR GHG emissions are higher than cumulative Waxman-Markey GHG emissions by 1.1 $GtCO_2e$. Taking into account OLAs for CLEAR and offsets for Waxman-Markey, CLEAR net cumulative GHG emissions are around 23 $GtCO_2e$ higher than Waxman-Markey net GHG emissions. If CERT is funded, CLEAR net cumulative GHG emissions are 17 $GtCO_2e$ higher than Waxman-Markey net GHG emissions.

Table 3. Cumulative CO_2 emissions (2012–2030).

	$GtCO_2$
Reference	113.3
CLEAR fossil cap	100.2
CLEAR	102.5
Waxman-Markey	101.4

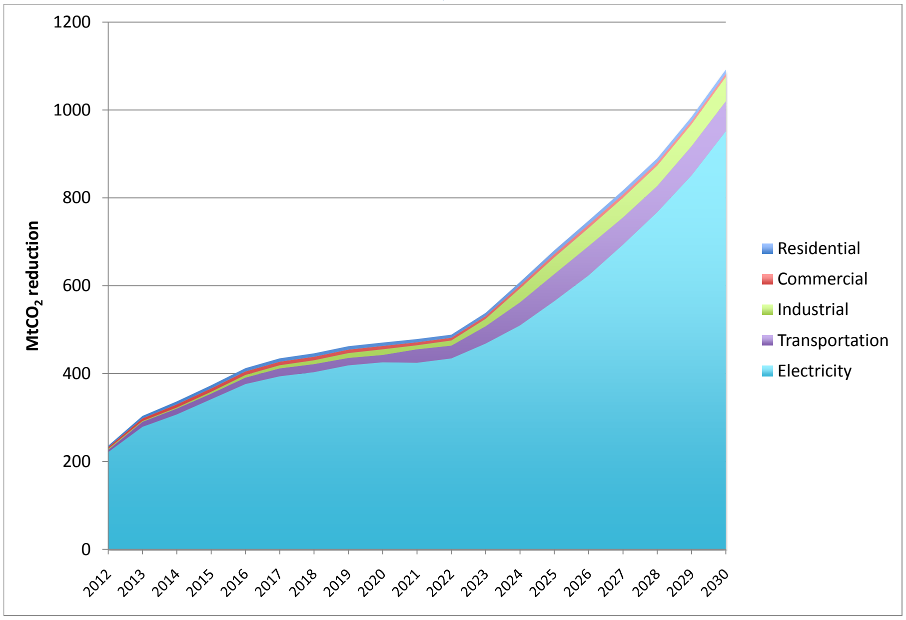
Table 4. Cumulative GHG emissions (2012–2030).

	$GtCO_2e$
Reference	142.5
CLEAR before OLAs	132.8
Waxman-Markey before offsets	131.1
CLEAR after OLAs (100% domestic)	129.8
CLEAR after OLAs (optimal international/domestic mix)	129.3
Sensitivity: CLEAR after OLAs (optimal international/domestic mix + 10% of CERT fund)	123.4
Waxman-Markey after offsets	106.1

CO_2 Emission Reductions by Sector

The electricity sector accounts for a significant portion of CO_2 reduction, though residential, commercial, industrial, and transportation sectors also contribute. This result is broadly consistent with the many economy-wide modeling studies of cap-and-trade policy in the United States over the last several years. On the margin, electric power reductions are the cheapest because of the opportunities for fuel switching and demand-side responses.

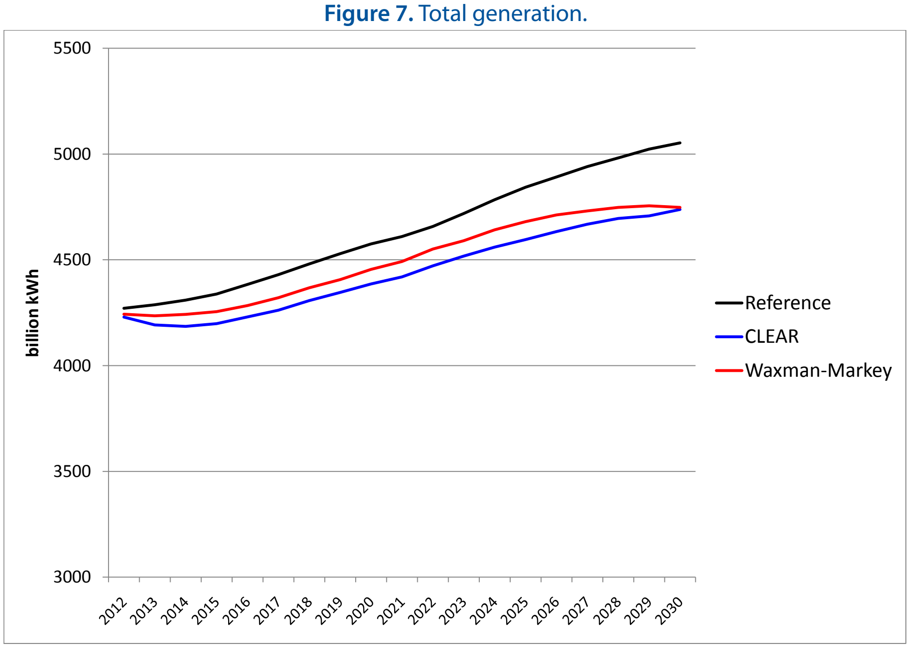
Figure 6. CO_2 reductions by sector relative to reference.



Electricity Sector Implications

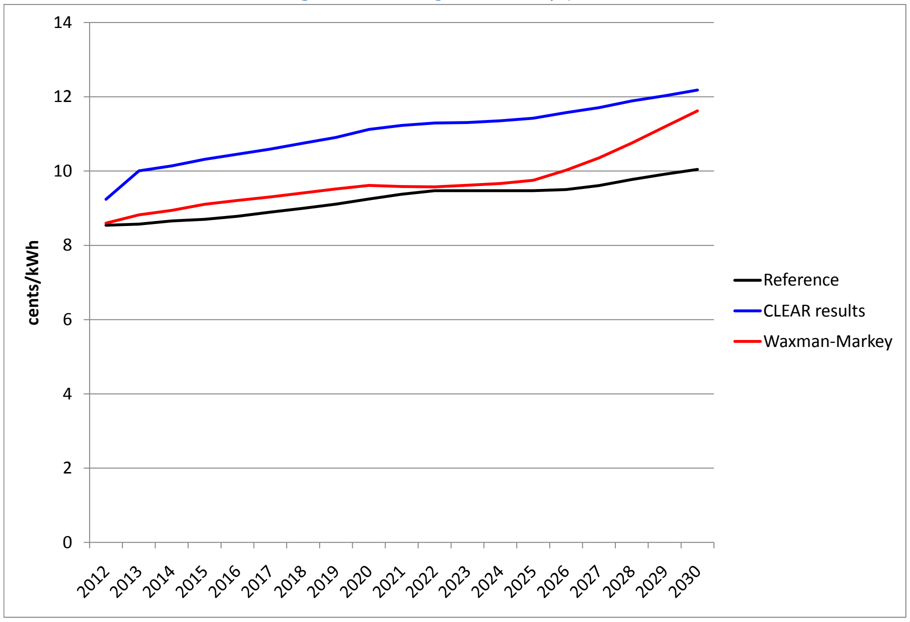
A small portion of the emissions reduction in the electricity sector can be attributed to demand-side responses such as energy efficiency investments, fuel switching, and reduced consumption. In 2030, generation is 6% lower compared to the reference case, and electricity sector emissions are 36% lower than in the reference case, suggesting that most of the reductions occur through changes in the electricity supply mix. In comparison, Waxman-Markey generation in 2030 is 7% lower than reference, and electricity emissions are 59% lower.

Figure 7. Total generation.



Electricity consumption declines under CLEAR and Waxman-Markey because of higher electricity prices. Electricity prices under CLEAR range from 8% higher than reference in 2012 to 21% higher in 2030. Waxman-Markey electricity prices are only 1% higher than reference in 2012 and 20% higher in 2030, diverging significantly from reference only after 2025. Waxman-Markey electricity prices are lower than CLEAR prices because in Waxman-Markey the value of free allowances that are given to utilities is passed on to consumers through lower electricity rates. In contrast, CLEAR redistributes 75% of the allowance auction revenue directly back to consumers.

Figure 8. Average electricity prices.



Because electricity consumption declines at the same time as prices increase, the increase in the per capita residential annual energy bill is less than the price increase—expenditures rise 6% in 2012 and 11% in 2030 (or an increase of $29 per year in 2012 and $60 per year in 2030). By comparison, the value of the allowance revenue that is given back directly to consumers under CLEAR is $290 per capita in 2012 and $456 per capita in 2030. The comparison is illustrative but not complete, as in addition to higher electricity costs, consumers will face higher costs for all goods and services in proportion to the fossil energy needed to produce, transport, and consume them. Depending on consumer choices, some consumers will pay more in higher costs than they receive in allowance revenue dividends, while other consumers will receive more in dividends than they pay in higher costs resulting from the CLEAR Act. These distributional effects are important to consider, but beyond the scope of this analysis.

As the price of CO_2 increases over time, coal generation declines more and more compared to the reference case. Because allowance prices begin in 2012 at the price ceiling in our modeling, rather than ramp up gradually, existing natural gas capacity is used more in the early years because of its lower emission rate than coal. As CO_2 prices continue to rise, natural gas generation drops below reference after 2022. The CO_2 price signal that drives down generation from fossil fuels encourages low-carbon generation; both nuclear and renewable generation increase compared to the reference case.

Figure 9. Change in generation relative to reference case.

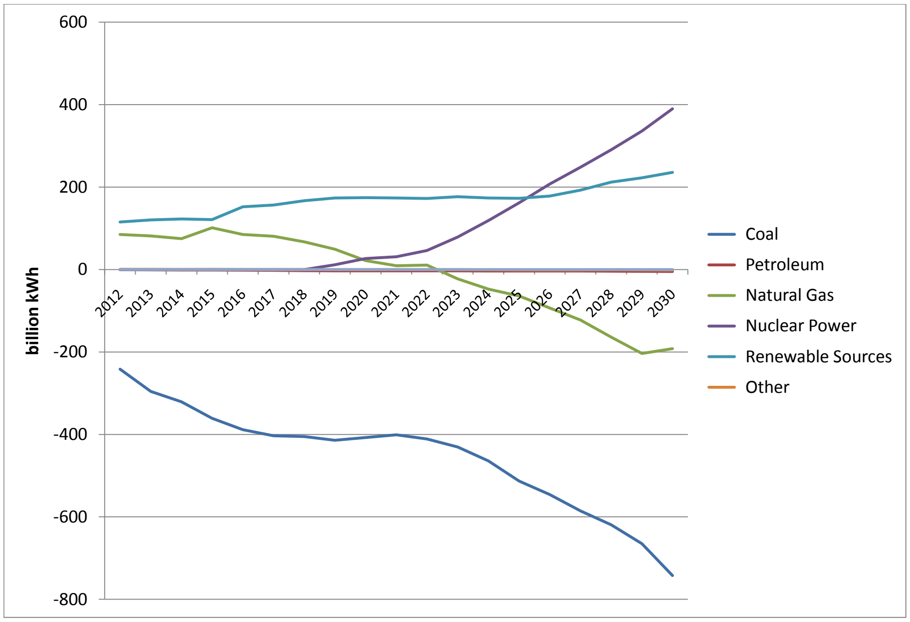


Figure 10. Electricity generation mix.