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Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009

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Energy Information Administration
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
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Preface and Contacts

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Executive Summary

This report responds to a request to the Energy Information Administration (EIA) from Chairman Henry Waxman and Chairman Edward Markey for an analysis of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA).[1] ACESA, as passed by the House of Representatives on June 26, 2009, is a complex bill that regulates emissions of greenhouse gases through market-based mechanisms, efficiency programs, and economic incentives.

The Title III cap-and-trade program for greenhouse gas (GHG) emissions, which covers roughly 84 percent of total U.S. GHG emissions by 2016, is in many respects the centerpiece of the bill and the primary driver of the results presented in this report. The program subjects covered emissions to a cap that declines steadily between 2012 and 2050. The cap requires a 17- percent reduction in covered emissions by 2020 and an 83-percent reduction by 2050, both relative to a 2005 baseline, with targets that decline steadily for intermediate years. Compliance is enforced through a requirement for entities subject to the cap to submit allowances, which are bankable, sufficient to cover their emissions. Allowance obligations may also be offset by reductions in domestic emissions of exempted sources, by international offsets, or by emission allowances from other countries with comparable laws limiting emissions. Maximum offsets from domestic and international sources are each capped separately at 1 billion metric tons (BMT) in each year of the program, with the proviso that up to 500 million metric tons (MMT) of the domestic offset cap may be shifted to the international offset cap if the Administrator of the Environmental Protection Agency (EPA) determines that a sufficient supply of domestic offsets is not available. In addition to its centerpiece cap-and-trade program, Title III also includes additional GHG standards, dedicated programs to limit hydrofluorocarbon (HFC) emissions and black carbon, and provisions governing markets in carbon-related derivatives.

Title I contains provisions related to a Federal combined efficiency and renewable electricity standard for electricity sellers, carbon capture and storage technology, performance standards for new coal-fueled power plants, research and development support for electric vehicles, support for deployment of a smart grid, and establishment of a Clean Energy Deployment Administration. Title II includes provisions related to building, lighting, appliance, and vehicle energy efficiency programs. Title IV includes provisions to preserve domestic competitiveness and support workers, provide assistance to consumers, and support domestic and international adaptation initiatives. Title V addresses the role of domestic agricultural and forestry-related offsets in the Title III cap-and-trade program.

This report considers the energy-related provisions in ACESA that can be analyzed using EIA's National Energy Modeling System (NEMS). The Reference Case used as the starting point for the analysis in this report is an updated version of the *Annual Energy Outlook 2009* (*AEO2009*) Reference Case issued in April 2009 that reflects the projected impacts of the American Recovery and Reinvestment Act as well as other significant energy legislation, including the Energy Improvement and Extension Act of 2008, the Energy Independence and Security Act of 2007, and

[1] The request letter from Chairman Waxman and Chairman Markey is provided in Appendix A.

the Energy Policy Act of 2005[2]. Cumulative GHG emissions covered by the Title III cap-and-trade program over the 2012 to 2030 period are estimated to be 113.4 BMT in CO_2-equivalent terms.

Key provisions of ACESA that are represented in the policy cases developed in this analysis include[3]:

- the GHG cap-and-trade program for gases other than HFCs, including provisions for the allocation of allowances to electricity and natural gas distribution utilities, low-income consumers, State efficiency programs, rebate programs, energy-intensive industries, and other specified purposes;
- the combined efficiency and renewable electricity standard for electricity sellers;
- the carbon capture and storage (CCS) demonstration and early deployment program;
- Federal building code updates for both residential and commercial buildings;
- Federal efficiency standards for lighting and other appliances;
- technology improvements driven by the Centers for Energy and Environmental Knowledge and Outreach; and
- the smart grid peak savings program.

While this analysis is as comprehensive as possible given its timing, it does not address all the provisions of ACESA. Provisions that are not represented include the Clean Energy Deployment Administration, the strategic allowance reserve, the separate cap-and-trade program for HFC emissions, the GHG performance standards for activities not subject to the cap-and-trade program, the distribution of allowances to coal merchant plants, new efficiency standards for transportation equipment, and the effects of increased investment in energy research and development. Of these provisions, the Clean Energy Deployment Administration may have the most significant potential to alter the reported results.

Like other EIA analyses of energy and environmental policy proposals, this report focuses on the impacts of those proposals on energy choices made by consumers in all sectors and the implications of those decisions for the economy. This focus is consistent with EIA's statutory mission and expertise. The study does not account for any possible health or environmental benefits that might be associated with curtailing GHG emissions.

Finally, while the emissions caps in the ACESA cap-and-trade program decline through the year 2050, the modeling horizon in this report runs only through 2030, the projection limit of NEMS. As in EIA analyses of earlier cap-and-trade proposals, the need to pursue higher-cost emissions reductions beyond 2030, driven by tighter caps and continued economic and population growth, can

[2] The development of the updated Reference Case is described in a recent EIA report, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook,* SR/OIAF/2009-03 (Washington, DC, April 2009), web site http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.

[3] Detailed descriptions of the assumptions used and changes made to the National Energy Modeling System to represent the provisions of the American Clean Energy and Security Act are provided in Appendix B.

be reflected in the modeling by assuming that a positive bank of allowances is held at the end of 2030 in all but one case.

Analysis Cases

EIA prepared a range of analysis cases for this report. The six main analysis cases discussed in this Executive Summary, while not exhaustive, focus on two key areas of uncertainty that impact the analysis results.

The role of offsets is a large area of uncertainty in any analysis of ACESA. The 2-BMT annual limit on total offsets in ACESA is equivalent to one-third of total energy-related GHG emissions in 2008 and represents nearly six times the projected growth in energy-related emissions through 2030 in the Reference Case used in this analysis.

While the ceiling on offset use is clear, their actual use is an open question. Beyond the usual uncertainties related to the technical, economic, and market supply of offsets, the future use of offsets for ACESA compliance also depends both on regulatory decisions that are yet to be made by the EPA, on the timing and scope of negotiations on international agreements or arrangements between the United States and countries where offset opportunities may exist, and on emissions reduction commitments made by other countries. Also, limits on offset use in ACESA apply individually to each covered entity, so that offset “capacity” that goes unused by one or more covered entities cannot be used by other covered entities. For some major entities covered by the cap-and-trade program, decisions regarding the use of offsets could potentially be affected by regulation at the State level. Given the many technical factors and implementation decisions involved, it is hardly surprising that analysts’ estimates of international offset use span an extremely wide range. One recent analysis doubts that even 150 MMT of international offsets will be used by 2020, while another posits that 1 BMT of international offsets will be used almost immediately from the start of the program in 2012, followed by a quick rise towards an expanded 1.5-BMT ceiling shortly thereafter.

The other major area of uncertainty in assessing the energy system and economic impacts of ACESA involves the timing, cost, and public acceptance of low- and no-carbon technologies. For the period prior to 2030, the availability and cost of low- and no-carbon baseload electricity technologies, such as nuclear power and fossil (coal and natural gas) with CCS, which can potentially displace a large amount of conventional coal-fired generation, is a key issue. However, technology availability over an extended horizon is a two-sided issue. Research and development breakthroughs over the next two decades could expand the set of reasonably priced and scalable low- and no-carbon energy technologies across all energy uses, including transportation, with opportunities for widespread deployment beyond 2030. The achievement of significant near-term progress towards such an outcome, however, could significantly reduce the size of the bank of allowances that covered entities and other market participants would want to carry forward to meet compliance requirements beyond 2030.

With these key uncertainties in mind, the main analysis cases discussed in this report are as follows:

- The **ACESA Basic Case** represents an environment where key low-emissions technologies, including nuclear, fossil with CCS, and various renewables, are developed and deployed on a large scale in a timeframe consistent with the emissions reduction requirements of ACESA without encountering any major obstacles. It also assumes that the use of offsets, both domestic and international, is not severely constrained by cost, regulation, or the pace of negotiations with key countries covering key sectors. In anticipation of increasingly stringent caps and rising allowance prices after 2030, covered entities and investors are assumed to amass an aggregate allowance bank of approximately 13 BMT by 2030 through a combination of offset usage and emission reductions that exceed the level required under the emission caps.

- The **ACESA Zero Bank Case** is similar to the Basic Case except that no banked allowances are held in 2030, reflecting the assumed availability of a broad array of reasonably priced low- and no-carbon technologies that can provide an alternative path to compliance with tighter emissions caps after 2030 through reductions across all energy uses, including transportation.

- The **ACESA High Offsets Case** is similar to the Basic Case except that it assumes the near-immediate use of international offsets at levels at or close to the specified aggregate ceiling, without regard to possible institutional or market impediments.

- The **ACESA High Cost Case** is similar to the Basic Case except that the costs of nuclear, coal with CCS, and dedicated biomass generating technologies are assumed to be 50 percent higher.

- The **ACESA No International Case** is similar to the Basic Case, but represents an environment where the use of international offsets is severely limited by cost, regulation, and/or slow progress in reaching international agreements or arrangements covering offsets in key countries and sectors.

- The **ACESA No International/Limited Case** combines the treatment of offsets in the ACESA No International Case with an assumption that deployment of key technologies, including nuclear, fossil with CCS, and dedicated biomass, cannot expand beyond their Reference Case levels through 2030.[4]

The full report discusses a number of additional analysis cases, including an accelerated Corporate Average Fuel Efficiency (CAFE) standards (35CAFE2016) case that incorporates the acceleration in fuel economy standards for light-duty vehicles announced by the Administration in May 2009, a 5-percent discount case that adopts an alternative view of real escalation in allowance prices (Low Discount), a case with limitations to the penetration of nuclear, CCS, and biomass gasification capacity (Limited Alternatives), an accelerated energy technology (High Tech) case, and a higher level of allowance banking (High Banking) case.

[4] This case was originally included in EIA's April 2008 analysis of the Lieberman-Warner Climate Security Act (S. 2191) pursuant to a request from Senators Barrasso, Inhofe, and Voinovich.

EIA cannot attach probabilities to the individual policy cases. However, both theory and common sense suggest that cases that reflect an unbroken chain of either failures or successes in a series of independent factors are inherently less likely than cases that do not assume that everything goes either wrong or right. In this respect, the No International/Limited and Zero Bank Cases might be viewed as more pessimistic and optimistic scenarios, respectively, which bracket a set of more likely cases. Similarly, if actual access to international offsets is dependent on a series of independent regulatory and negotiating outcomes, cases with intermediate access to international offsets might be viewed as more likely than those representing either complete and immediate success across the board (High Offsets), or a permanent lack of progress (No International) in such activities.

Key Findings

Given the potential of offsets as a low-cost compliance option, the amount of reduction in covered emissions is exceeded by the amount of compliance generated through offsets in most of the main analysis cases (Figure ES-1). Cumulative compliance between 2012 and 2030, including reductions both in domestic emissions of covered gases and in domestic and international offsets, ranges from 24.4 BMT to 37.6 BMT carbon dioxide (CO_2)-equivalent emissions in the main analysis cases, representing a 21-percent to 33-percent reduction from the level of cumulative covered emissions projected in the Reference Case.[5] In the ACESA Basic Case, domestic abatement of covered gases represents only 39 percent of cumulative compliance. In the ACESA High Offsets Case, where the maximum quantity of international offsets is used immediately at the start of the program in 2012, domestic abatement in covered gases accounts for just 22 percent of the cumulative compliance. Reductions in the emissions of energy-related CO_2 account for more than half of projected cumulative compliance through 2030 only in the cases where international offsets are not assumed to be available.

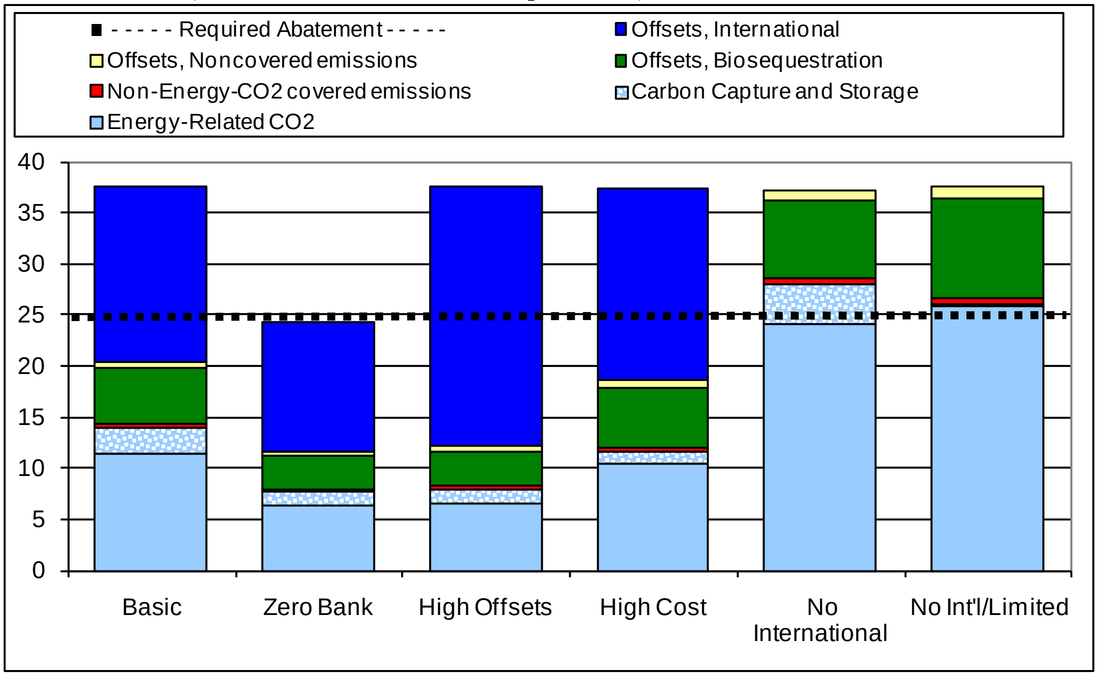
The vast majority of reductions in energy-related emissions are expected to occur in the electric power sector. Across the ACESA main cases, the electricity sector accounts for between 80 percent and 88 percent of the total reduction in energy-related CO_2 emissions relative to the Reference Case in 2030. Reductions in electricity-sector emissions are primarily achieved by reducing the role of conventional coal-fired generation, which in 2007 provided 50 percent of total U.S. generation, and increasing the use of no- or low-carbon generation technologies that either exist today (e.g. renewables and nuclear) or are under development (fossil with CCS). In addition, a portion of the electricity-related CO_2 emissions reductions results from reduced electricity demand stimulated both by consumer responses to higher electricity prices and incentives in ACESA to stimulate greater efficiency in energy use.

If new nuclear, renewable, and fossil plants with CCS are not developed and deployed in a timeframe consistent with emissions reduction requirements under ACESA, covered entities are expected to respond by increasing their use of offsets, if available, and by turning to increased natural gas use to offset reductions in coal generation. While natural gas generation is expected to fall below the Reference Case level in most ACESA Cases, in the ACESA No International/Limited Case natural gas generation is 68 percent above the Reference Case level by

[5] This overall compliance level includes both the projected cumulative 24.6–BMT-difference between the Reference Case projection and the ACESA cap on covered CO_2-equivalent emissions between 2012 and 2030 and the accumulation of an additional 13 BMT in allowances that are banked for use in post-2030 compliance.

2030, due to the assumed limited availability of international offsets, new plants with CCS, as well as new nuclear and dedicated biomass capacity (Table ES-1).

Figure ES-1. Components of Cumulative Compliance in ACESA Main Cases, 2012-2030
(billion metric tons CO_2-equivalent)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Emissions reductions from changes in fossil fuel use in the residential, commercial, industrial and transportation sectors are small relative to those in the electric power sector. Taken together, changes in fossil fuel use in these sectors account for between 12 percent and 20 percent of the total reduction in energy-related CO_2 emissions relative to the Reference Case in 2030, reflecting both lesser percentage changes in delivered fossil fuel prices than experienced by the electricity generation sector and the low availability of alternatives in many applications (Figure ES-2). For example, motor gasoline prices in the ACESA Basic Case are only 20 cents per gallon higher than in the Reference Case in 2020 and 35 cents per gallon higher in 2030 (in 2007 dollars). In addition, since all cases include the 35-mile-per-gallon CAFE standard enacted in the Energy Independence and Security Act of 2007, many of the most cost-effective vehicle efficiency options are adopted in all cases, including the Reference Case. Beyond reductions in direct fuel use, the reduction in electricity demand, which ranges from 4.1 percent to 14.7 percent below the Reference Case level in 2030 across the main policy cases, makes an important contribution to the overall reduction in electricity-related emissions.

Table ES-1. Summary Results

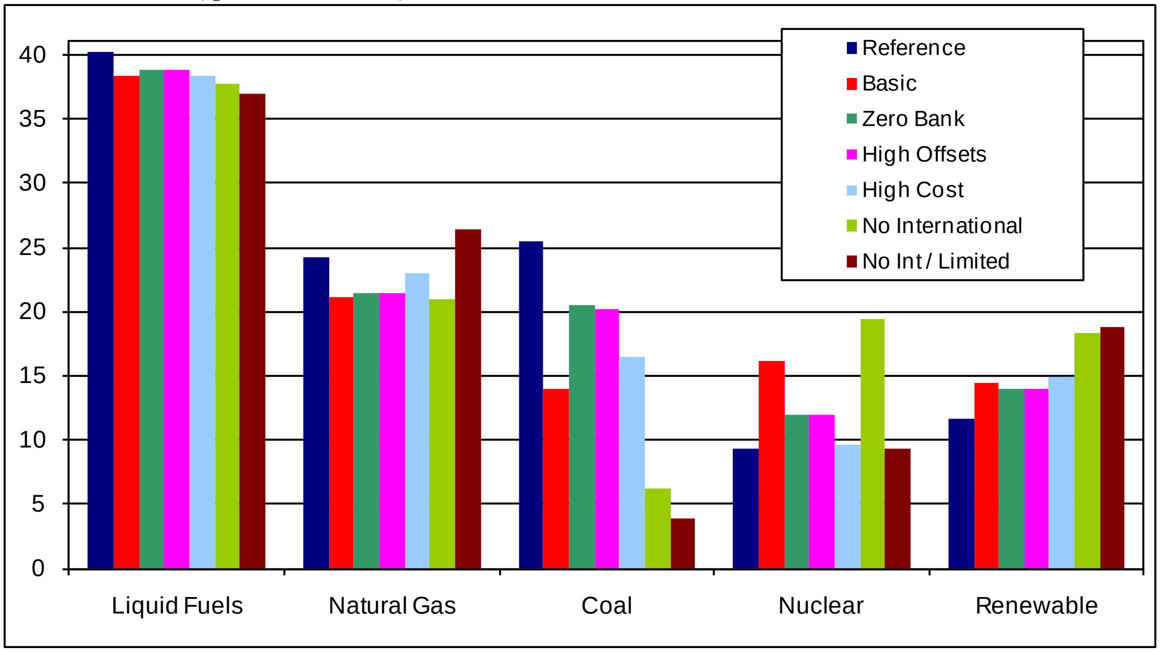
	2007	2020							2030						
			ACESA Cases							ACESA Cases					
		Refer-ence	Basic	Zero Bank	High Offsets	High Cost	No Inter-national Offsets	No Inter-national / Limited	Refer-ence	Basic	Zero Bank	High Offsets	High Cost	No Inter-national Offsets	No Inter-national / Limited
Greenhouse gas emissions (mmt)															
Covered emissions															
Energy-related carbon dioxide	4948	5910	5355	5560	5553	5417	4691	4655	6212	4408	5286	5233	4883	3626	4041
Other covered emissions	167	171	150	152	152	149	148	146	177	152	153	154	152	150	146
Total covered emissions	5114	6081	5505	5712	5705	5566	4839	4801	6389	4560	5440	5387	5034	3776	4187
Noncovered emissions	2242	1411	1388	1401	1400	1385	1377	1358	1665	1624	1634	1633	1613	1604	1599
Total greenhouse gas emissions	7357	7492	6893	7113	7105	6951	6216	6158	8054	6184	7074	7020	6647	5380	5786
Offset credits (mmt)															
Noncovered gases	0	0	35	22	23	38	46	65	0	53	43	44	64	73	78
Biogenic sequestration	0	0	251	155	161	278	385	515	0	448	292	301	481	596	676
Total domestic offset credits	0	0	286	177	183	315	431	580	0	501	335	345	545	669	754
International offset credits (post exchange)	0	0	966	135	1305	1272	0	0	0	1320	1479	1470	1361	0	0
Total domestic and international	0	0	1252	312	1488	1587	431	580	0	1821	1814	1814	1906	669	754
Total emissions net of biosequestration and international reductions (mmt)	7357	7492	5435	6789	5313	5084	5831	5643	8054	4086	4932	4882	4465	4784	5109
Cap and trade compliance summary (mmt)															
Allowances issued (cap)	n.a	5086	5086	5086	5086	5086	5086	5086	3554	3554	3554	3554	3554	3554	3554
Covered emissions, less offset credits	5114	6081	4254	5400	4217	3979	4409	4221	6389	2739	3625	3573	3128	3107	3433
Net allowance bank change	0	0	833	-313	870	1107	678	866	0	815	-71	-18	426	447	122
Allowance bank balance	0	0	4616	-930	10122	6221	6033	8720	0	13085	-35	13069	13040	12774	13186
Allowance and offset prices (2007 dollars per metric ton CO2 equivalent)															
Emission allowance	0.0	0.0	31.7	19.9	20.5	35.4	52.1	93.3	0.0	64.8	40.6	41.9	72.2	106.4	190.5
Domestic offset	0.0	0.0	31.7	19.9	20.5	35.4	52.1	93.3	0.0	64.8	40.6	41.9	72.2	106.4	134.0
International offset	0.0	0.0	25.4	15.9	16.4	28 3	41.7	74.6	0.0	22.6	23.3	33.5	22.8	85.1	152.4
Delivered energy prices (including allowance cost after adjustment for free allocations) (2007 dollars per unit indicated)															
Motor gasoline, transport (per gallon)	2 82	3 62	3.82	3.74	3.74	3.84	3.97	4.29	3 82	4.17	4.02	4.03	4 31	4 51	5.10
Jet fuel (per gallon)	2.17	3 02	3.28	3.18	3.18	3.32	3.48	3.85	3 33	3 80	3.58	3.59	3 85	4.18	4.97
Diesel (per gallon)	2 87	3 64	3.90	3.79	3.79	3.92	4.08	4.48	3 88	4 36	4.13	4.15	4.44	4.75	5.61
Natural gas (per thousand cubic feet)															
Residential	13 05	12 91	13.27	13.07	13.10	13.59	13.72	15.91	14 35	16 81	15.49	15.51	18 00	19 06	25.17
Electric power	7 22	7 22	8.52	7.93	8.00	9.08	9.65	13.89	8 57	10.44	9.18	9.20	11 84	12.72	19.49
Coal, electric power sector (per million Btu)	1.78	1 96	4.84	3.76	3.82	5.18	6.60	10.47	2 04	7 82	5.71	5.83	8 64	11.49	19.38
Electricity (cents per kilowatthour)	9.10	9 27	9.51	9.51	9.55	9.65	9.59	10.69	10 05	12 01	11.08	11.12	12 98	12 69	17.83
Energy consumption (quadrillion Btu)															
Liquid fuels	40.8	38.7	37.5	37.7	37.8	37 6	37.3	37.0	40.3	38.3	38.9	38.9	38.4	37.7	37.0
Natural gas	23.7	22.1	21.5	21.6	21.6	22 0	21.5	25.4	24.2	21.1	21.4	21.5	23.0	21.0	26.5
Coal	22.7	24.4	20.6	22.0	21.9	20 2	14.4	10.5	25.4	14.0	20.5	20.2	16.5	6.2	3.9
Nuclear power	8.4	9.1	9.8	9.4	9.4	9.1	10.6	9.1	9.3	16.2	12.0	12.0	9.6	19.4	9.3
Renewable/Other	6.3	10.4	12.2	11.4	11.5	12 5	17.0	15.3	11.8	14.9	14.1	14.2	15.5	18.8	19.3
Total	101.9	104.7	101.6	102.1	102.1	101 3	100.8	97.5	111.0	104.5	106.8	106.7	103.0	103.2	96.0
Purchased electricity	12.8	14.1	13.8	13.8	13.8	13.7	13.7	13.3	15.4	14.5	14.7	14.7	14.2	14.3	13.0
Electricity generation (billion kilowatthours)															
Petroleum	66	49	46	47	46	47	44	45	50	43	46	46	45	41	43
Natural gas	892	714	694	696	704	770	700	1320	976	704	717	721	1040	739	1638
Coal	2021	2198	1875	2003	1987	1833	1309	943	2311	1354	1912	1897	1574	540	300
Nuclear power	806	876	940	904	904	869	1018	876	890	1548	1147	1151	923	1863	890
Renewable/Other	374	736	907	832	837	930	1364	1118	827	1048	1007	1015	1004	1426	1346
Total	4159	4573	4462	4481	4479	4449	4436	4303	5055	4697	4830	4829	4587	4608	4216

mmt: million metric tons of carbon dioxide equivalent

Source: National Energy Modeling System, runs STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT D072909A, and HR2454NIBIV D072909A

Note: 2007 total covered emissions reflect the coverage of H.R. 2454 as defined in 2012.

Figure ES-2. Primary Energy Consumption by Fuel in Main ACESA Cases, 2030
(quadrillion Btu)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

GHG allowance prices are sensitive to the cost and availability of emissions offsets and low-and no-carbon generating technologies. Allowance prices in the ACESA Basic Case are projected at $32 per metric ton in 2020 and $65 per metric ton in 2030. Across all main analysis cases, allowance prices range from $20 to $93 per metric ton in 2020 and from $41 to $191 (2007 dollars) per metric ton in 2030 (Figure ES-3). The lower prices in the range occur in cases where technological options such as CCS and adoption of new nuclear power plants can be deployed on a large scale before 2030 at relatively low costs, the use of international offsets helps to hold down compliance costs, and/or optimism about future technology availability holds down the near-term incentive to bank allowances for use beyond 2030 (ACESA Basic, ACESA High Offset, and/or ACESA Zero Bank cases). Higher allowance prices occur if international offsets are unavailable, particularly if it is also the case that low- or no-emission baseload electricity supply technologies cannot be expanded beyond the Reference Case level (ACESA No International and ACESA No International/Limited cases).

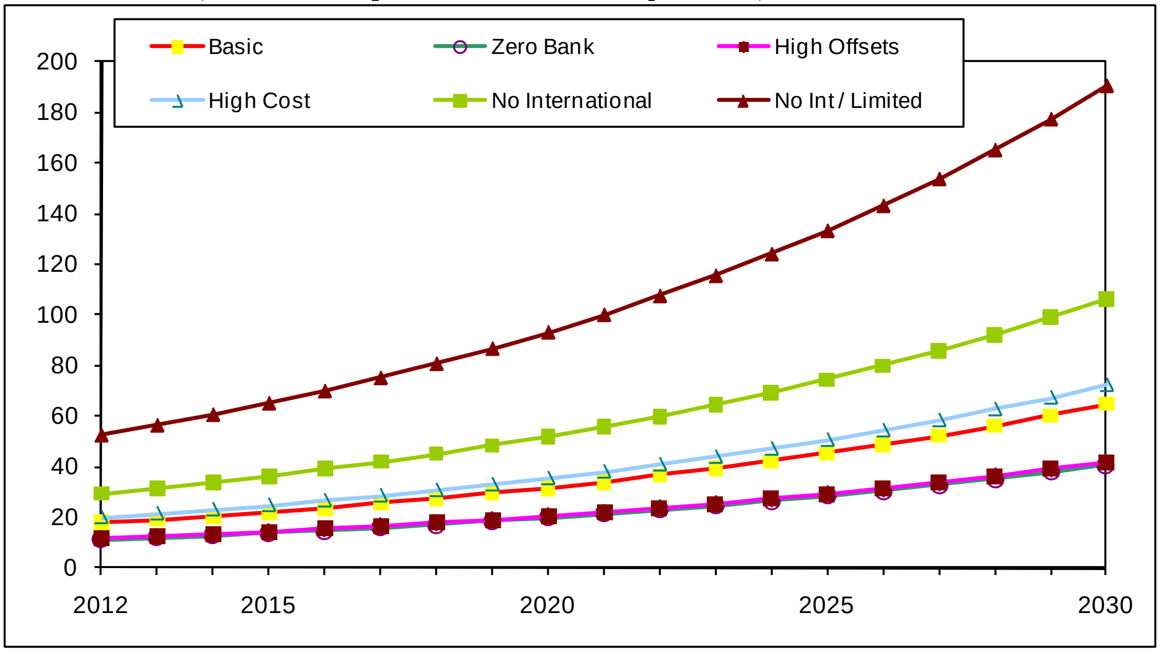
ACESA increases energy prices, but effects on electricity and natural gas bills of consumers are substantially mitigated through 2025 by the allocation of free allowances to regulated electricity and natural gas distribution companies. Except for the ACESA No International/Limited Case, electricity prices in five of the six main ACESA cases range from 9.5 to 9.6 cents per kilowatthour in 2020, only 3 to 4 percent above the Reference Case level.[6] Average impacts on electricity prices in 2030 are projected to be substantially greater, reflecting both higher allowance prices and the phase-out of the free allocation of allowances to distributors between 2025

[6] The average electricity price in the No International/Limited case in 2020 is 10.7 cents per kilowatthour.

and 2030. By 2030, electricity prices in the ACESA Basic Case are 12.0 cents per kilowatthour, 19 percent above the Reference Case level, with a wider band of 11.1 cents to 17.8 cents (10 to 77 percent above the Reference Case level) across all six main policy cases.

Figure ES-3. Allowance Prices in Main ACESA Cases, 2012-2030

(2007 dollars per metric ton CO_2-equivalent)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

ACESA increases the cost of using energy, which reduces real economic output, reduces purchasing power, and lowers aggregate demand for goods and services. The result is that projected real gross domestic product (GDP) generally falls relative to the Reference Case. Total discounted GDP losses over the 2012 to 2030 time period are $566 billion (-0.3 percent) in the ACESA Basic Case, with a range from $432 billion (-0.2 percent) to $1,897 billion (-0.9 percent) across the main ACESA cases (Table ES-2). Similarly, the cumulative discounted losses for personal consumption are $273 billion (-0.2 percent) in the ACESA Basic Case and range from $196 billion (-0.1 percent) to $988 billion (-0.7 percent). GDP losses in 2030, the last year explicitly modeled in this analysis, range from $104 billion to $453 billion (-0.5 to -2.3 percent), while consumption losses in that year range from $36 billion to $180 billion (-0.3 to -1.3 percent). The estimated 2030 GDP and consumption losses in the ACESA No International/Limited Case, at the top of these ranges, are nearly or more than twice as large as those in the ACESA No International and High Cost Cases, which have the next highest level of impacts.

Consumption and energy bill impacts can also be expressed on a per household basis in particular years. In 2020, the reduction in household consumption is $134 (2007 dollars) in the ACESA Basic Case, with a range of $30 to $362 across all main ACESA cases. In 2030, household consumption is reduced by $339 in the ACESA Basic Case, with a range of $157 to $850 per household across all main ACESA cases. By 2030, the estimated reductions in household consumption in the ACESA No International/Limited Case, at the top of these ranges, are approximately double the impacts in the ACESA High Cost Case, which has the next highest level of impacts.

Table ES-2. Macroeconomic Impacts of ACESA Cases Relative to the Reference Case
(billion 2000 dollars, except where noted)

	Basic	Zero Bank	High Offsets	High Cost	No International	No Int / Limited
Cumulative Real Impacts 2012-2030 (present value using 4-percent discount rate)						
GDP						
Change	-566	-432	-523	-781	-717	-1897
Percent Change	-0.3%	-0.2%	-0.2%	-0.4%	-0.3%	-0.9%
Consumption						
Change	-273	-196	-252	-384	-323	-988
Percent Change	-0.2%	-0.1%	-0.2%	-0.3%	-0.2%	-0.7%
Industrial Shipments (excludes services)						
Change	-910	-753	-480	-958	-1720	-2877
Percent Change	-1.0%	-0.8%	-0.5%	-1.1%	-1.9%	-3.2%
Nominal Revenue Collected 2012-2030[a]	2971	1292	1332	2299	3462	6350
2020 Impacts (not discounted)						
GDP						
Change	-50	-19	-26	-70	-34	-112
Percent Change	-0.3%	-0.1%	-0.2%	-0.5%	-0.2%	-0.7%
Consumption						
Change	-21	-7	-11	-30	-15	-64
Percent Change	-0.2%	-0.1%	-0.1%	-0.3%	-0.1%	-0.6%
Industrial Shipments (excludes services)						
Change	-68	-54	-32	-69	-108	-186
Percent Change	-1.0%	-0.8%	-0.5%	-1.0%	-1.6%	-2.8%
Nominal Revenue Collected[a]	71	44	46	79	118	215
2030 Impacts (not discounted)						
GDP						
Change	-161	-104	-120	-214	-226	-453
Percent Change	-0.8%	-0.5%	-0.6%	-1.1%	-1.1%	-2.3%
Consumption						
Change	-63	-36	-50	-97	-69	-180
Percent Change	-0.4%	-0.3%	-0.4%	-0.7%	-0.5%	-1.3%
Industrial Shipments (excludes services)						
Change	-183	-125	-87	-198	-338	-506
Percent Change	-2.5%	-1.7%	-1.2%	-2.7%	-4.6%	-6.8%
Nominal Revenue Collected[a]	330	205	211	367	556	1030

[a] Includes revenues from allowance auctions and revenues generated by the resale of allowances distributed to non-emitters. These values are not discounted.
Note: All changes shown are relative to the updated *AEO2009* Reference Case.
Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

The free allocation of output-based allowances reduces the impact of ACESA on energy-intensive, trade- vulnerable industries. Receiving free allowances in proportion to output softens the impacts of increased energy prices on these industries. As a result, when energy prices increase under ACESA, the reductions in output of these trade- and energy-vulnerable industries are less than overall manufacturing impacts and mirror the impacts of total industrial shipments. The discounted cumulative percent losses of energy-intensive industrial output range from -0.5 percent to -3.6 percent from 2012-2030 compared to manufacturing losses of -0.5 percent to -4.3 percent.

Additional Insights

The role of baseline assumptions. The choice of a baseline is one of the most influential assumptions for any analysis of global climate change legislation. This analysis uses the updated Reference Case of the *AEO2009* as a starting point. These projections and our analysis are not meant to be exact predictions of the future but represent plausible energy futures given technological and demographic trends, current laws and regulations, and consumer behavior as derived from available data. EIA recognizes that projections of energy markets over a nearly 25-year period are highly uncertain and subject to many events that cannot be foreseen, such as supply disruptions, policy changes, and technological breakthroughs. In addition to these phenomena, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a different path than expected in the projections. Generally, differences between cases, which are the focus of our report, are likely to be more robust than the specific projections for any one case. The published *AEO2009*, which includes numerous cases reflecting a variety of alternative futures for the economy, energy markets, and technology, is a resource that can be used to examine the implications of alternative baselines.

The strategic allowance reserve. The strategic allowance reserve, which focuses on the important issue of short-term volatility in allowance prices, is not addressed in this analysis. As currently structured, the strategic allowance reserve, following a startup period, relies on a "trigger price" for auctions that is set in relation to recent allowance prices. Such an approach does not appear to preclude a scenario in which allowance prices evolve along a "high" trajectory given underlying conditions that would support such an outcome, such as those examined in the No International and No International/Limited cases. Also, the strategic allowance reserve, in contrast to other cost-containment mechanisms that more directly tie compliance pressure to the level of compliance costs or other measures of economic impact, would be unlikely to discourage stakeholders who view GHG emissions limitation as the highest environmental protection priority from pursuing efforts to block the deployment of nuclear power, CCS, or other technologies that, from their perspective, may raise important, but lesser, concerns. Therefore, as discussed in earlier EIA analyses, decisions regarding the design of a cost-containment mechanism can affect the public acceptance of key low- and no-carbon technologies that may be part of a cost-effective compliance mix.

Free allowance allocation to electricity and natural gas distributors. The analysis shows that the free allocation of allowances to electricity and natural gas distributors significantly ameliorates impacts on consumer electricity and natural gas prices prior to 2025, when it starts to be phased out. While this result may serve goals related to regional and overall fairness of the program, the overall efficiency of the cap-and-trade program is reduced to the extent that the price signal that would encourage cost-effective changes by consumers in their use of electricity and natural gas is delayed.

Electricity capacity siting challenges. Besides changing the projected mix of new electricity generation capacity, compliance with ACESA will also significantly increase the total amount of new electric capacity that must be added between now and 2030 due to the retirement of many existing coal-fired power plants that otherwise would be expected to continue operating beyond 2030. Obstacles to siting major electricity generation projects and/or the transmission facilities needed to support the greatly expanded use of renewable energy sources are not explicitly considered in this report. However, the additional capacity needs in all of the ACESA cases suggest the need for review of siting processes so that they will be able to support a large-scale transformation of the Nation's electricity infrastructure by 2030.

Challenges beyond 2030. As previously noted, the modeling horizon for this analysis ends in 2030. Unless substantial progress is made in identifying low- and no-carbon technologies outside of electricity generation, the ACESA emissions targets for the 2030-to-2050 period are likely to be very challenging as opportunities for further reductions in power sector emissions are exhausted and reductions in other sectors are thought to be more expensive.

Background and Scope of the Analysis

Background

This report responds to a request from Chairman Henry Waxman and Chairman Edward Markey for an analysis of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA).[7] ACESA, as passed by the U.S. House of Representatives on June 26, 2009, is a complex bill that regulates emissions of greenhouse gases (GHGs) through a variety of market-based mechanisms, efficiency programs, and economic incentives. The bill includes four titles designed to spur clean energy development, increase investment in energy efficiency, reduce global warming pollution, and transition to a clean energy economy.

Clean Energy

Title I of H.R. 2454 focuses primarily on the development of clean energy resources. It establishes a combined efficiency and renewable electricity standard (CERES) requiring that all retail electricity suppliers with annual sales above 4 million megawatthours meet 20 percent of their load with qualified renewable energy sources or electricity efficiency savings by 2020. One-fifth of the requirement can initially be met with efficiency savings, with the possibility of an additional 20 percent if approved by the Federal Energy Regulatory Commission.

Title I also includes provisions to spur the commercialization of carbon capture and storage (CCS) technology, encourage increased investment in energy efficiency through allowance distributions to States, stimulate reductions in peak electricity loads, and motivate investment in an electric vehicle infrastructure. In addition, it establishes a Clean Energy Deployment Administration to promote the domestic development and deployment of clean energy technologies, including advanced or enabling infrastructure technologies, energy efficiency technologies, and related manufacturing technologies, through partnership with and support of the private capital market.

Energy Efficiency

Title II of H.R. 2454 focuses on improving energy efficiency. It requires revisions to building codes for both new construction and existing facilities. It provides financial assistance for efficiency retrofit projects in existing buildings and calls for the development of new efficiency standards for several lighting and appliance applications, such as street lights, parking lot lights, portable light fixtures, hot food holding cabinets, bottle-type drinking water dispensers, commercial grade natural gas furnaces, and portable spas (hot tubs).

In order to address transportation efficiency, Title II directs the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) to set GHG emission standards for heavy highway vehicles, non-road vehicles, and aircraft. It requires States to develop transportation GHG reduction plans and calls for EPA to expand its fuel-saving technologies deployment program. The Department of Energy (DOE) is also directed to establish further

[7] The request letter from Chairman Waxman and Chairman Markey is provided in Appendix A.

standards for industrial energy efficiency, create an awards program for increasing efficiency in the thermal electricity generation process, and clarify the waste-to-heat energy incentives in the Energy Independence and Security Act of 2007 (EISA 2007).

Reducing Global Warming Pollution

Title III of H.R. 2454 focuses on reducing GHG emissions by establishing a cap on emissions beginning in 2012 that covers electricity generators, liquid fuel refiners and importers, and fluorinated gas manufacturers. In 2014, the cap is expanded to include industrial sources that emit greater than 25,000 tons of carbon dioxide-(CO_2) equivalent emissions, and in 2016 it is further expanded to include retail natural gas distribution companies. Relative to their emissions in 2005, covered sources must reduce their emissions 3 percent by 2012, 17 percent by 2020, 58 percent by 2030, and 83 percent by 2050. It provides for unlimited banking of allowances, while borrowing future allowances to meet current compliance obligations is allowed with some restrictions.

Title III also allows covered entities to offset up to 2 billion metric tons (BMT) of CO_2-equivalent emissions through the use of domestic and international offsets. The offset limits are applied on a pro-rata basis to individual covered entities. The annual percentage of offsets a covered entity can use to comply with its limit is determined by dividing 2 billion by the sum of 2 billion and the number of allowances issued for the previous year. The pro-rata limit can therefore restrict offset usage independently of the overall 2-BMT limit. Under the overall limit, the title allows 1 BMT of international offsets and 1 BMT of domestic offsets. Furthermore, beginning in 2018, five international offsets must be submitted to account for four allowances. As with the overall limit, domestic and international offsets under the pro-rata limit can each be no more than half the total. However, if the EPA Administrator expects the availability of domestic offset credits to be less than 900 million metric tons (MMT), given expected allowance prices, then the maximum percentage of international offsets is increased to reflect an amount equal to 1,000 MMT less the expected domestic offset availability, up to 500 MMT. International allowances can also be used for compliance, provided that they originate from a program with mandatory emissions reductions and have not been used already to comply with another program. The authority to designate a limit on the use of international allowances is granted to EPA. Title V addresses the role of domestic agricultural and forestry-related offsets in the Title III cap-and-trade program.

Transitioning to Clean Energy Economy

Title IV of H.R. 2454 includes provisions intended to mitigate adverse economic impacts caused by the provisions of Title III. It directs EPA to provide rebates for industrial facilities that it determines face significant additional costs as a result of Title III. It also authorizes tax credits and refunds for low income energy consumers, in order to compensate them for any losses in purchasing power due to higher energy costs and provides for financial assistance to workers who loose their job as a result of the Title III program. In addition, it authorizes an increase in grants for colleges and universities that are developing programs in clean energy technology and energy efficiency.

Representing H.R. 2454 in the National Energy Modeling System[8]

The analysis of energy sector and energy-related economic impacts of the various GHG emission reduction proposals in this report is based on results from the Energy Information Administration's (EIA) National Energy Modeling System (NEMS). NEMS projects emissions of energy-related CO_2 emissions resulting from the combustion of fossil fuels, representing about 84 percent of total U.S. GHG emissions today. The emissions in NEMS account for the vast majority of total emissions covered by the main ACESA cap-and-trade program.

The Reference Case used in this report was published in a recent EIA report, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook.*[9] The Reference Case is designed to reflect only current laws and policies, so it explicitly avoids assumptions about "expected" policy changes such as future fuel economy standards, taxes, or new regulatory requirements for conventional pollutants or GHGs. For this reason, EIA Reference Case projections are not directly comparable with private energy forecasts that include estimates of policy change in their baseline scenarios.

NEMS endogenously calculates changes in energy-related CO_2 emissions in the analysis cases. The cost of using each fossil fuel includes the costs associated with the GHG allowances needed to cover the emissions produced when they are used. These adjustments influence energy demand and energy-related CO_2 emissions. The GHG allowance price also determines the reductions in projected baseline emissions of other GHGs based on assumed abatement cost relationships. With emission allowance banking, NEMS solves for the time path of permit prices such that cumulative emissions match the cumulative emissions target with price escalation consistent with the average cost of capital to the electric power sector.

The NEMS Macroeconomic Activity Module (MAM), which is based on the IHS Global Insight U.S. Model, interacts with the energy supply, demand, and conversion modules of NEMS to solve for an energy-economy equilibrium. In an iterative process within NEMS, MAM reacts to changes in energy prices, energy consumption, and allowance revenues, solving for the effect on macroeconomic and industry level variables such as real gross domestic product (GDP), the unemployment rate, inflation, and real industrial output.

Key provisions of ACESA that are represented in the policy cases developed in this analysis include:

- the cap-and-trade program for GHGs other than hydrofluorocarbons (HFCs), including provisions for the allocation of allowances to electricity and natural gas distribution utilities, low-income consumers, State efficiency programs, rebate programs, energy-intensive industries, and other specified purposes,
- the combined efficiency and renewable electricity standard for electricity sellers,

[8] Detailed discussion of the changes made to the NEMS to represent ACESA is provided in Appendix B.

[9] Energy Information Administration, *An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook*, SR/OIAF/2009-03 (Washington, DC, April 2009), http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.

- the CCS demonstration and early deployment program,
- Federal building code updates for both residential and commercial buildings,
- Federal efficiency standards for lighting and other appliances,
- technology improvements driven by the Centers for Energy and Environmental Knowledge and Outreach, and
- the smart grid peak savings program.

While this analysis is as comprehensive as possible given its timing, it does not address all the provisions of ACESA. Provisions that are not represented include the Clean Energy Deployment Administration, the strategic allowance reserve, the separate cap-and-trade program for HFC emissions, the GHG performance standards for activities not subject to the cap-and-trade program, the distribution of allowances to coal merchant plants, new efficiency standards for transportation equipment, and the effects of increased investment in energy research and development. Of these provisions, the Clean Energy Deployment Administration may have the most significant potential to alter the reported results.

Like other EIA analyses of energy and environmental policy proposals, this report focuses on the impacts of those proposals on energy choices made by consumers in all sectors and the implications of those decisions for the economy. This focus is consistent with EIA's statutory mission and expertise. The study does not account for any possible health or environmental benefits that might be associated with curtailing GHG emissions.

Finally, while the emissions caps in the ACESA cap-and-trade program decline through the year 2050, the modeling horizon in this report runs only through 2030, the projection limit of NEMS. As in EIA analyses of earlier cap-and-trade proposals, the need to pursue higher-cost emissions reductions beyond 2030, driven by tighter caps and continued economic and population growth, can be reflected in the modeling by assuming that a positive bank of allowances is held at the end of 2030 in all but one case.

Analysis Cases

Because of the complex interactions of the various policy instruments called for in ACESA, a large number of cases were prepared. These cases, while not exhaustive, are meant to explore key areas of uncertainty that impact the analysis results.

The role of offsets is a large area of uncertainty in any analysis of ACESA. The 2-BMT annual limit on total offsets in ACESA is equivalent to one-third of total energy-related GHG emissions in 2008 and represents nearly six times the projected growth in energy-related emissions through 2030 in the Reference Case used in this analysis.

While the ceiling on offset use is clear, their actual use is an open question. Beyond the usual uncertainties related to the technical, economic, and market supply of offsets, the future use of offsets for ACESA compliance also depends both on regulatory decisions that are yet to be made by the EPA, on the timing and scope of negotiations on international agreements or arrangements between the United States and countries where offset opportunities may exist, and on emissions reduction commitments made by other countries. Also, limits on offset use in ACESA apply individually to each covered entity, so that offset "capacity" that goes unused by one or more covered entities cannot be used by other covered entities. For some major entities covered by the cap-and-trade program, decisions regarding the use of offsets could potentially be affected by regulation at the State level. Given the many technical factors and implementation decisions involved, it is hardly surprising that analysts' estimates of international offset use span an extremely wide range. One recent analysis doubts that even 150 MMT of international offsets will be used by 2020, while another posits that 1 BMT of international offsets will be used almost immediately from the start of the program in 2012, followed by a quick rise towards an expanded 1.5-BMT ceiling shortly thereafter.

The other major area of uncertainty in assessing the energy system and economic impacts of ACESA involves the timing, cost, and public acceptance of low- and no-carbon technologies. For the period prior to 2030, the availability and cost of low- and no-carbon baseload electricity technologies, such as nuclear power and fossil (coal and natural gas) with CCS, which can potentially displace a large amount of conventional coal-fired generation, is a key issue. However, technology availability over an extended horizon is a two-sided issue. Research and development breakthroughs over the next two decades could expand the set of reasonably priced and scalable low- and no-carbon energy technologies across all energy uses, including transportation, with opportunities for widespread deployment beyond 2030. The achievement of significant near-term progress towards such an outcome, however, could significantly reduce the size of the bank of allowances that covered entities and other market participants would want to carry forward to meet compliance requirements beyond 2030.

Main Analysis Cases

- The **ACESA Basic Case** represents an environment where key low-emissions technologies, including nuclear, fossil with CCS, and various renewables, are developed and deployed on a large scale in a timeframe consistent with the emissions reduction requirements of ACESA without encountering any major obstacles. It also assumes that the use of offsets, both domestic and international, is not overly constrained by cost, regulation, or the pace of negotiations with key countries covering key sectors. In anticipation of increasingly stringent caps and rising allowance prices after 2030, covered entities and investors are assumed to amass an aggregate allowance bank of approximately 13 billion metric tons by 2030 through a combination of offset usage and emission reductions that exceed the level required under the emission caps.
- The **ACESA Zero Bank Case** is similar to the ACESA Basic Case but assumes that there is no accumulation of excess allowances for use beyond 2030. Instead, over the period 2012 to 2030 the cumulative covered emissions net of offsets are assumed to match the cumulative quantity of allowances issued, leaving an approximate zero balance in 2030. This scenario might occur if allowance prices were widely expected to stabilize or drop off after 2030, limiting the financial incentives to accumulate and hold allowances. This would imply the availability of a broad array of reasonably priced low- and no-carbon technologies that can

provide an alternative path to compliance with tighter emissions caps after 2030 through reductions across all energy uses, including transportation.

- The **ACESA High Offsets Case** is similar to the ACESA Basic Case except that it assumes that covered entities use the maximum allowable amount of international offsets beginning in 2012, with such offsets available at prices competitive with allowances and the necessary bilateral agreements in place with the supplying countries. This case illustrates the potential impacts where greater use of international compliance options reduces the share of emissions reduction requirements that must be met domestically. In the ACESA Basic Case and other cases, it is assumed that international offsets will penetrate the U.S. market more gradually.
- The **ACESA High Cost Case** is similar to the ACESA Basic Case except that the costs of nuclear, fossil with CCS, and biomass generating technologies are assumed to be 50 percent higher. There is great uncertainty about the costs of these technologies, as well as the feasibility of introducing them rapidly on a large scale. Cost estimates for these technologies rose rapidly from 2000 through 2008 and have only recently begun to moderate. The actual costs of these technologies will not become clearer until a number of full-scale projects are constructed and brought on line.
- The **ACESA No International Case** is similar to the ACESA Basic Case but represents an environment where the use of international offsets is severely limited by cost, regulation, and/or slow progress in reaching international agreements or arrangements covering offsets in key countries and sectors. The regulations that will govern the use of offsets have yet to be developed and their availability will depend on actions taken in the United States and around the world. It is possible that some significant portion of the potential international offsets will not be able to meet all of the requirements set forth in ACESA or, in meeting them, will make them uneconomical.
- The **ACESA No International/Limited Case** combines the treatment of offsets in the ACESA No International Case with an assumption that deployment of key technologies, including nuclear, fossil with CCS, and dedicated biomass, cannot expand beyond their Reference Case levels through 2030. There is great uncertainty about how fast these technologies, the industries that support them, and the regulatory infrastructure that licenses/permits them might be able to grow and, for fossil with CCS, when the technology will be fully commercialized. For nuclear, this assumption limits new plant additions to roughly 11,000 megawatts, or 7 to 11 new generators, by 2030. For fossil with CCS, this assumption limits new plant additions to 2,000 megawatts of demonstration projects or roughly 4 to 8 commercial-sized plants.

Additional Analysis Cases

- The **ACESA High Tech Case** is similar to the ACESA Basic Case except that it incorporates the technology assumptions from the Integrated High Technology Case published in the *Annual Energy Outlook 2009* (*AEO2009*). This case illustrates the impact of more aggressive assumptions about technological improvements and their role in reducing GHG emissions.
- The **ACESA Low Discount Case** is similar to the ACESA Basic Case except that it assumes a 5-percent discount rate for allowance-banking decisions. There is significant uncertainty about how the market for allowances will evolve and what rate of return investors in

allowances will require in order to hold allowance balances in anticipation of future higher compliance costs.

- The **ACESA 35CAFE2016 Case** is similar to the ACESA Basic Case except that it also incorporates an accelerated schedule for raising the combined fuel economy standards for cars and light trucks to 35 miles per gallon in 2016, as announced by the White House in May 2009.
- The **ACESA High Banking Case** similar to the ACESA Basic Case but assumes a greater level of allowances is banked from 2012 through 2030 and that covered entities and investors accumulate a 20-BMT allowance bank by 2030. Such a scenario could occur if widespread expectations of rising allowance prices spur market participants to make greater use of offsets and invest more heavily in emissions reduction opportunities early on, thus banking allowances for sale in the future.
- The **ACESA Limited Alternatives Case** represents an environment where the deployment of key technologies, including nuclear, fossil with CCS, and biomass, is limited to their Reference Case levels through 2030. There is great uncertainty about how fast these technologies, the industries that support them, and the regulatory infrastructure that license/permit them might be able to grow and, for fossil with CCS, when the technology will be fully commercialized. For nuclear, this assumption limits new plant additions to roughly 11,000 megawatts, or 7 to 11 new generators by 2030. For fossil with CCS, this assumption limits new plant additions to 2,000 megawatts of demonstration projects or roughly 4 to 8 commercial-sized plants.

EIA cannot attach probabilities to the individual policy cases. However, both theory and common sense suggest that cases that reflect an unbroken chain of either failures or successes in a series of independent factors are inherently less likely than scenarios that do not assume that everything goes either wrong or right. In this respect, the No International/Limited and Zero Bank Cases might be viewed as more pessimistic and optimistic scenarios, respectively, which bracket a set of more likely cases. Similarly, if actual access to international offsets is dependent on a series of independent regulatory and negotiating outcomes, cases with intermediate access to international offsets might be viewed as more likely than those representing either complete and immediate success across the board (High Offsets), or a permanent lack of progress (No International) in such activities.

Results

This section presents the results of the analysis, focusing on the effects of ACESA in the six main cases that vary technology and offset assumptions. The impacts on GHG emissions, energy markets, and the economy are presented in turn. A full set of report tables for all analysis cases is available on the EIA website.

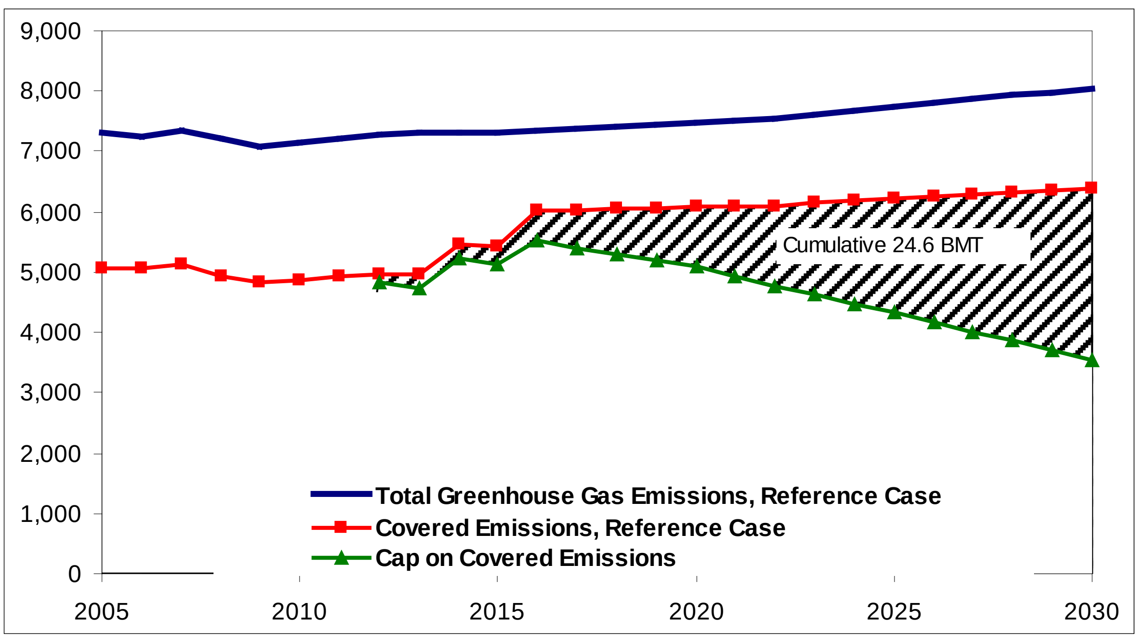
Greenhouse Gas Emissions and Allowance Prices

Greenhouse Gas Emissions and Compliance Patterns

The cap-and-trade provisions in ACESA impose a gradually tightening cap on covered GHG emissions beginning in 2012, with some industrial sector and natural gas coverage phased in between 2012 and 2016. By 2016 about 84 percent of total U.S.GHG emissions are covered emissions under the cap, including most sources of energy-related CO_2 and some industrial emissions of non-energy CO_2, nitrous oxide, perfluorocarbons, sulfur hexafluoride, and HFCs.

Figure 1 compares the total and covered portions of GHG emissions in the reference case under the cap, with covered emissions prior to 2012 shown based on the bill's 2012 coverage provisions.[10] Cumulative covered emissions from 2012 to 2030 in the Reference Case are about 113 BMT, compared to 89 BMT tons allowed under the cap, a 21-percent or 24.6-BMT reduction requirement. Given incentives to bank allowances and an increasingly stringent cap on emissions through 2050, in five of the main analysis cases, an additional 13 BMT of abatement is assumed to occur over the same period, leaving a 13-BMT allowance bank balance at the end of 2030. In the Zero Bank Case, a target of 0 for the 2030 bank balance is assumed.

Figure 1. Reference Case GHG Emissions, Covered Emissions, and Cap, 2005-2030
(million metric ton CO_2-equivalent)



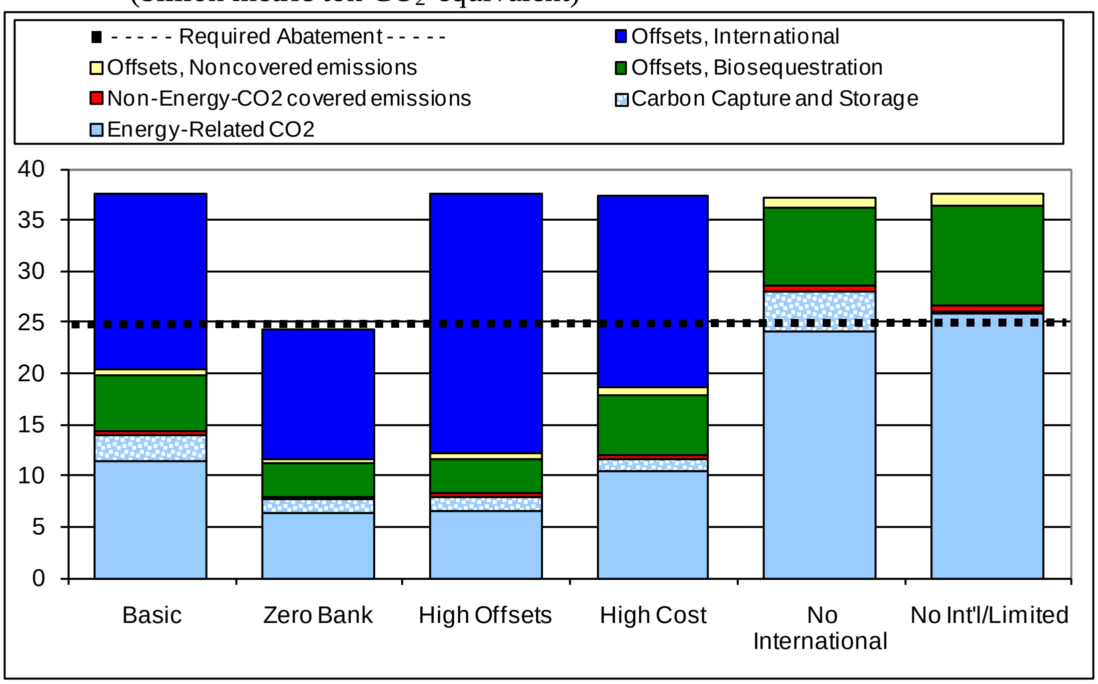
Source: National Energy Modeling System run, STIMULUS.D041409A.

Although all of the main analysis cases start from the same Reference Case, apply the same cap on covered emissions, and five carry the same 13-BMT balance of banked allowances in 2030,

[10] Due to the Energy Information Administration's limited disaggregation of the non-CO_2 gases for modeling purposes, some non-CO_2 gases are modeled as being covered beginning in 2012 rather than 2014. As a result, the percentage of covered gases assumed before 2014 is about 2 percentage points higher than the 66-percent figure cited in ACESA Sec. 721.

the mix of offset usage and reductions in covered emissions vary a great deal across these cases (Figure 2). In the ACESA Basic, ACESA High Cost, and ACESA High Offset Cases, the cumulative use of offsets is projected to substantially exceed the 13-BMT bank balance that is carried forward beyond 2030. Covered entities are therefore able to meet the their obligations under the cap-and-trade program between 2012 and 2030 in those cases even though the reduction in their covered emissions, shown as the bottom three segments of the bars in Figure 2, is significantly below the cumulative 24.6-BMT reduction target shown in Figure 1. This effect is particularly evident in the High Offsets Case, where the reduction in covered emissions over the 2012 to 2030 period is only 8.3 BMT. In the ACESA Zero Bank Case, cumulative abatement matches the minimum required, yet the compliance mix includes a similarly large share of offsets, with international offsets accounting for about half the total abatement. In the two cases where no international offsets are assumed to be available, reductions in covered emissions are much greater, actually exceeding the cumulative 24.6 BMT reduction shown in Figure 1 in the cases that assume the ready availability of low- and no-carbon electric generation technology.

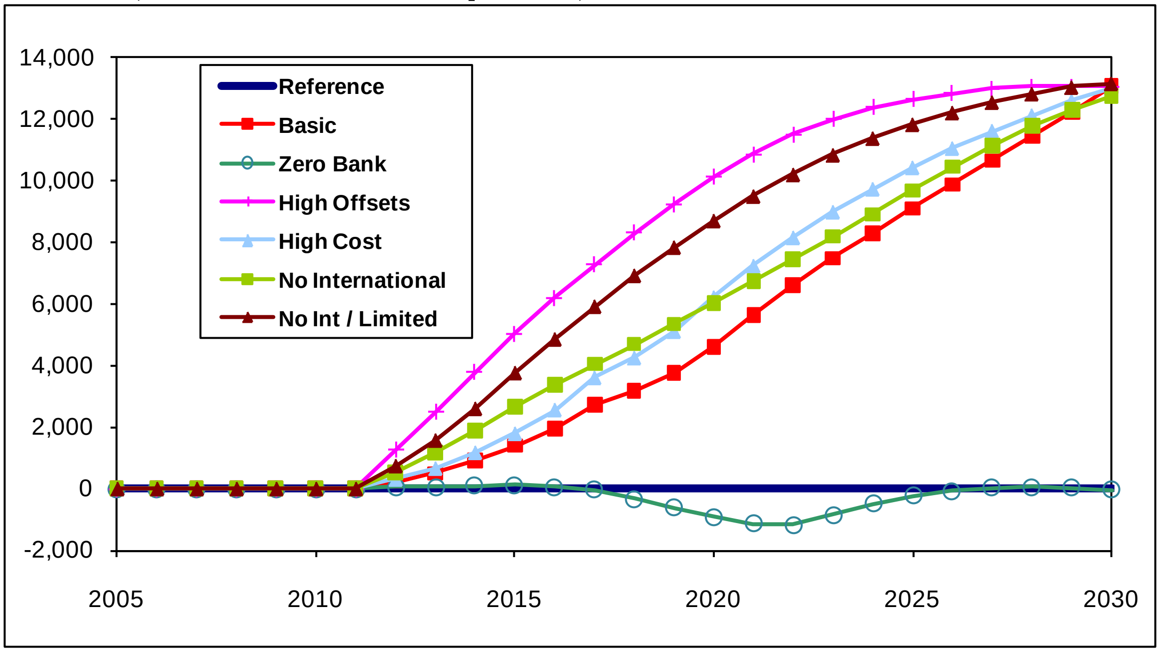
Figure 2. Components of Cumulative Abatement in ACESA Main Cases, 2012-2030
(billion metric ton CO_2-equivalent)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

The temporal pattern of compliance also varies significantly across cases, as shown in Figure 3, which shows the accumulation of allowance bank balances. The build-up of allowance bank balances is most rapid in the High Offsets Case, where the maximum allowable quantity of offsets is assumed to be available immediately. For the other main analysis cases, allowance banks are generally accumulated more rapidly in the cases that assume restricted access to international offsets and/or low- and-no carbon technologies for electricity generation. These assumptions, which lead to higher allowance prices, encourage covered entities to take advantage of near-term fuel-switching opportunities in the electric sector. In the Zero Bank Case, a relatively small negative allowance balance accumulates from 2019 to 2022, reflecting some allowance borrowing as permitted in the bill, subject to some limitations and repayment penalties. The borrowing period is followed by a similar length payoff period, leaving a near-zero balance over the last 5 years of the projection, consistent with the terminal bank assumption of the case.

Figure 3. Cumulative Allowance Bank Balance in ACESA Main Cases, 2012-2030
(million metric ton CO_2-equivalent)

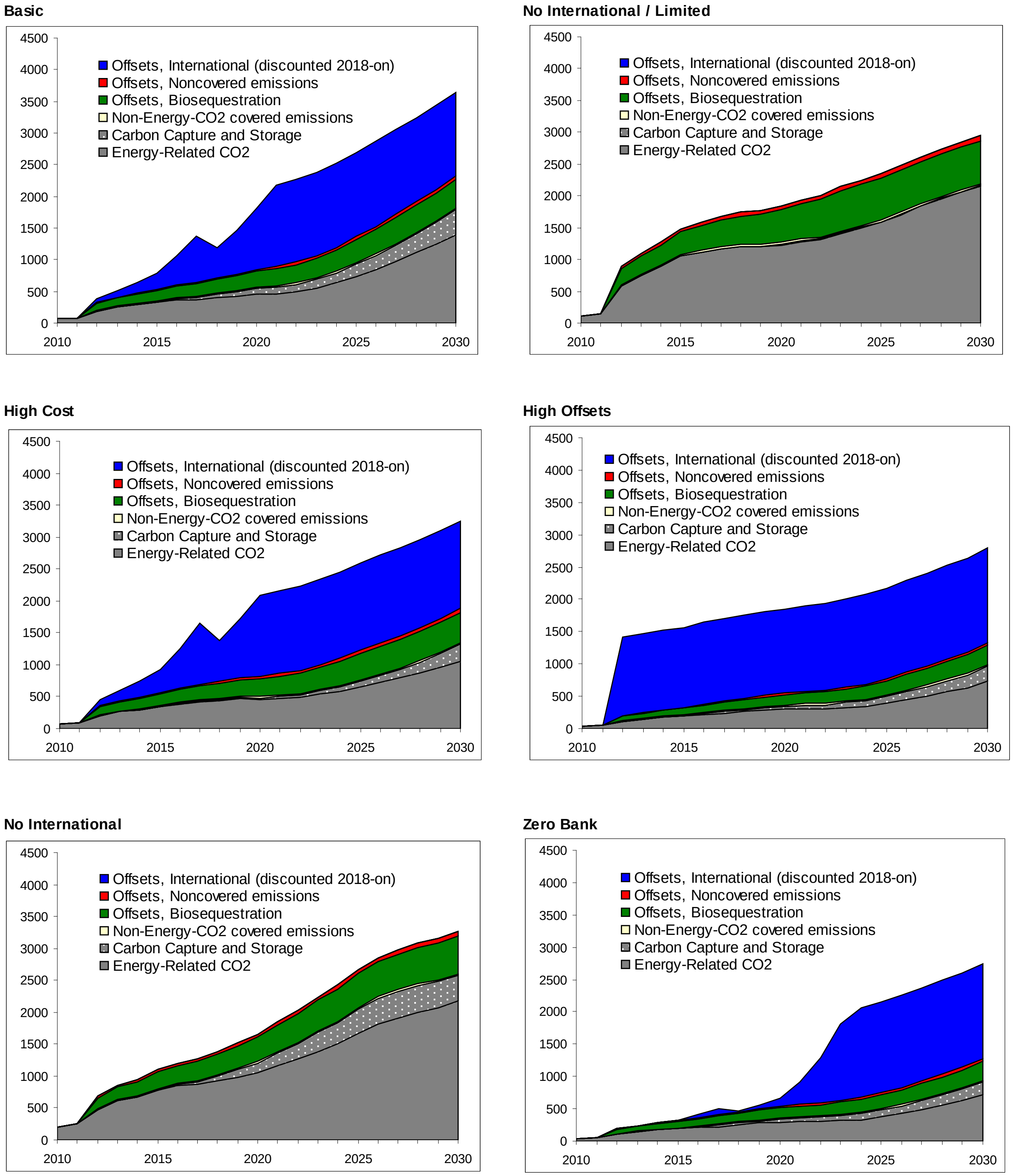


Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Given the relatively generous limit on offsets and their potential as a low-cost compliance option, the reductions in covered emissions are projected to be smaller than the abatement from offsets in most cases. In the ACESA Basic Case, which includes an increasing availability of international offsets over time, abatement in covered gases represents only 39 percent of cumulative total emission abatement from 2012 to 2030. In the ACESA High Offsets Case, where the maximum quantity of international offsets are also used beginning in 2012, abatement in covered gases represents even less of the overall abatement, accounting for just 22 percent of the cumulative abatement through 2030. Reductions in the emissions of energy-related CO_2 account for more than half of the cumulative abatement only in the cases where international offsets are not assumed to be available.

The abatement measures used change over time, depending on how quickly offsets and other abatement opportunities become economical (Figure 4). In the ACESA Basic and ACESA High Cost Cases the “kink” in the international offsets trend occurs due to the discounting rule change that goes into effect in 2018. After 2018, 1.25 international offsets are required for each allowance credit. This discounting is assumed to reduce the market price covered entities in the United States are willing to pay for international offsets to 80 percent (1/1.25) of the domestic

Figure 4. Sources of Cumulative Compliance in ACESA Main Cases, 2010-2030
(million metric ton CO_2-equivalent)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

allowance price and also reduce the quantity of offsets supplied by international sources. Both the discounting and the market supply reaction to the lower international offset price contribute to the reduced use of international offsets in 2018. A second change in the international offsets trend occurs in 2021 when the limit on international offsets is reached.

The temporal abatement pattern in the Zero Bank Case is distinct from the other cases. Relatively low levels of abatement occur in the first 10 years of the cap-and-trade policy in this case, as investors are assumed to forego possible opportunities to bank allowances, as might occur with expectations of stabilizing allowance prices after 2030 that would reduce profits from such investments.

Allowance Prices

Under the ACESA cap-and-trade provisions, the market price of allowances will establish an incremental cost to emitting GHGs. That cost provides an incentive to reduce emissions whether or not some allowances are received for free, since operating costs can be reduced by emitting less and any unused allowances can be sold.

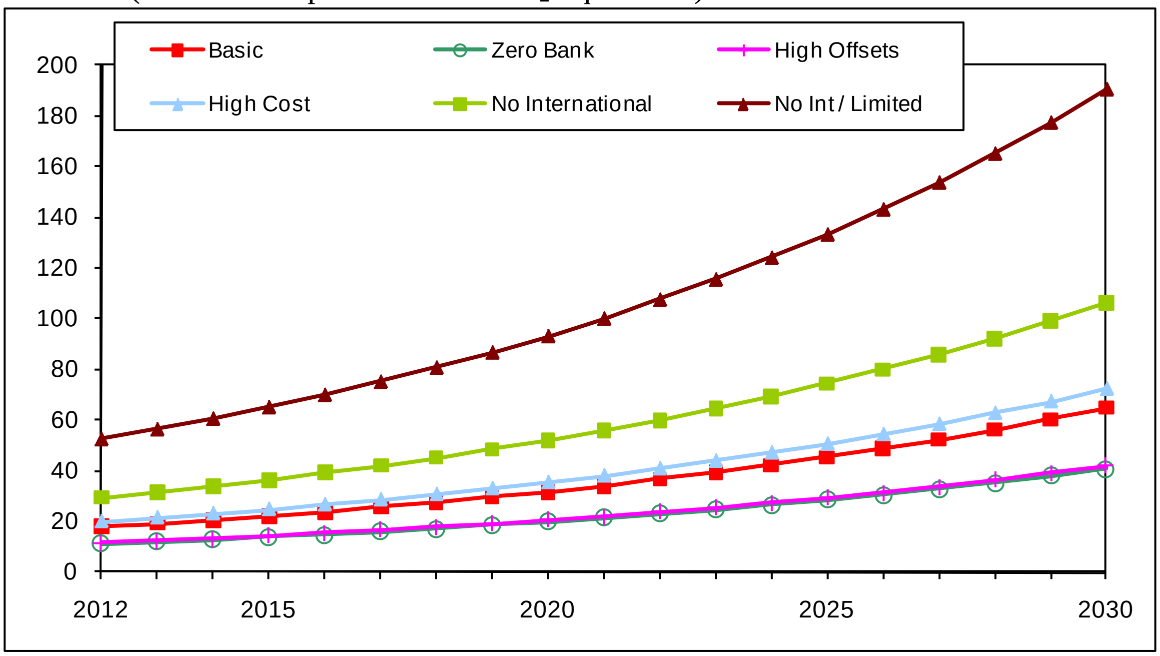
Prices in allowance markets will be influenced by the banking provisions. Covered entities or traders may hold allowances if they expect higher allowance prices in the future. Allowance prices and levels of emissions are estimated such that covered emissions, less offsets, meet the emissions caps over a time period. The allowance price path is estimated assuming a constant rate of growth matching the cost of capital, or discount rate, assumed in financing the investment in allowance banking. The projected allowance prices represent idealized paths. In reality, allowance prices would tend to fluctuate as markets respond to new information and as unanticipated events unfold.

Allowance prices in the ACESA Basic Case are projected at $32 per metric ton in 2020 and $65 per metric ton in 2030. The projected allowances prices are highly uncertain and sensitive to modeling assumptions, including such factors as the cost and availability of low-emissions technology options and the potential supplies of domestic and international offset credits (Figure 5 and Table 1). Allowance prices in the main cases, where these assumptions are analyzed, vary widely, from $20 to $93 per metric ton of CO_2-equivalent emissions in 2020 and from $41 to $191 per metric ton in 2030. The lower prices in that range occur in cases where technological options such as CCS and adoption of new nuclear power plants become available at relatively low costs, and the use of international offsets helps to hold down compliance costs, as in the ACESA Basic and ACESA High Offset Cases, and where aggregate banking of allowances is minimal, as in the ACESA Zero Bank Case. Significantly higher allowances prices occur if international offsets are unavailable or low-emitting electricity supply technologies are more costly, or the development of these technologies is limited, as in the ACESA No International Offsets, ACESA High Cost, and ACESA No International/Limited Cases.

Variation in allowances prices also occurs in some of the additional cases examined (Figure 6 and Table 2). Allowance prices in the ACESA Low Discount Case are initially higher than in the ACESA Basic Case, but they grow at the slower discount rate assumed and end up lower than in the ACESA Basic Case by 2024. Generally, the lower the return that investors in allowances are willing to accept, the greater the incentive to reduce emissions early, building a larger bank of allowances that can be used for compliance later. Relatively high allowance prices result in both the ACESA High Banking and ACESA Limited Alternatives Cases, while relatively lower prices are projected in the ACESA High Tech Case. Not shown are the prices in the ACESA 35CAFE2016 Case, which are not significantly different than in the Basic Case.

Figure 5. Projected Allowance Prices in ACESA Main Cases, 2012-2030

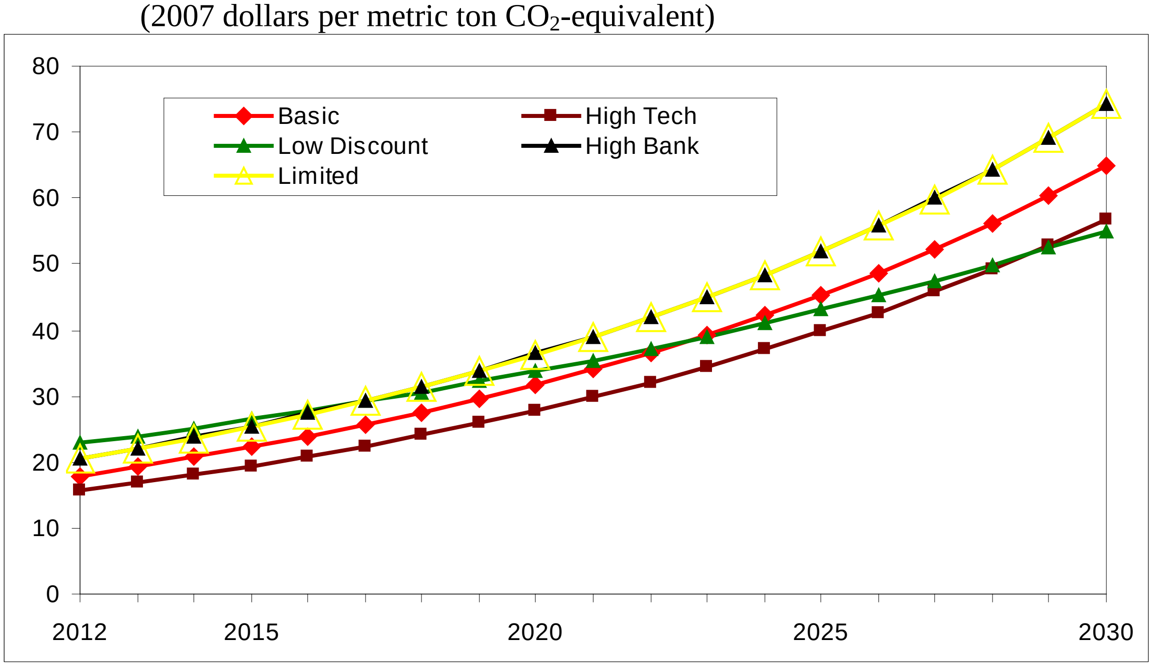
(2007 dollars per metric ton CO_2-equivalent)



Source: National Energy Modeling System runs, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 6. Projected Allowance Prices in ACESA Sensitivity Cases, 2012-2030

(2007 dollars per metric ton CO_2-equivalent)



Source: National Energy Modeling System runs HR2454CAP.D072909A, HR2454DSCT5.D072909A, HR2454HIBNK.D072909A, HR2454BIV.D072909A, and HR2454HITEK.D072909A..

Table 1. Summary Results in ACESA Main Cases

	2007	2020							2030							
			ACESA Cases							ACESA Cases						
		Refer-ence	Basic	Zero Bank	High Offsets	High Cost	No Inter-national Offsets	No Inter-national / Limited	Refer-ence	Basic	Zero Bank	High Offsets	High Cost	No Inter-national Offsets	No Inter-national / Limited
Greenhouse gas emissions (mmt)															
Covered emissions															
Energy-related carbon dioxide	4948	5910	5355	5560	5553	5417	4691	4655	6212	4408	5286	5233	4883	3626	4041
Other covered emissions	167	171	150	152	152	149	148	146	177	152	153	154	152	150	146
Total covered emissions	5114	6081	5505	5712	5705	5566	4839	4801	6389	4560	5440	5387	5034	3776	4187
Noncovered emissions	2242	1411	1388	1401	1400	1385	1377	1358	1665	1624	1634	1633	1613	1604	1599
Total greenhouse gas emissions	7357	7492	6893	7113	7105	6951	6216	6158	8054	6184	7074	7020	6647	5380	5786
Offset credits (mmt)															
Noncovered gases	0	0	35	22	23	38	46	65	0	53	43	44	64	73	78
Biogenic sequestration	0	0	251	155	161	278	385	515	0	448	292	301	481	596	676
Total domestic offset credits	0	0	286	177	183	315	431	580	0	501	335	345	545	669	754
International offset credits (post exchange)	0	0	966	135	1305	1272	0	0	0	1320	1479	1470	1361	0	0
Total domestic and international	0	0	1252	312	1488	1587	431	580	0	1821	1814	1814	1906	669	754
Total emissions net of biosequestration and international reductions (mmt)	7357	7492	5435	6789	5313	5084	5831	5643	8054	4086	4932	4882	4465	4784	5109
Cap and trade compliance summary (mmt)															
Allowances issued (cap)	n.a	5086	5086	5086	5086	5086	5086	5086	3554	3554	3554	3554	3554	3554	3554
Covered emissions, less offset credits	5114	6081	4254	5400	4217	3979	4409	4221	6389	2739	3625	3573	3128	3107	3433
Net allowance bank change	0	0	833	-313	870	1107	678	866	0	815	-71	-18	426	447	122
Allowance bank balance	0	0	4616	-930	10122	6221	6033	8720	0	13085	-35	13069	13040	12774	13186
Allowance and offset prices (2007 dollars per metric ton CO2 equivalent)															
Emission allowance	0.0	0.0	31.7	19 9	20.5	35.4	52.1	93.3	0.0	64.8	40 6	41.9	72 2	106.4	190.5
Domestic offset	0.0	0.0	31.7	19 9	20.5	35.4	52.1	93.3	0.0	64.8	40 6	41.9	72 2	106.4	134.0
International offset	0.0	0.0	25.4	15 9	16.4	28 3	41.7	74.6	0.0	22.6	23 3	33.5	22 8	85.1	152.4
Delivered energy prices (including allowance cost after adjustment for free allocations) (2007 dollars per unit indicated)															
Motor gasoline, transport (per gallon)	2.82	3.62	3.82	3.74	3.74	3.84	3.97	4 29	3.82	4.17	4.02	4.03	4.31	4.51	5.10
Jet fuel (per gallon)	2.17	3.02	3.28	3.18	3.18	3.32	3.48	3 85	3.33	3 80	3.58	3.59	3.85	4.18	4 97
Diesel (per gallon)	2.87	3.64	3.90	3.79	3.79	3.92	4.08	4.48	3.88	4 36	4.13	4.15	4.44	4.75	5 61
Natural gas (per thousand cubic feet)															
Residential	13.05	12.91	13.27	13.07	13.10	13.59	13.72	15 91	14.35	16 81	15.49	15.51	18.00	19.06	25.17
Electric power	7.22	7.22	8.52	7.93	8 00	9.08	9.65	13 89	8.57	10.44	9.18	9.20	11.84	12.72	19.49
Coal, electric power sector (per million Btu)	1.78	1.96	4.84	3.76	3 82	5.18	6.60	10.47	2.04	7 82	5.71	5.83	8.64	11.49	19 38
Electricity (cents per kilowatthour)	9.10	9.27	9.51	9.51	9 55	9.65	9.59	10 69	10.05	12 01	11.08	11.12	12.98	12.69	17 83
Energy consumption (quadrillion Btu)															
Liquid fuels	40.8	38.7	37 5	37.7	37.8	37 6	37.3	37.0	40.3	38.3	38 9	38.9	38.4	37.7	37.0
Natural gas	23.7	22.1	21 5	21 6	21.6	22 0	21.5	25.4	24.2	21.1	21.4	21.5	23 0	21.0	26.5
Coal	22.7	24.4	20 6	22 0	21.9	20 2	14.4	10.5	25.4	14.0	20 5	20.2	16 5	6.2	3.9
Nuclear power	8.4	9.1	9 8	9.4	9.4	9.1	10.6	9.1	9.3	16.2	12 0	12.0	9 6	19.4	9.3
Renewable/Other	6.3	10.4	12 2	11.4	11.5	12 5	17.0	15.3	11.8	14.9	14.1	14.2	15 5	18.8	19.3
Total	101 9	104.7	101 6	102.1	102.1	101 3	100.8	97.5	111.0	104.5	106 8	106.7	103 0	103.2	96.0
Purchased electricity	12.8	14.1	13 8	13 8	13.8	13.7	13.7	13.3	15.4	14.5	14.7	14.7	14 2	14.3	13.0
Electricity generation (billion kilowatthours)															
Petroleum	66	49	46	47	46	47	44	45	50	43	46	46	45	41	43
Natural gas	892	714	694	696	704	770	700	1320	976	704	717	721	1040	739	1638
Coal	2021	2198	1875	2003	1987	1833	1309	943	2311	1354	1912	1897	1574	540	300
Nuclear power	806	876	940	904	904	869	1018	876	890	1548	1147	1151	923	1863	890
Renewable/Other	374	736	907	832	837	930	1364	1118	827	1048	1007	1015	1004	1426	1346
Total	4159	4573	4462	4481	4479	4449	4436	4303	5055	4697	4830	4829	4587	4608	4216

mmt: million metric tons of carbon dioxide equivalent

Source: National Energy Modeling System, runs ST MULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NO NT.D072909A, and HR2454NIBIV.D072909A

Note: 2007 total covered emissions reflect the coverage of H.R. 2454 as defined in 2012.

Table 2. Summary Results in ACESA Sensitivity Cases

	2007	2020							2030						
			ACESA Cases							ACESA Cases					
		Refer-ence	Basic	High Tech	Low Discount	35CAFE-2016	High Bank	Limited Alter-natives	Refer-ence	Basic	High Tech	Low Discount	35CAFE-2016	High Bank	Limited Alter-natives
Greenhouse gas emissions (mmt)															
Covered emissions															
Energy-related carbon dioxide	4948	5910	5355	5259	5361	5352	5173	5486	6212	4408	4300	4906	4392	4015	4856
Other covered emissions	167	171	150	151	150	150	150	149	177	152	154	153	153	152	151
Total covered emissions	5114	6081	5505	5410	5511	5502	5323	5635	6389	4560	4454	5059	4545	4167	5007
Noncovered emissions	2242	1411	1388	1392	1386	1388	1384	1384	1665	1624	1627	1628	1624	1611	1611
Total greenhouse gas emissions	7357	7492	6893	6802	6897	6890	6707	7020	8054	6184	6081	6687	6169	5778	6618
Offset credits (mmt)															
Noncovered gases	0	0	35	31	36	34	38	38	0	53	50	49	52	66	66
Biogenic sequestration	0	0	251	220	266	249	285	285	0	448	408	395	446	489	488
Total domestic offset credits	0	0	286	251	303	284	323	323	0	501	458	444	498	555	554
International offset credits (post exchange)	0	0	966	662	1136	945	1251	1295	0	1320	1302	1411	1318	1195	1347
Total domestic and international	0	0	1252	912	1439	1229	1574	1618	0	1821	1760	1855	1816	1750	1902
Total emissions net of biosequestration and international reductions (mmt)	7357	7492	5435	5755	5211	5459	4858	5116	8054	4086	4045	4528	4075	3795	4445
Cap and trade compliance summary (mmt)															
Allowances issued (cap)	n.a	5086	5086	5086	5086	5086	5086	5086	3554	3554	3554	3554	3554	3554	3554
Covered emissions, less offset credits	5114	6081	4254	4498	4072	4273	3748	4017	6389	2739	2694	3204	2728	2417	3105
Net allowance bank change	0	0	833	589	1015	814	1338	1069	0	815	861	350	826	1137	449
Allowance bank balance	0	0	4616	3649	6700	4518	8067	6305	0	13085	12680	12937	13000	19856	13051
Allowance and offset prices (2007 dollars per metric ton CO2 equivalent)															
Emission allowance	0.0	0.0	31.7	27 8	33.8	31 5	36.4	36 3	0.0	64.8	56.8	55 0	64.3	74.3	74 2
Domestic offset	0.0	0.0	31.7	27 8	33.8	31 5	36.4	36 3	0.0	64.8	56.8	55 0	64.3	74.3	74 2
International offset	0.0	0.0	25.4	22 2	27.0	25 2	28.1	28 5	0.0	22.6	22.5	23 0	22.6	22.1	22.7
Delivered energy prices (including allowance cost after adjustment for free allocations) (2007 dollars per unit indicated)															
Motor gasoline, transport (per gallon)	2 82	3.62	3.82	3.77	3.83	3.80	3 85	3.85	3 82	4.17	4.12	4.11	4.15	4 34	4.33
Jet fuel (per gallon)	2.17	3.02	3.28	3 24	3.31	3.28	3 32	3.33	3 33	3.80	3.70	3.70	3.79	3 88	3.87
Diesel (per gallon)	2 87	3.64	3.90	3 84	3.91	3.88	3 93	3.93	3 88	4.36	4.24	4.27	4.36	4.46	4.45
Natural gas (per thousand cubic feet)															
Residential	13 05	12.91	13.27	13.01	13.23	13.21	13 22	13.64	14 35	16.81	16.13	16.26	16.78	17 30	18.66
Electric power	7 22	7.22	8.52	8 08	8.60	8.44	8 58	9.15	8 57	10.44	9.72	9.94	10.40	10 99	12.67
Coal, electric power sector (per million Btu)	1.78	1.96	4.84	4.43	5.03	4.82	5 24	5.29	2 04	7.82	6.96	7.00	7.77	8 58	8.74
Electricity (cents per kilowatthour)	9.10	9.27	9.51	9.15	9.61	9.47	9.42	9.65	10 05	12.01	11.32	11.62	11.97	12 33	13.36
Energy consumption (quadrillion Btu)															
Liquid fuels	40.8	38.7	37.5	37 3	37.6	37 3	37.6	37 6	40.3	38.3	37.9	38 6	38.0	38.1	38 5
Natural gas	23.7	22.1	21.5	21.1	22.0	21.4	21.2	22 0	24.2	21.1	20.3	21.4	21.1	20.8	24.1
Coal	22.7	24.4	20.6	19 8	20.2	20 8	18.9	20 8	25.4	14.0	12.3	18 0	13.9	10.0	12 8
Nuclear power	8.4	9.1	9.8	10 3	9.5	9 8	10.0	9.1	9.3	16.2	17.0	13 0	16.5	18.5	9 3
Renewable/Other	6.3	10.4	12.2	12 2	12.2	12 2	14.4	11 5	11.8	14.9	15.8	14 3	14.7	16.7	17 2
Total	101.9	104.7	101.6	100 8	101.5	101.4	102.1	101.1	111.0	104.5	103.4	105 3	104.3	104.1	101 9
Purchased electricity	12.8	14.1	13.8	13 6	13.7	13 8	13.8	13.7	15.4	14.5	14.1	14 6	14.5	14.4	14.1
Electricity generation (billion kilowatthours)															
Petroleum	66	49	46	46	46	46	45	46	50	43	42	44	43	42	45
Natural gas	892	714	694	645	755	681	646	780	976	704	593	731	699	671	1256
Coal	2021	2198	1875	1802	1837	1893	1726	1906	2311	1354	1154	1712	1341	947	1179
Nuclear power	806	876	940	989	909	937	963	876	890	1548	1634	1249	1582	1775	890
Renewable/Other	374	736	907	932	907	910	1092	836	827	1048	1212	1011	1039	1227	1182
Total	4159	4573	4462	4481	4479	4449	4436	4303	5055	4697	4830	4829	4587	4608	4216

mmt: million metric tons of carbon dioxide equivalent

Source: National Energy Modeling System, runs STIMULUS D041409A, HR2454CAP.D072909A, HR2454HITEK.D072909A, HR2454DSCT5.D072909A, HR2454CAFE.D072909A, HR2454H BNK D072909A, and HR2454BIV.D072909A

Note: 2007 total covered emissions reflect the coverage of H.R. 2454 as defined in 2012.

The lower emissions under the somewhat higher Corporate Average Fuel Economy (CAFE) standards in the early part of the projection occur gradually and do not significantly shift aggregate long-term abatement costs at the margin.

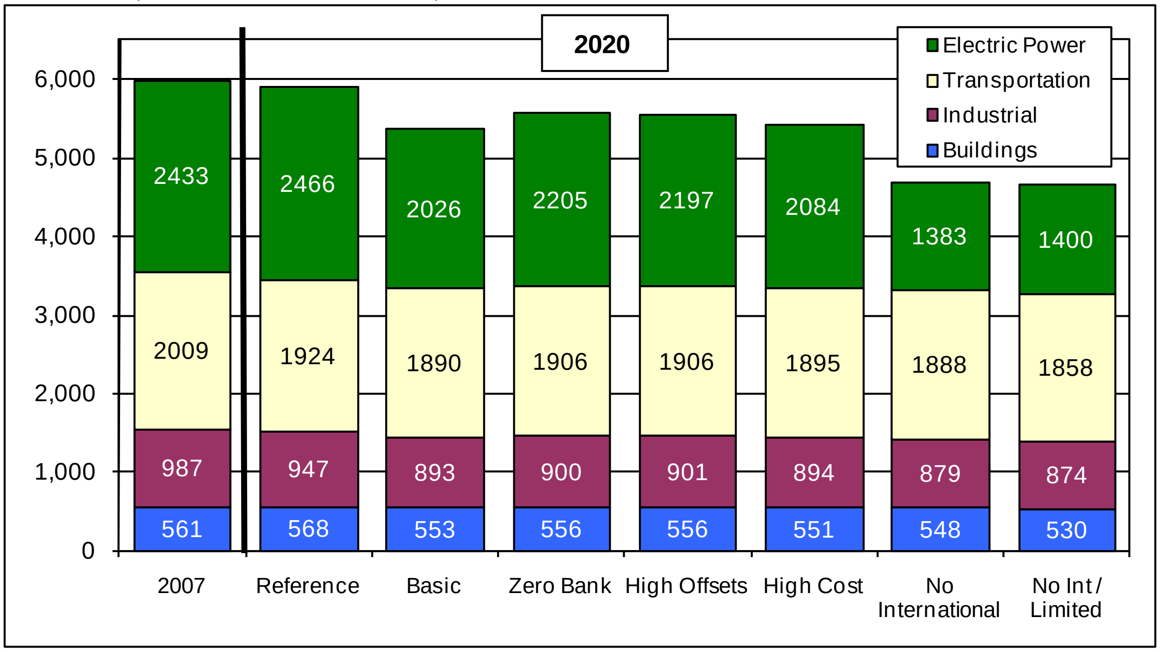
Domestic and international offset prices are closely tied to allowance prices and ACESA's limits on offset usage. Estimated domestic offset usage, which may be constrained by the pro-rata percentage limit imposed on covered emissions, varies across the cases and over time, ranging from 75 to 290 MMT in 2012, from 177 to 580 MMT in 2020, and from 335 to 754 MMT in 2030. In all but one of the main cases examined, the ACESA No International/Limited Case, the estimated quantity of domestic offset credits falls below the pro-rata limits throughout the projection. When offset usage is below the limit, the offset credit price is assumed to match the allowance price. In the No International/Limited Case, the case with the highest allowance prices, the domestic offset limit is reached in 2024 through 2030. Beginning in 2024, competition to supply a limited quantity of offsets drives the offset price below the allowance price.

The limit on international offset credits is initially established to match the domestic limit but is adjusted higher (by up to 500 MMT, or 1,000 MMT less the anticipated domestic offset usage) if domestic offset usage is anticipated to be less than 900 MMT. In the cases where international offsets are assumed to be available, the adjusted international offset limit ranges from 1,196 to 1,479 MMT in 2030, with the estimated limit in the ACESA Basic Case of 1,320 MMT falling in the middle of that range. Given the assumed offset supplies available, international offsets limits are projected to be reached in all of these cases. In the ACESA High Offsets Case, the maximum allowable quantity of international offsets is assumed to be used beginning in 2012, resulting in much lower levels of abatement and allowance prices than in the ACESA Basic Case.

Energy-Related Carbon Dioxide Emissions

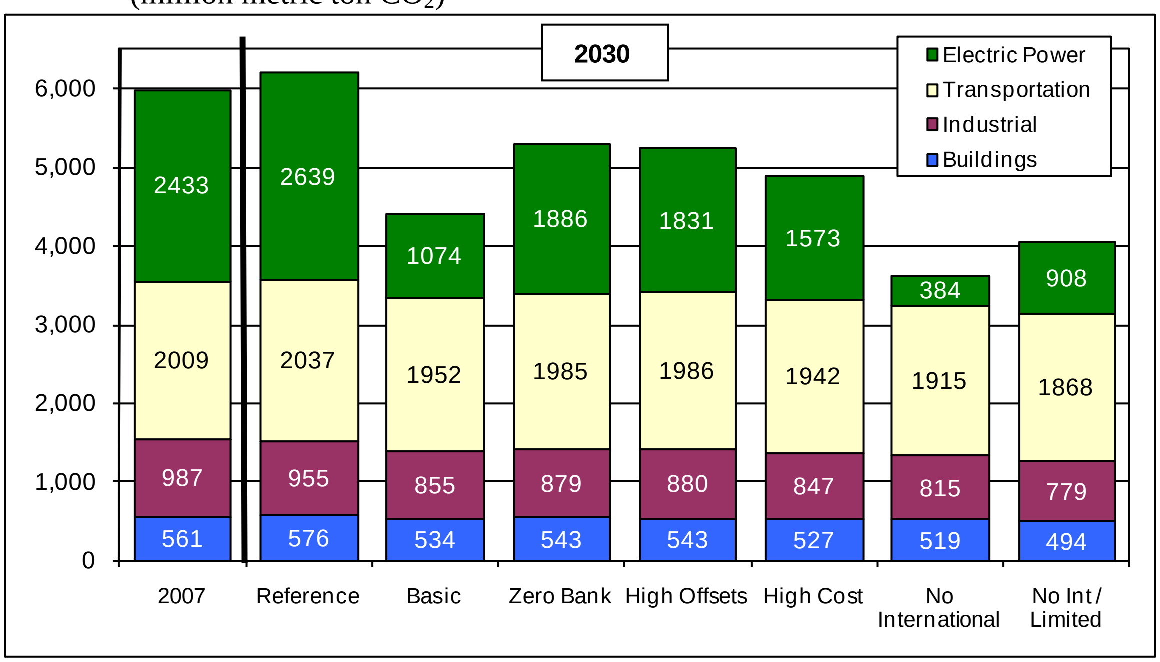
The allowance program and other incentives under ACESA are expected to reduce energy-related CO_2 emissions. The vast majority of the energy-related emissions reductions are expected to occur in the electricity sector (Figures 7 and 8). In fact, across the ACESA main cases, the electricity sector accounts for between 80 percent and 88 percent of the total reduction in energy-related CO_2 emissions relative to the Reference Case in 2030. The electricity sector reductions stem from the use of more efficient, less carbon-intensive sources of generation. This results from a variety of factors, particularly the industry's current dependence on coal, the availability and economics of technologies to switch from coal to less carbon-intensive energy sources, and the comparative economics of fuel switching in other sectors. In addition, a portion of the electricity-related CO_2 emissions reductions results from reduced electricity demand stimulated both by consumers' responses to higher electricity prices and incentives in ACESA to stimulate greater efficiency in energy use.

Figure 7. Energy-Related CO_2 Emissions by Sector in ACESA Main Cases, 2020
(million metric ton CO_2)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 8. Energy-Related CO_2 Emissions by Sector in ACESA Main Cases, 2030
(million metric ton CO_2)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Energy Market Impacts

Energy consumers are expected to face higher costs of using energy as a result of the ACESA cap-and-trade program. To the extent that they are not ameliorated by the free distribution of allowances to regulated distribution companies, the cost of the allowances required to be submitted by covered sources will tend to be passed on to consumers of primary fuels through higher delivered energy prices. Table 1, presented earlier, summarizes the projected impacts on the delivered cost of energy under ACESA. Detailed projection tables on energy production, consumption, and prices for each case accompany the presentation of this report on EIA's web site.[11]

Energy-related emissions will be influenced by both the higher energy costs from the allowance program, as well as the ACESA incentives that promote energy efficiency and low-carbon fuel sources. Overall, the use of fossil fuels generally decreases relative to the Reference Case, while the use of renewable energy sources and nuclear power increases (Figure 9). As discussed earlier, the greatest changes occur in the electricity sector, with reductions in the use of coal and increases in nuclear and renewable fuels in most cases, relative to the Reference Case. The impacts tend to grow over time as the caps become more stringent and the allowance price increases.

Electricity Sector Emissions, Generation, and Prices

The provisions of ACESA alter electric power projections by favoring low-carbon technologies such as new nuclear, renewable, and fossil plants that sequester CO_2. The impact on CCS technology is also affected by the provisions that provide additional incentives for these plants. The shifts in the generation mix caused by ACESA lead to lower CO_2 emissions from the electricity sector, higher electricity prices (particularly after 2025) and lower electricity demand than would otherwise occur. The higher electricity prices are due to the higher capital costs of cleaner, more efficient technologies and the costs of holding allowances.

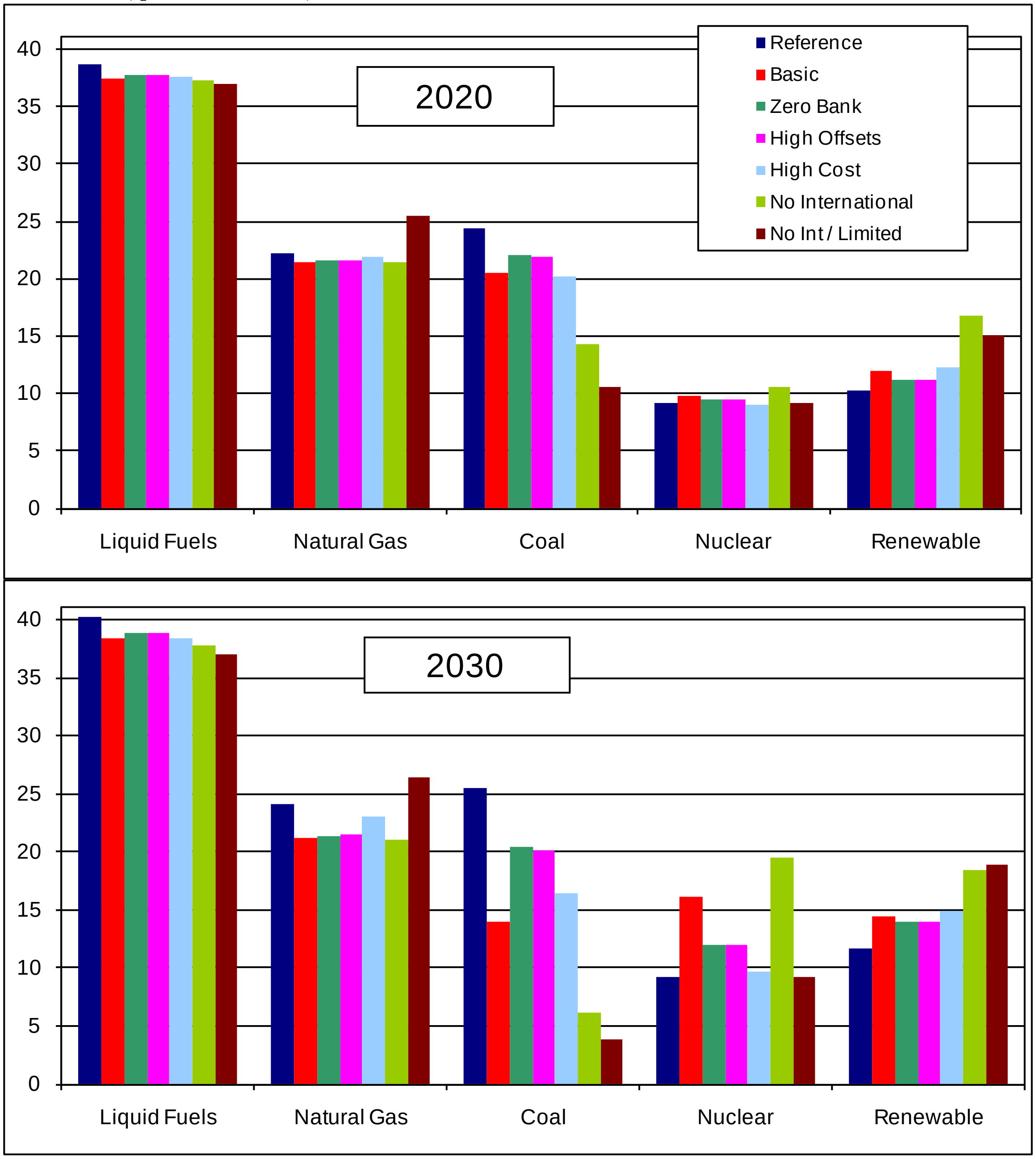
Emissions

In the Reference Case, which assumes no explicit policy to reduce GHG emissions, power sector CO_2 emissions are projected to increase 8 percent between 2007 and 2030 as the industry increases its use of fossil fuels (Figure 10). In the main ACESA cases, power sector CO_2 emissions are expected to be 11 percent to 44 percent below the Reference Case level in 2020 and 29 percent to 85 percent below the Reference Case level in 2030. The electricity sector, in fact, accounts for the vast majority of the energy-related CO_2 emissions reductions expected to occur under ACESA, with its share ranging from 79 to 88 percent in 2030 across the main ACESA cases. The largest changes in electricity emissions occur in the cases where it is assumed that international offsets are not available. Without these offsets, covered U.S. entities must make larger reductions in their own emissions to comply with the emissions cap established in ACESA. In contrast, the smallest change occurs in the ACESA High Offsets Case where

[11] See www.eia.doe.gov/oiaf/service_rpts.htm.

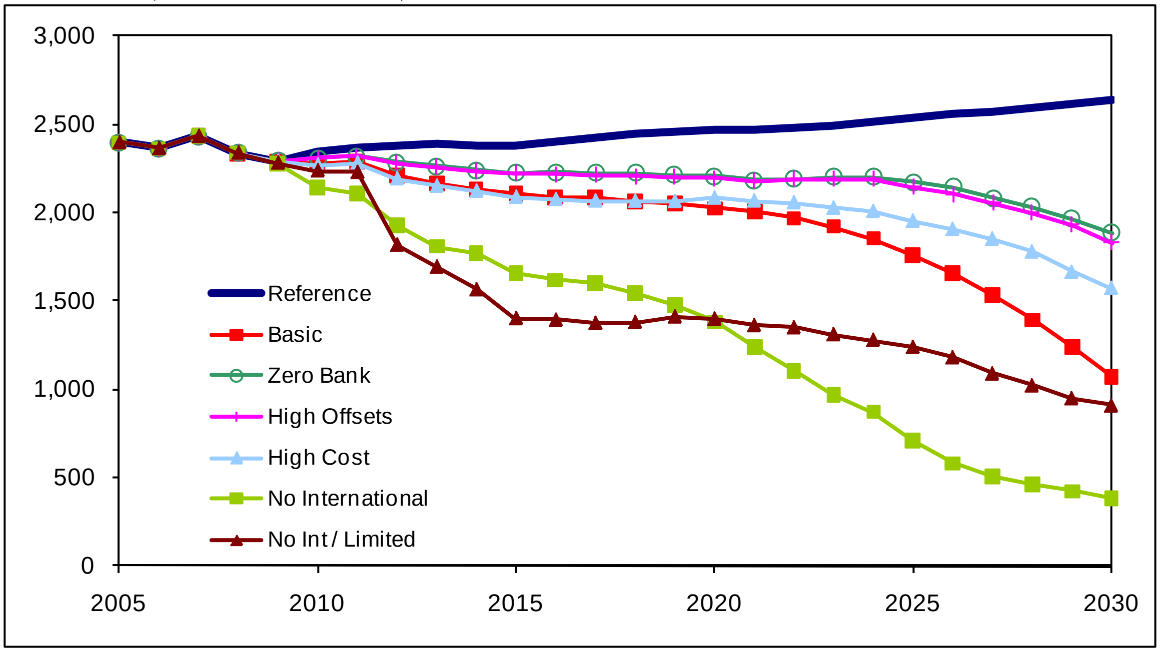
covered entities are assumed to be able to rely more on international offsets as compliance options.

Figure 9. Total Energy Consumption by Source in ACESA Main Cases
(quadrillion Btu)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 10. Electricity Sector CO_2 Emissions in ACESA Main Cases, 2005-2030
(million metric tons)



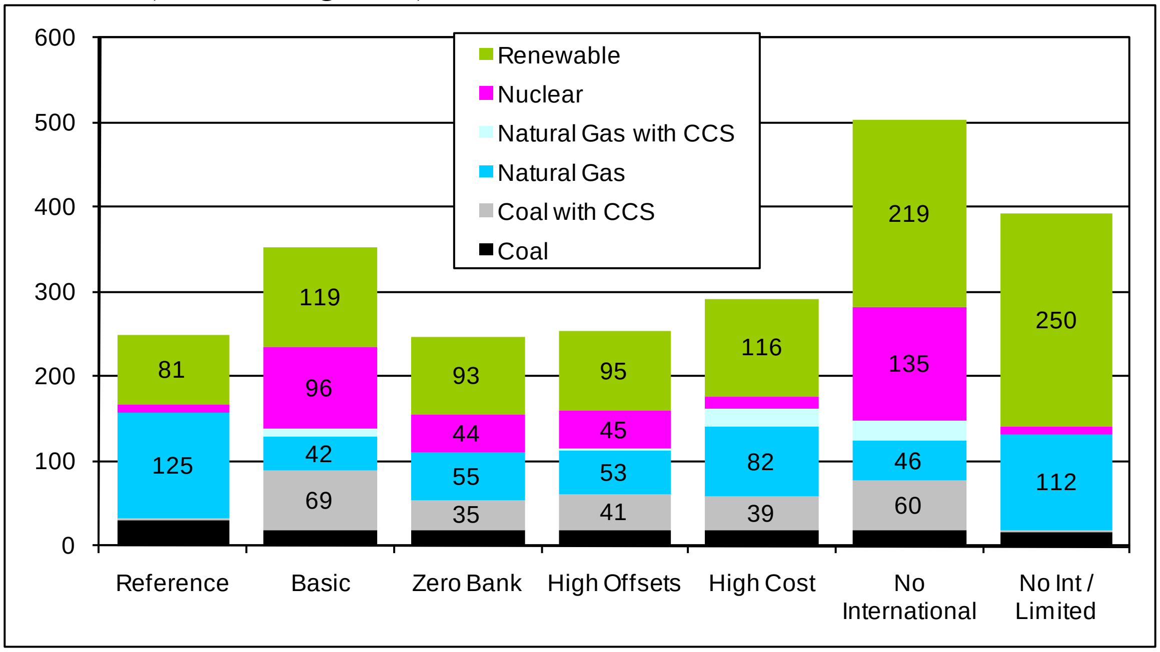
Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Capacity and Generation

In the Reference Case, which does take account of growing concerns about GHG emissions, natural gas plants and renewable plants meet a large share of new capacity requirements through 2030 (Figure 11). Natural-gas-fired generation, with a CO_2 emission rate roughly 40 percent that of conventional coal-fired generation, gains competitiveness relative to coal but loses competitiveness relative to carbon-free technologies under the ACESA cap-and-trade program. The efficiency and cap-and-trade programs in ACESA also have the effect of reducing projected growth in electricity demand, which reduces the need for all generation sources.

Under ACESA, new coal builds without CCS beyond those that are already under construction are almost eliminated. There is also a large increase in coal power plant retirements with between 6 and 85 percent of existing coal capacity projected to retire by 2030 in the ACESA main cases, well above the 1 percent of existing coal capacity projected to retire in the Reference Case. These retiring coal plants are replaced by a combination of new nuclear, renewable, and coal plants with CCS. The Reference Case projects 11 gigawatts of new nuclear capacity by 2030, but under ACESA, nuclear builds by 2030 range from 15 gigawatts to 135 gigawatts, when allowed to grow. Renewable capacity also grows significantly, representing between 33 percent and 63 percent of all new capacity added between 2008 and 2030 across the ACESA main cases.

Figure 11. Cumulative Capacity Additions in ACESA Main Cases, 2007-2030
(thousand megawatts)

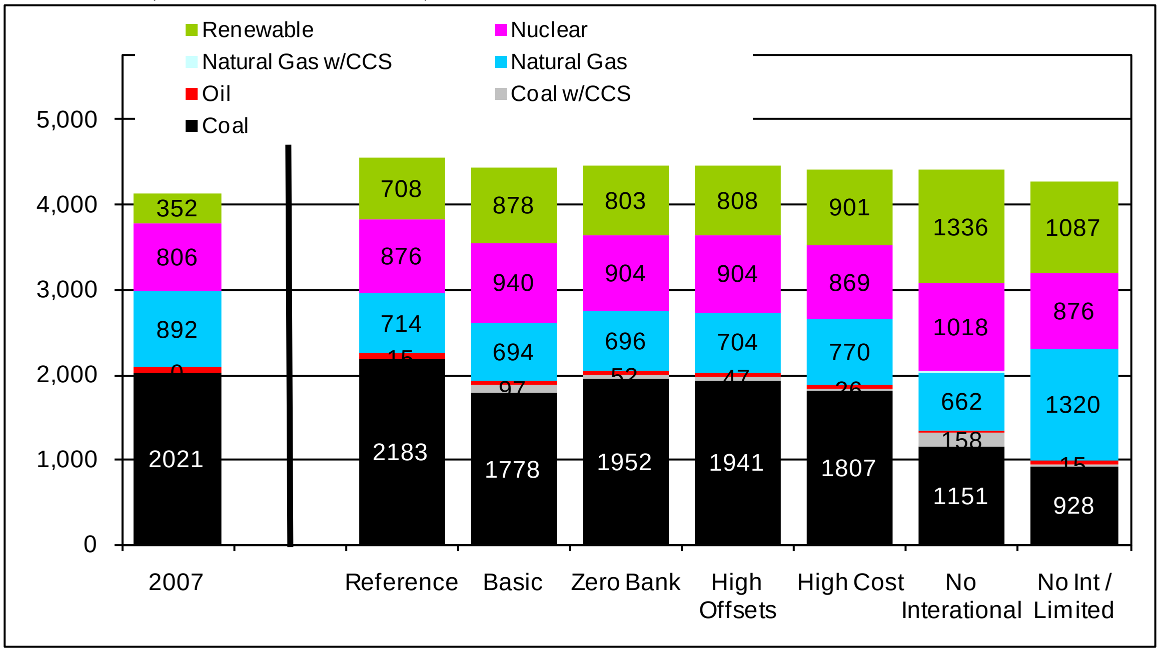


Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

When technologies with CCS, nuclear, and biomass are limited to Reference Case levels, as could occur if the technologies prove more costly, take longer to develop, and/or meet with strong market resistance, the addition of new renewable and natural gas capacity grows significantly. In the ACESA Basic Case, natural gas additions are below those in the Reference Case, since CCS is not as economic on combined-cycle plants as on coal plants, and other non-fossil technologies are built instead of natural-gas-fired plants without CCS.

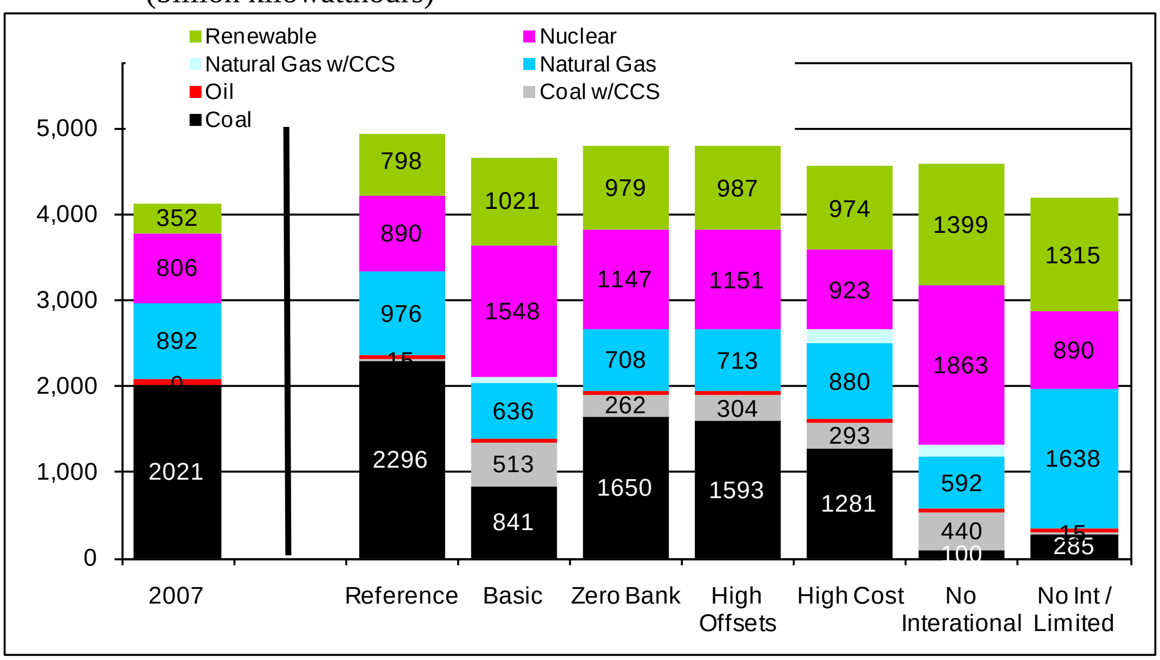
Changes in electricity generation are consistent with capacity choices and are influenced by the GHG allowance price (Figures 12 and 13). In the Reference Case, coal generation grows to 2,311 billion kilowatthours in 2030, an increase of 14 percent over 2007 levels, providing 46 percent of total electricity needs. In the ACESA main cases, coal generation drops, with its generation share in 2030 dropping to between 7 percent and 40 percent. Although some new coal capacity with CCS is added in most cases, the increased generation from these new plants is more than offset by reductions from the retirement of existing coal capacity. In the ACESA High Cost, Zero Bank, and High Offsets Cases, coal generation is above that in the ACESA Basic Case, but still much lower than the Reference Case. In those cases, the higher costs of new coal plants with CCS, the availability of greater international offsets, and/or reduced banking result in fewer coal retirements than in the ACESA Basic Case.

Figure 12. Generation by Fuel in ACESA Main Cases, 2020
(billion kilowatthours)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 13. Generation by Fuel in ACESA Main Cases, 2030
(billion kilowatthours)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Nuclear generation follows the capacity additions, growing most significantly in the ACESA No International and ACESA Basic Cases. In the Reference Case, nuclear generation grows by 10 percent between 2007 and 2030, reaching 890 billion kilowatthours and providing 18 percent of total generation. In the ACESA Basic Case, nuclear grows to 1,548 billion kilowatthours in 2030, nearly 74 percent more than the Reference Case level. If nuclear costs are higher than expected, then new nuclear capacity additions are still projected but at a level only slightly above that seen in the Reference Case in 2030.

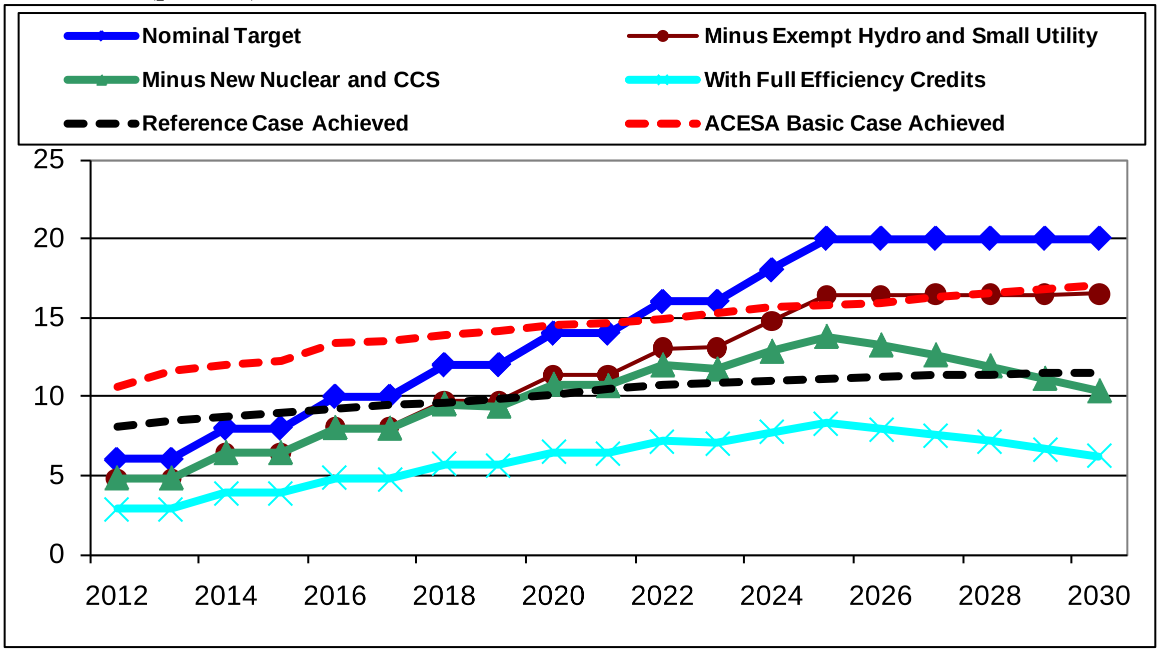
In most of the ACESA cases, natural gas generation in 2030 is lower than in the Reference Case. In the Reference Case, natural gas generation increases 9 percent by 2030, relative to the 2007 level. However, in the ACESA Basic Case, natural gas generation falls 21 percent between 2007 and 2030. In the ACESA No International/Limited Case, natural gas generation is 68 percent above the Reference Case level by 2030, due to the assumed limited availability of new plants with CCS, as well as new nuclear and biomass capacity. This case demonstrates the role of the development and deployment of key low-carbon generating technologies like nuclear, renewables, and fossil with CCS in a timeframe consistent with the emission reduction requirements of ACESA. Without them, allowance prices would be higher and greater demands would be placed on natural gas markets.

Renewable generation is dramatically higher under the provisions of ACESA, growing to between 22 percent and 75 percent above the generation level in the Reference Case in 2030. The vast majority of the increase is from wind generation, followed by biomass generation. The increase in biomass generation in the ACESA cases comes from a combination of increased cofiring of biomass in existing coal plants and the addition of new dedicated biomass plants. In most cases, cofiring dominates, particularly in the early years of the projections. However, as new dedicated biomass plants are added, they play a larger role in the later years. Cofiring is generally an economic way to reduce CO_2 emissions without investing in new capacity, but as the allowance price increases throughout the projections, the economics begin to shift towards less CO_2-intensive generation.

The share of renewable generation far exceeds that required to comply with the combined efficiency and renewable electricity standard in all of the ACESA cases. As shown in Figure 14, the nominal share of renewables required to comply with the target, assuming no efficiency credits, grows to a final target of 20 percent. When the required share is adjusted for the exemption of small utilities and the removal of hydroelectric generation from the baseline, the national average required share falls to approximately 16.5 percent. Moreover, the national average required share falls to just over 10 percent when the generation contribution from new nuclear and fossil plants with CCS is removed from the baseline for renewable electricity standard calculations in the ACESA Basic Case. After these adjustments, the level of renewable generation in the Reference Case exceeds the requirement in 2025 and beyond, while the level in the ACESA Basic Case far exceeds it.

Figure 14. Renewable Electricity Standard Compliance in the ACESA Basic Case, 2012-2030

(percent)



Source: National Energy Modeling System runs, STIMULUS.D041409A and HR2454CAP.D072909A.

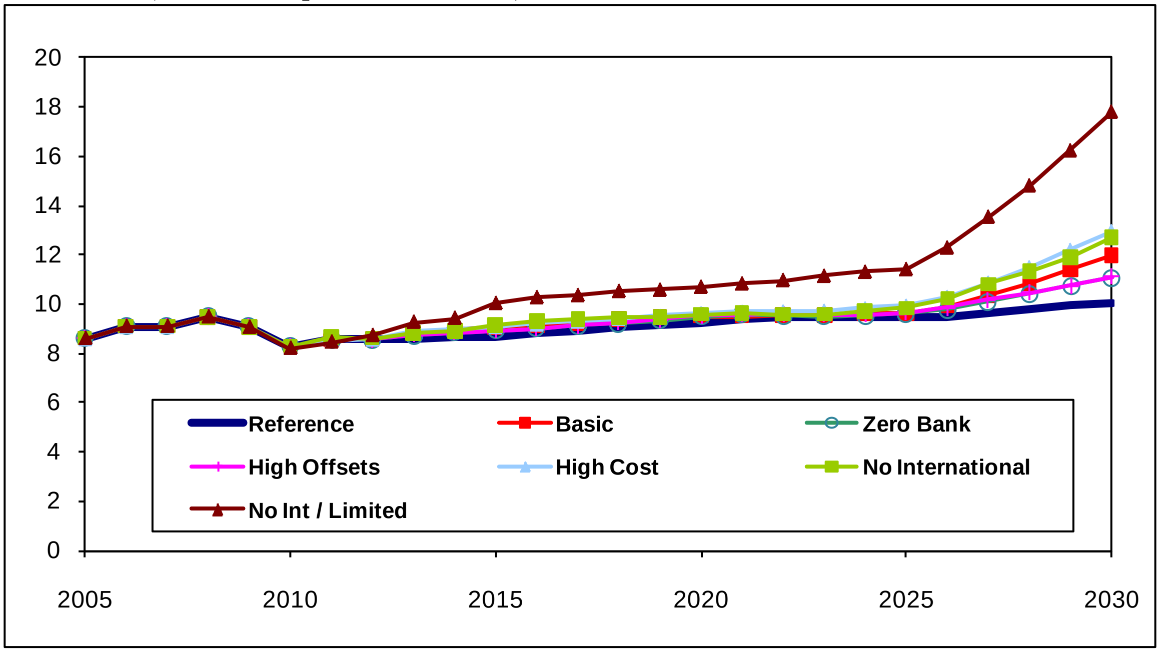
Price and Demand

H.R. 2454 is projected to lead to higher electricity prices and lower electricity demand, though most of the price impacts are expected after 2025, as the allowances allocated to retail electricity providers are phased out. Except for the ACESA No International/Limited Case, electricity prices in five of the six main ACESA cases range from 9.5 to 9.6 cents per kilowatthour in 2020, only 3 to 4 percent above the Reference Case level (Figure 15).[12] Average impacts on electricity prices in 2030 are projected to be substantially greater, reflecting both higher allowance prices and the phase-out of the free allocation of allowances to distributors between 2025 and 2030. By 2030, electricity prices in the ACESA Basic Case are 12.0 cents per kilowatthour, 19 percent above the Reference Case level, with a wider band of 11.1 cents to 17.8 cents (10 to 77 percent above the Reference Case level) across all six main policy cases.

The combination of higher electricity prices and provisions in H.R. 2454 designed to improve energy efficiency causes growth in the demand for electricity to slow relative to the Reference Case in the main ACESA cases. The long-term trend of slowing growth in the demand for electricity is reflected in the Reference Case. After averaging nearly 2.4 percent per year in the 1990s and 1.2 percent per year between 2000 and 2007, the demand for electricity is projected to increase just 0.9 percent per year between 2007 and 2030 in the Reference Case (Figure 16). This projection reflects ongoing improvements in appliance efficiency, new appliance standards, and consumer responses to higher electricity prices. Among the main ACESA cases the growth slows further, ranging from 0.2 percent per year to 0.7 percent per year between 2007 and 2030.

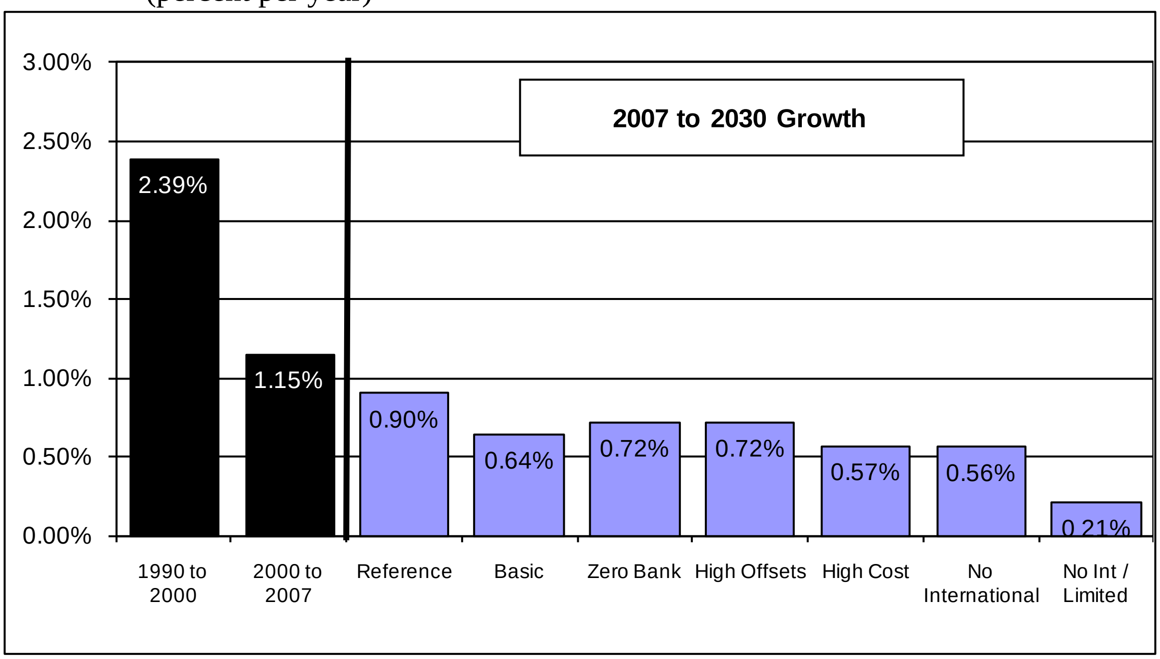
[12] The average electricity price in the No International/Limited case in 2020 is 10.7 cents per kilowatthour.

Figure 15. Electricity Prices in Main ACESA Cases, 2005-2030
(2007 cents per kilowatthour)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 16. Electricity Demand Growth in Main ACESA Cases, 2007-2030
(percent per year)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

The impacts on regional electricity prices vary for many reasons including the demand characteristics, the mix of generating sources used, the availability and delivered prices of different resources and fuels, the regulatory regime, and the local costs of construction (Figure 17). Generally, the largest changes in prices caused by the provisions of H.R. 2454 would be expected in regions that are most reliant on coal, regions without large renewable resources that can be developed, and regions where electricity prices are set competitively. However, since retail distributers remain regulated in all regions it is assumed that the benefit of allowances allocated to them for free will be passed on to their consumers. This significantly dampens the prices impacts of ACESA through 2025 in all regions.

As shown in Figure 17, all regions are expected to see prices increases in most of the ACESA cases by 2030. Regions like the Northwest Power Pool (NWP) and California, which do not rely heavily on coal, continue to have regulated prices, and have significant renewable resources, are projected to see relatively modest prices increases in the ACESA main cases.

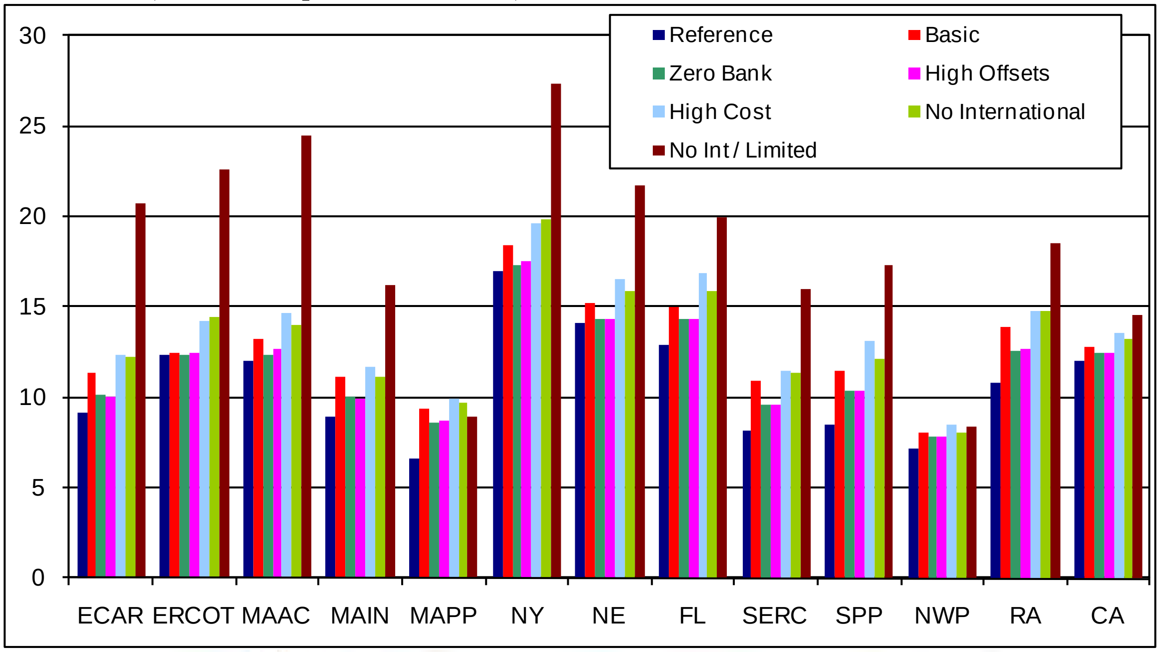
Coal Markets

Because coal has the highest carbon content of any of the key fossil fuels, the cost of using coal when a GHG cap-and-trade program is imposed increases dramatically (Figures 18 and 19). For example, in 2020 the cost of using coal in a plant that does not have CCS equipment is between 92 percent and 435 greater in the main ACESA cases than in the Reference Case. By 2030 the increase in coal costs to a plant without CCS equipment is even larger, ranging from 179 percent to 848 percent greater than in the Reference Case in the main ACESA cases. The vast majority of this cost increase is due to the need to hold allowances to cover the CO_2 emissions that will be generated when the coal is used to produce electricity. The underlying delivered price of coal without the allowance costs is actually lower in the ACESA cases because of the reduced consumption of coal.

As a result of the reduced use of coal for electricity generation, coal production volumes (in tons) are projected to be 19 to 83 percent lower in the ACESA main cases in 2030 compared to the Reference Case (Figure 20). Lower coal consumption in the ACESA main cases disproportionately affects western coal producers, because they are expected to meet most of the growth in coal demand in the Reference Case.

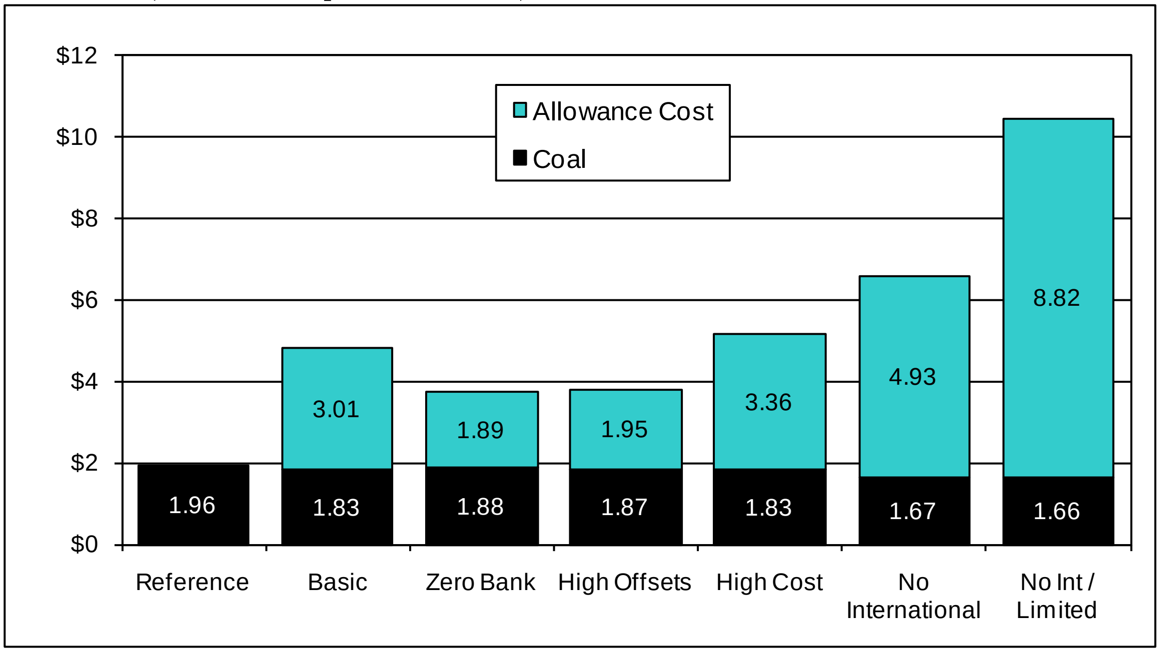
Figure 17. Regional Electricity Prices in ACESA Main Cases, 2030

(2007 cents per kilowatthour)



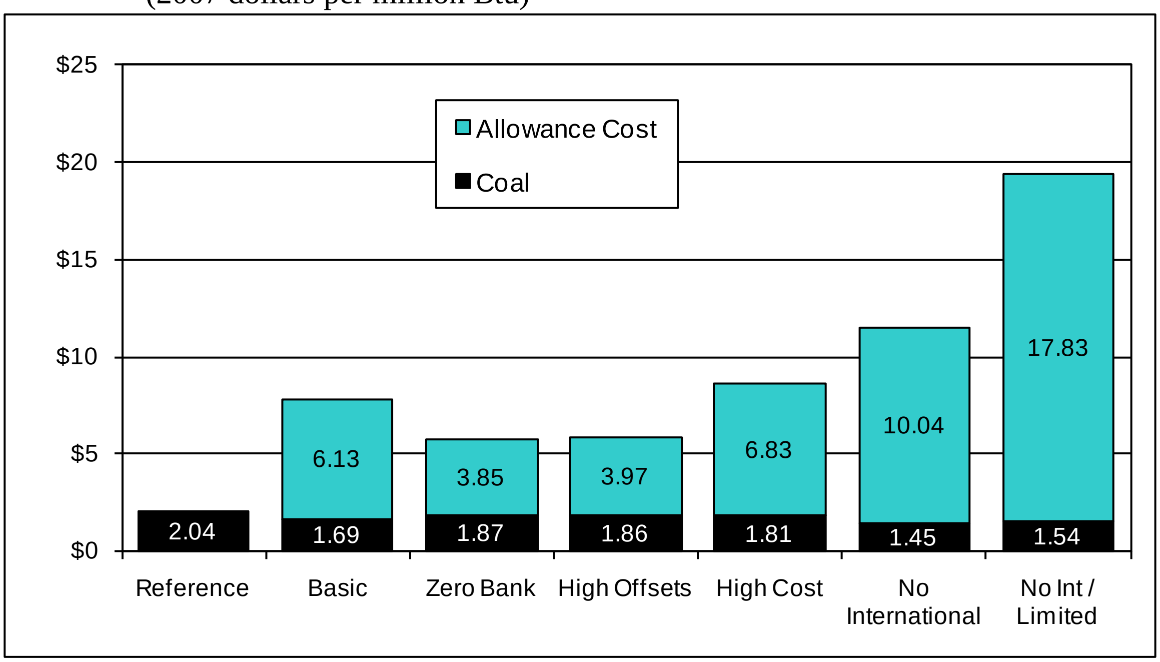
1 East Central Area Reliability Coordination Agreement (ECAR)
2 Electric Reliability Council of Texas (ERCOT)
3 Mid-Atlantic Area Council (MAAC)
4 Mid-America Interconnected Network (MAIN)
5 Mid-Continent Area Power Pool (MAPP)
6. New York (NY)
7. New England (NE)
8. Florida Reliability Coordinating Council (FL)
9. Southeastern Electric Reliability Council (SERC)
10. Southwest Power Pool (SPP)
11. Northwest Power Pool (NWP)
12. Rocky Mountain Power Area, Arizona, New Mexico, and Southern Nevada (RA)
13. California (CA)

Figure 18. Coal Costs to Electricity Producers in ACESA Main Cases, 2020
(2007 dollars per million Btu)



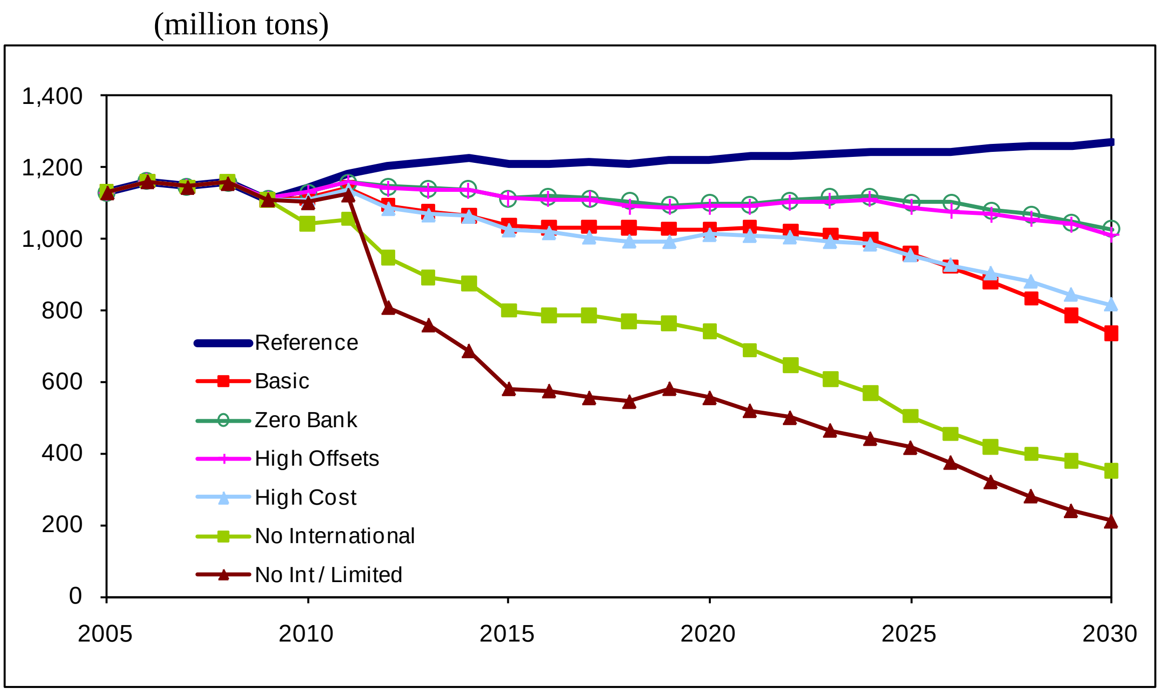
Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 19. Coal Costs to Electricity Producers in ACESA Main Cases, 2030
(2007 dollars per million Btu)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 20. Coal Production in ACESA Main Cases, 2005-2030



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Buildings

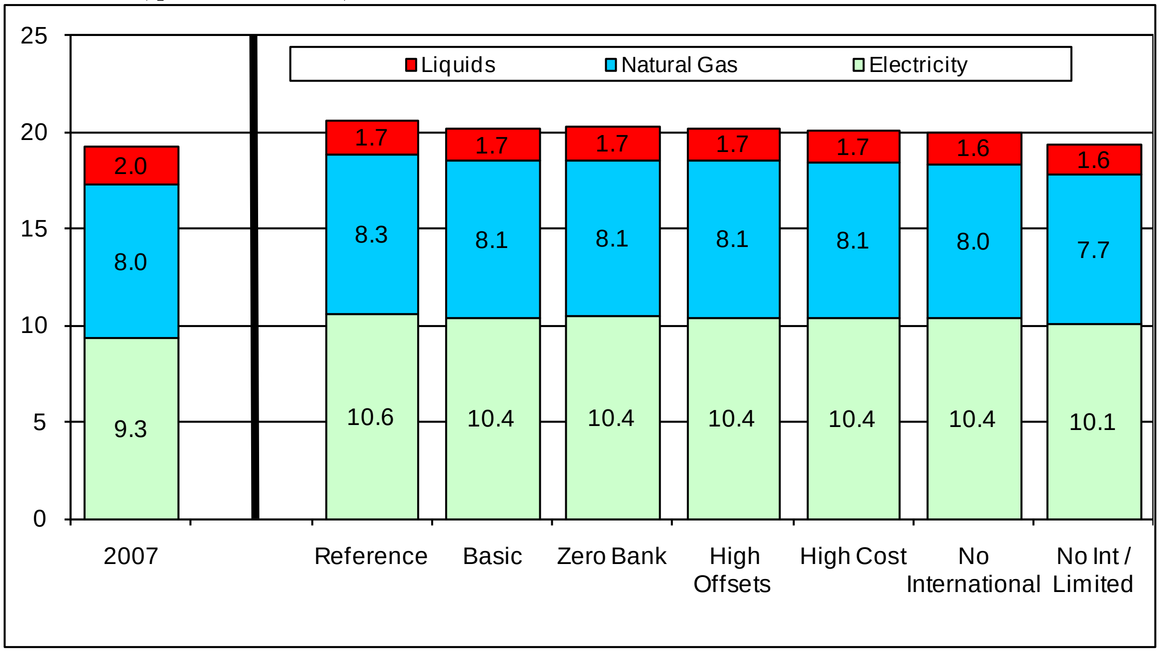
Residential and commercial buildings are affected by programs targeting energy efficiency and the energy price consequences of the GHG emissions cap. Figures 21 and 22 depict buildings sector delivered energy consumption by fuel across the main ACESA cases in 2020 and 2030, respectively. Electricity and natural gas, which account for nearly 90 percent of the delivered energy used in buildings, are also the fuels most impacted by ACESA.

Electricity use in buildings is projected to be 1.5 percent lower in the ACESA Basic Case relative to the Reference Case in 2020, with a range of 1.1 to 4.8 percent across the main ACESA cases. By 2030, electricity use is projected to be 4.9 percent lower in the ACESA Basic Case, with a range of 3.2 to 14.4 percent across the ACESA main cases. In the ACESA Basic Case, most of the electricity savings in buildings is due to price-induced conservation.

Natural gas use in buildings is more directly affected by the energy efficiency provisions in ACESA, given the importance of building codes and building retrofit programs which tend to affect heating fuels more than electricity. In 2020, natural gas use in buildings in the ACESA Basic Case is projected to be 2.5 percent lower than in the Reference Case, with a range of 2.0 to 7.1 percent across the ACESA main cases. By 2030, the ACESA Basic Case is projected to be 7.8 percent lower than the Reference Case with a range of 6.0 to 15.4 percent, across the ACESA main cases. Most of the reduction in natural gas use is due to the energy efficiency provisions in ACESA, particularly the building codes and building retrofit programs.

Figure 21. Buildings Sector Delivered Energy Consumption by Fuel in Main ACESA Cases, 2020

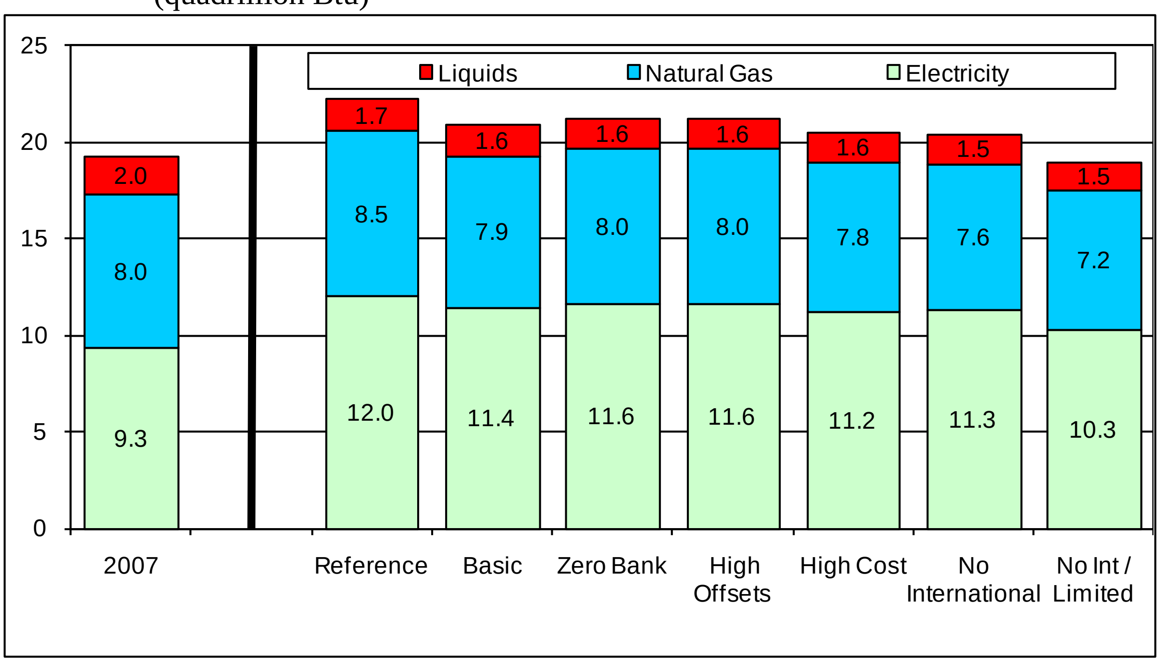
(quadrillion Btu)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 22. Buildings Sector Delivered Energy Consumption by Fuel in Main ACESA Cases, 2030

(quadrillion Btu)

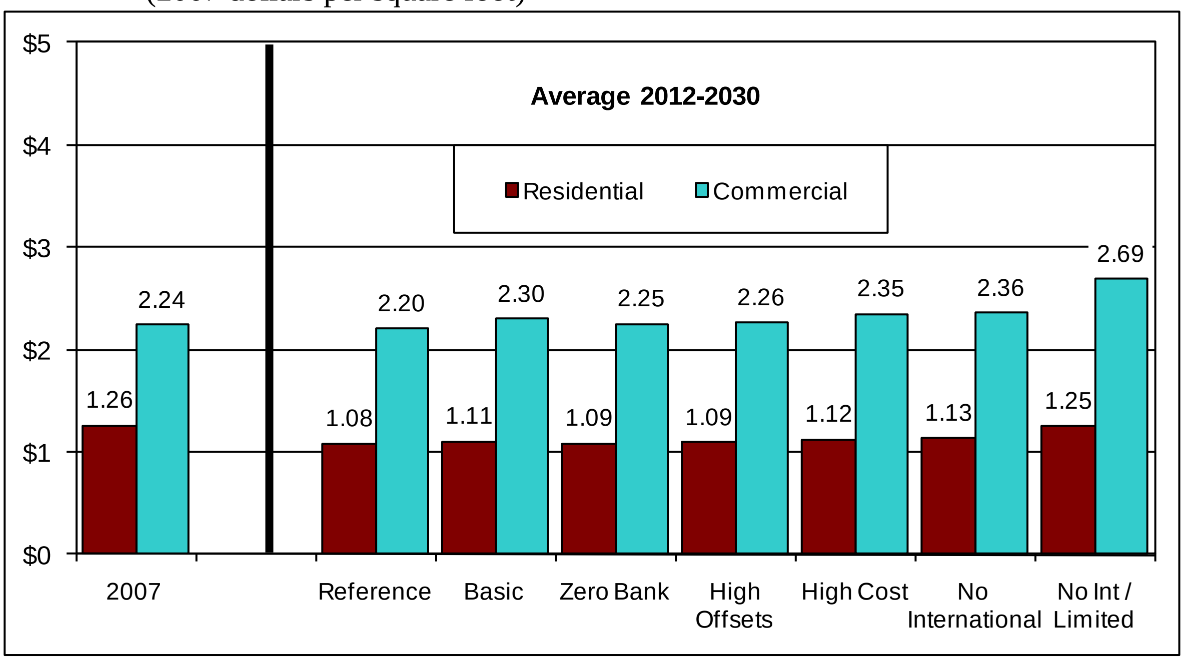


Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Even with lower energy consumption in the main ACESA cases, energy expenditures are projected to increase, relative to the Reference Case, due to increases in delivered energy prices to the buildings sector. Figure 23 depicts the average projected energy expenditures per square foot in residential and commercial buildings over the 2012 through 2030 period in the main ACESA cases. These estimates include **only** expenditures for energy used in buildings and not any additional costs associated with the purchase of energy-efficient equipment or any transportation costs. For all residential and commercial buildings, energy expenditures in the ACESA Basic Case are projected to increase 4 percent over the Reference Case average over the 2012–to-2030 period on a per–square-foot basis (in real 2007 dollars). Of all the main ACESA cases, only the most restrictive case shows an increase in the average expenditures per square foot relative to 2007, when energy expenditures were at near-record highs in real terms.

Figure 23. Buildings Sector Energy Expenditures in Main ACESA Cases, 2007 and 2012-2030 Average

(2007 dollars per square foot)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Increases in energy prices impact households not only for the energy used in the house, but also for transportation costs and products they buy on an everyday basis. Several provisions in ACESA direct that the funds generated from emissions allowance auctions or the sale of freely allocated allowances be used to ameliorate the adverse impact on households. In addition to the funds generated for low-income households through the auctioning of 15 percent of the allowances allocated each year, local electricity and natural gas distribution companies are also directed to use freely allocated allowances to minimize the impact on residential energy consumers. These provisions, along with the energy efficiency programs such as building codes, partially shield residential consumers from significant increases in energy expenditures for uses inside the house. Transportation costs, however, do increase significantly on a per-household basis since there are no provisions designed to dampen motor gasoline price impacts.

As a result of the provisions in ACESA, the average household can expect increases in the cost of the energy they use to heat and cool their homes as well as the cost to operate their vehicles. Figures 24 and 25 depict these cost increases as well as the increase in the cost to purchase more energy-efficient equipment as a result of more stringent building codes. Since the building codes affect only new construction on an annual basis and the annualized cost (over 15 years) is spread out over all households in Figures 24 and 25, the impact of the increase in this cost is relatively small. Based on the three cost measures represented in Figure 24, households can expect an increase of $165 in 2020 in the ACESA Basic Case, with a range of $103 to $767 across the ACESA main cases. Increases in light-duty vehicle energy expenditures account for about 81 percent of the increase in 2020 in the ACESA Basic Case. In 2030, the cost to the consumers increases to $501 per household in the ACESA Basic Case, with the non-transportation costs accounting for about 52 percent of the increase (Figure 25). In 2030, the increased costs to households range from $282 to $1,870 across the ACESA main cases. The higher cost impacts in 2030 are stimulated by the rising allowances costs and the phase-out of the freely allocated allowances to electricity and natural gas distribution companies that begins in 2025.

The adoption of more efficient technology can play a role in mitigating the cost to households due to ACESA. In the ACESA High Tech Case, energy expenditures for household uses (excluding transportation costs) decline by $63, relative to the Reference Case, in 2020. In 2030, energy expenditures for household uses increase by $26 relative to the Reference Case, but are much less than the $191-increase projected in the Basic Case. The increased adoption of more efficient technologies, including rooftop photovoltaics, contributes to the reduction in household energy expenditures. Total per-household expenditures are lower in this case, relative to any of the main cases, even with a modest increase in annualized capital expenditures caused by the adoption of more efficient equipment. Per-household expenditures are 54 percent lower in 2020 relative to the Basic Case and 40 percent lower than the Basic Case in 2030.

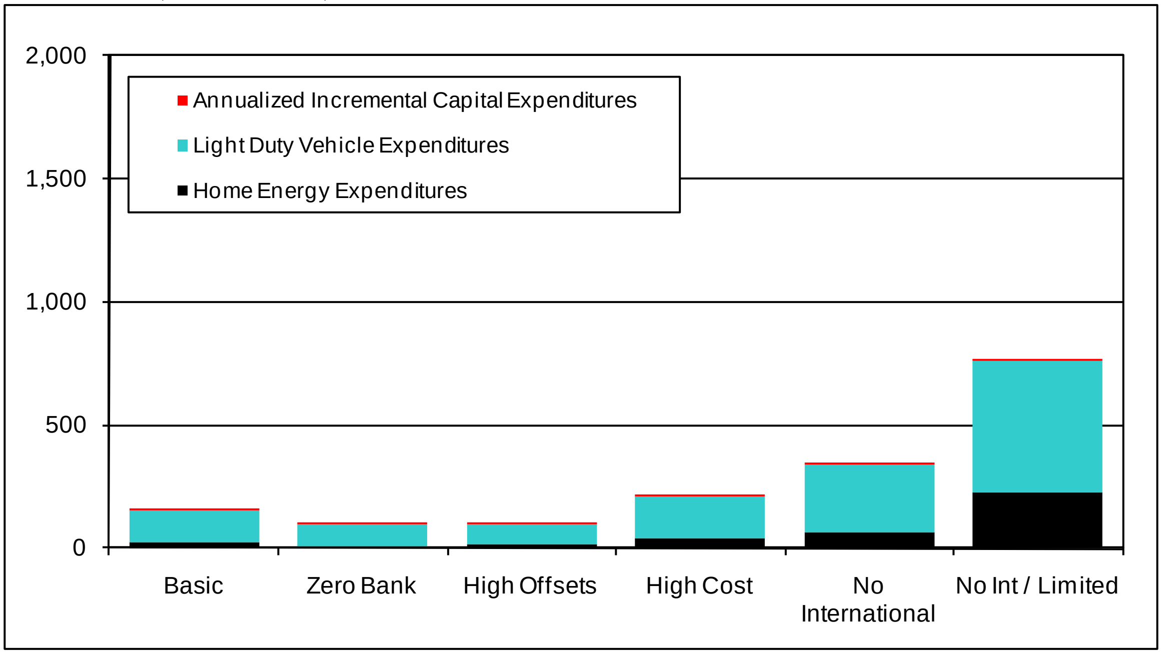
Transportation

The impact of ACESA on projections of CO_2 emissions from the transportation sector are relatively small compared to emissions reductions realized in the other demand sectors. In 2020, CO_2 emissions from the transportation sector are reduced from1.0 percent to 3.5 percent (19 to 68 MMT) across the main ACESA cases relative to the Reference Case. By 2030, transportation-related CO_2 emission reductions increase and range from 2.6 percent to 8.5 percent (53 to 174 MMT) across the main ACESA cases compared to the Reference Case.

Because reductions in transportation-related emissions are not proportional to reductions in other sectors, by 2030 the transportation sector accounts for a larger percentage of total U.S. GHG emissions across all cases. The relatively small changes in the transportation sector are driven by the modest changes in gasoline prices, which are expected by 2020 to range from $0.12 to $0.66 per gallon higher than in the Reference Case (Figure 26).

Figure 24. Average Change in Household Energy Expenditures in Main ACESA Cases, 2020

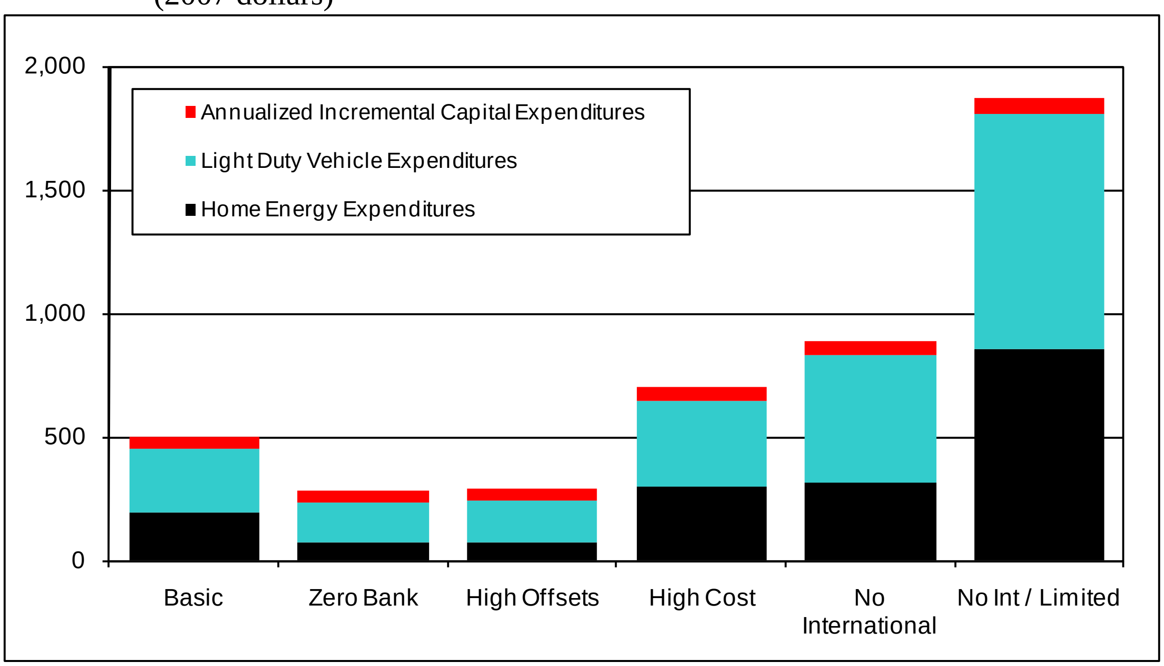
(2007 dollars)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 25. Average Change in Household Energy Expenditures in Main ACESA Cases, 2030

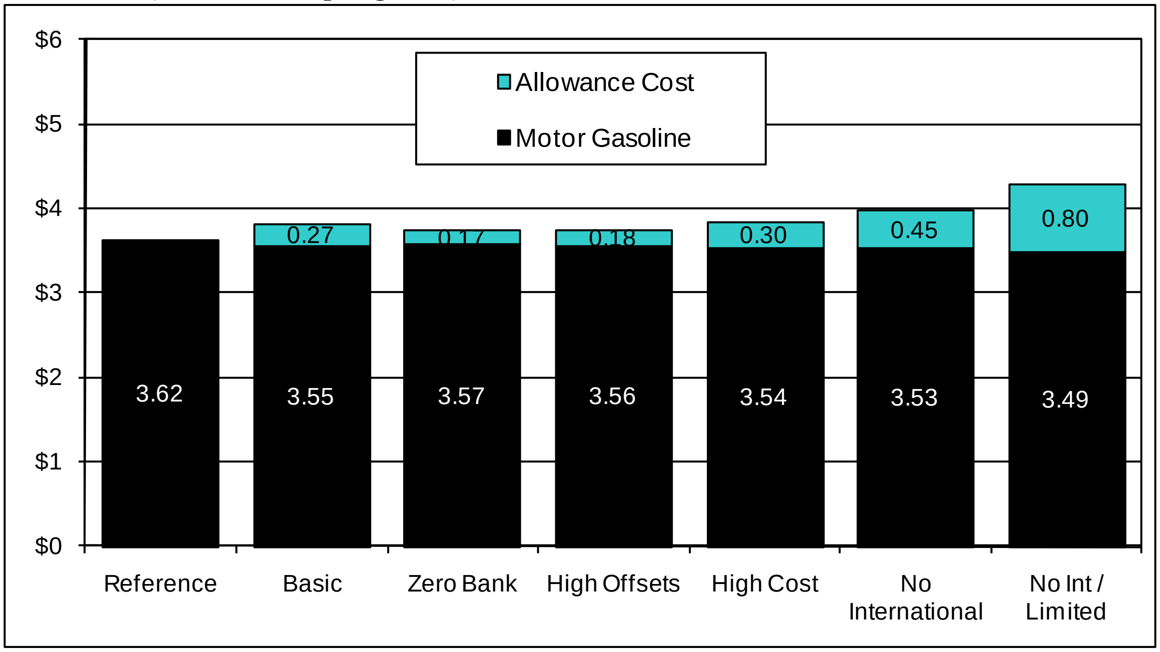
(2007 dollars)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 26. Motor Gasoline Prices in Main ACESA Cases, 2020

(2007 dollars per gallon)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

However, ACESA does contain provisions aimed at stimulating further advances in vehicle fuel efficiency and a more rapid penetration of vehicles that rely at least partially on electricity. Uncertainty about the impacts of these provisions led to them not being explicitly analyzed in this report. If they are successful, larger reductions in transportation sector emissions would be expected.

These results may also be impacted by proposed revisions to CAFE standards. On May 19, 2009, President Obama unveiled new light vehicle fuel economy standards increasing the minimum passenger car requirement to 39 miles per gallon and the light truck requirement to 30 miles per gallon by model year 2016. The proposed rule making jointly developed by the EPA and the National Highway Traffic Safety Administration mandates a 5-percent annual increase in fuel economy for model years 2012 through 2016. The new standards will address both fuel economy and GHG emissions via a vehicle-attribute-based CAFE standard and a tailpipe GHG emission standard.

To evaluate their potential impact, the proposed CAFE standards were incorporated into the 35CAFE2016 Case. Except for the revised CAFE standards, this case uses the same assumptions as the ACESA Basic Case, to examine the impact on transportation-related GHG emissions and how that effects total GHG emission reductions from all sectors. Relative to the ACESA Basic Case, the proposed CAFE standards reduce GHG emissions from the transportation sector by 0.5 percent in 2020 (9 MMT carbon-equivalent) and 0.8 percent in 2030 (16 MMT carbon-equivalent) relative to the ACESA Basic Case. Total GHG emissions are unchanged between the two cases since reductions in the transportation sector are offset by smaller reductions in other sectors. This occurs because allowance prices decrease in proportion to emissions reductions achieved in the transportation sector.

The transportation sector could contribute more to emissions reductions if the provisions of ACESA were to spur more rapid improvement in transportation technology. Relative to the ACESA Basic Case, in the ACESA High Tech Case, transportation sector CO_2 emissions are 32 million metric tons lower in 2030 (1.6 percent).

Economic Impacts

Implementing the ACESA GHG cap-and-trade program will affect the economy through two key mechanisms. First, the cost of using energy, particularly fossil fuels and electricity, will be increased by the requirement to submit allowances for ongoing emissions. Second, the auctioning of allowances and the free distribution of allowances to emitting and non-emitting sources will generate revenue, which, in turn, will be spent by various government entities on programs designed to help businesses and consumers reduce their emissions or ameliorate the impacts associated with higher energy prices. In the ACESA cases, roughly 99 percent of the value of allowances, allocated freely or auctioned, goes to producers and consumers of energy from 2012 to 2030, while 1 percent is devoted to deficit reduction. Through 2025, the allocation of allowances under ACESA tends to dampen the changes in energy prices, but energy prices begin to escalate and the economy shows greater losses in the last 5 years of the projection horizon, as many of the early programs are phased out..

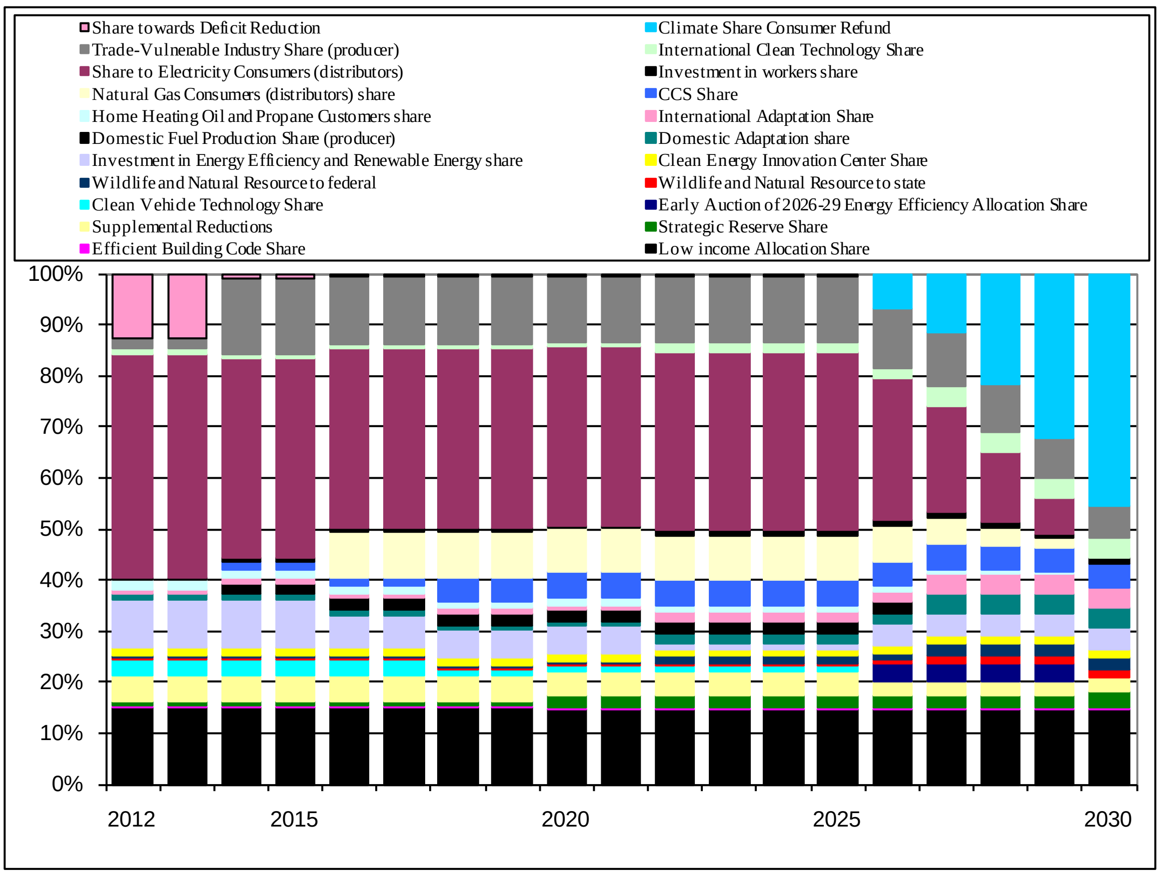
Prices increase and real output declines as a result of meeting the carbon reductions stipulated in ACESA. If all of the revenue collected by the carbon allowances were returned, deficits would be significantly higher, especially during the period where the carbon allowance prices are at their highest levels. As a result, for all ACESA cases, the full employment deficit was not allowed to change from the reference case. Government expenditures were adjusted so that the deficit remained at reference case values. The uses of the carbon allowance revenues as stipulated by H.R. 2454 were modeled; however to the extent that the resulting change in government expenditures were lower than the actual amounts specified by the bill, other non-defense government expenditures would have to be reduced to insure unchanged Federal deficits over time.

Allowance Revenues

Figure 27 shows the detailed shares of allowances going to different entities as called for in ACESA over the 2012 to 2030 time period. As shown, the share devoted to the energy industry, mainly to be used to reduce impacts on their consumers, drops off dramatically post-2025, with an increasing share rebated to consumers via the climate change consumer refund program. The amounts going to the energy industry and trade-vulnerable industries are not directly collected as revenue in the macroeconomic model. Those revenues are used by the industries themselves to lessen the impact of rising energy prices to consumers. The remaining uses of the allowances are distributed through Federal transfer payments abroad (International Adaptation and Clean

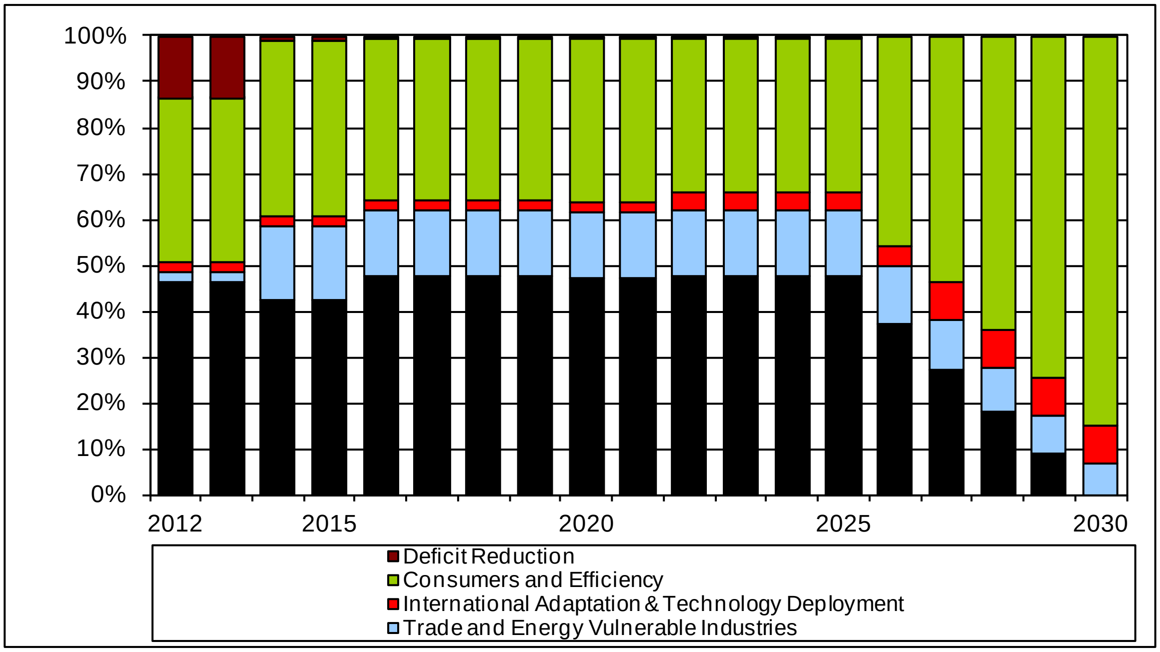
Technology Deployment funds), imports of services (purchases of international offsets), increased transfer payments to individuals (low income allocations), or increased Federal non-defense expenditures (clean energy innovation centers and energy efficient programs). The cumulative amount of revenues (not discounted) collected for redistribution by the government ranges from $1.3 trillion in the ACESA Zero Bank Case to $6.4 trillion in the ACESA No International/Limited Case between 2012 and 2030. These sums essentially include the value of all the allowances that will fund increased local, State, and Federal government expenditures for various purposes but exclude the value of allowances going directly to businesses, including to local electricity and natural gas distribution companies, or those that will be used for deficit reduction. Figure 28 provides another view of the distribution of allowances dividing them into five broad categories, electricity, natural gas and oil distributors, trade- and energy-vulnerable industries, international adaptation, consumers and efficiency, and deficit reduction.

Figure 27. ACESA Allocation Shares, 2012-2030



Source: ACESA H.R. 2454 Sections 726, 781 and 782.

Figure 28. ACESA H.R. 2454 Allocation of Revenue by Major Category, 2012-2030



Source: H.R. 2454, American Clean Energy and Security Act of 2009.

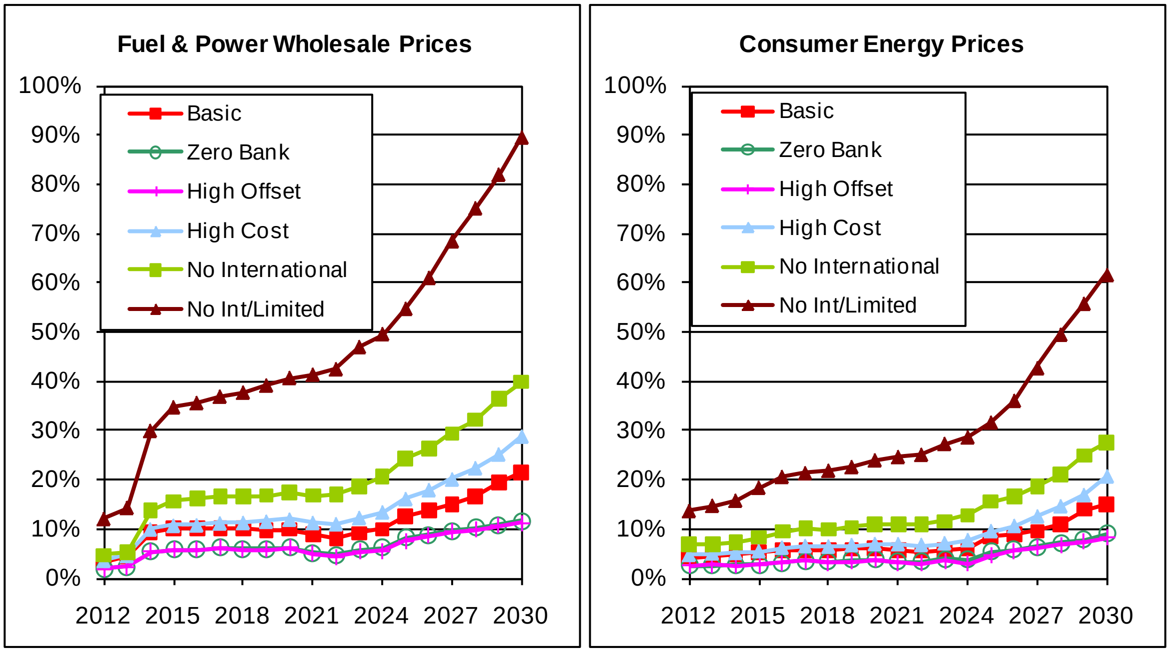
Impacts on Energy and Aggregate Prices

Rising energy costs influence the aggregate economy through their effect on prices and energy expenditures. Figure 29 shows the percentage changes in both the consumer and producer indices for energy in the ACESA cases. Figure 30 highlights the All-Urban Consumer Price Index (CPI), a measure of aggregate consumer prices in the economy. The CPI for energy, a summary measure of energy prices facing households at the retail level, increases by approximately 15 percent above the Reference Case level by 2030 in the ACESA Basic Case. Industrial energy prices increase by 22 percent above the Reference Case by 2030. However, between 2012 and 2025, when electricity, natural gas, and heating oil distributors are assumed to use the large amount of allowances they receive to mitigate the impacts that their customers would otherwise see, industrial energy prices rise by roughly twice as much in percentage terms as do consumer energy prices.

Both wholesale and consumer energy prices rise quickly in the first 4 years, level off for the next 10 years and then sharply rise for the last 5 years. All cases show the same pattern with the amount of increase depending on the allowance prices and compliance options chosen in each case. The relative stability of energy prices from 2014 to 2025 reduces projected economic impacts from levels experienced following the initial energy price shock. However, when energy prices start to escalate post-2025, economic impacts begin to grow.

Across the ACESA cases, consumer energy prices increase between 8 and 62 percent above the Reference Case level in 2030, with the ACESA High Offsets Case showing the smallest change in energy prices and the ACESA No International/Limited Case showing the largest change, more than twice that in the next highest case.

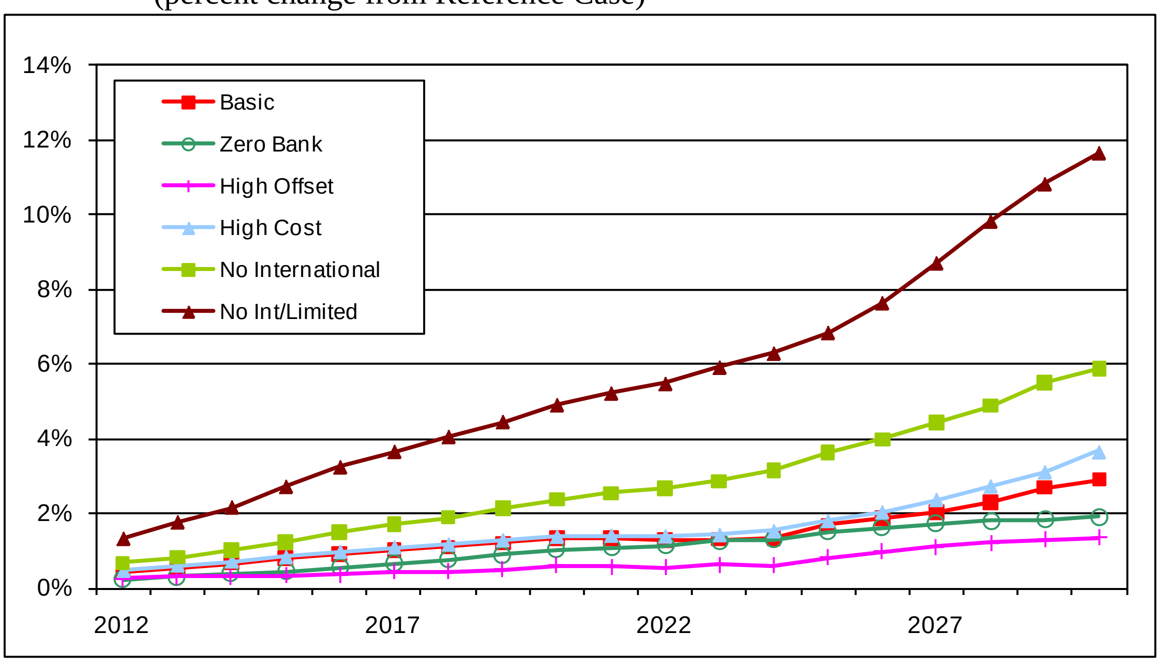
Figure 29. Wholesale and Consumer Energy Prices in ACESA Main Cases, 2012-2030



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 30. Change in Consumer Prices in ACESA Main Cases, 2012-2030

(percent change from Reference Case)



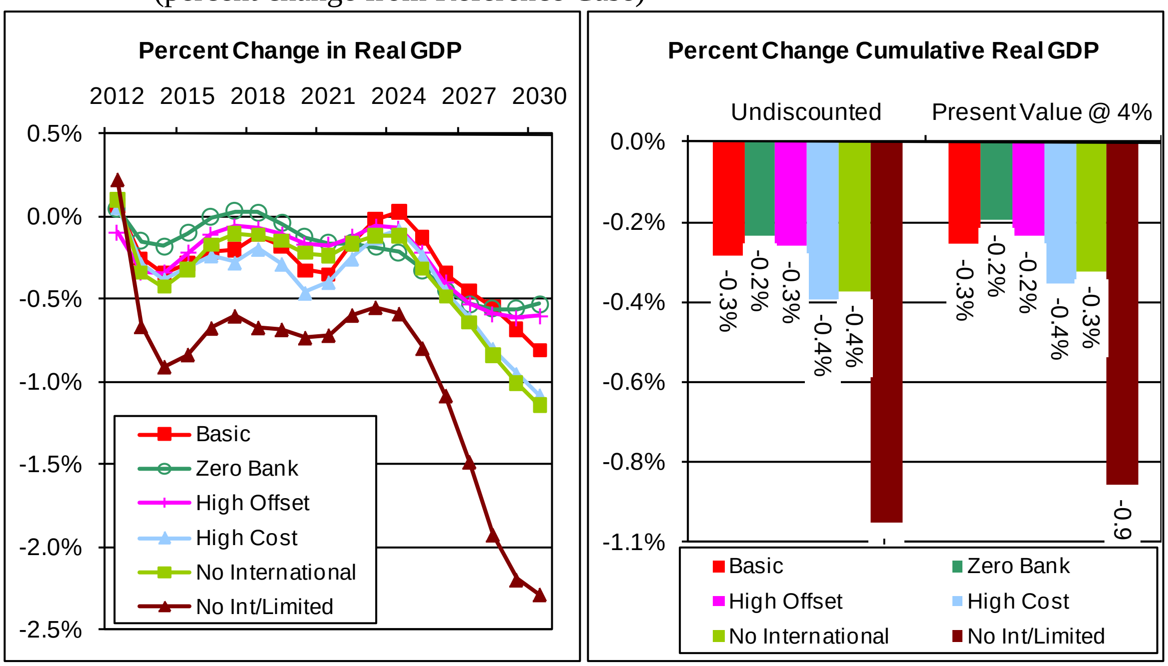
Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Ultimately, consumers will also see the impact of higher energy prices directly through final prices paid for energy-related goods and services and higher prices for other goods and services using energy as an input, and, if the cost increases cannot be passed on to consumers, labor and capital stock may be reallocated. Figure 30 shows that the increase in consumer prices ranges from 1.5 percent to 12.0 percent above Reference Case levels in the main ACESA cases, with the increase in the No International/Limited Case nearly twice that in the next highest case.

Real GDP and Consumption Impacts

The higher delivered energy prices lead to lower real output for the economy. They reduce energy consumption, but also indirectly reduce real consumer spending for other goods and services due to lower purchasing power. The lower aggregate demand for goods and services results in lower real GDP relative to the Reference Case (Figure 31 and Table 3). Over the entire projection period, the change in the cumulative present value of GDP from the Reference Case in the ACESA Basic Case is 0.3 percent ($566 billion in 2000 dollars), with a range from $432 billion (-0.2 percent) to $1,897 billion (-0.9 percent) across the main ACESA cases. Impacts in the No International/Limited Case are more than twice as high as those in any other case.

Figure 31. Change in Real GDP in ACESA Main Cases, 2012-2030
(percent change from Reference Case)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

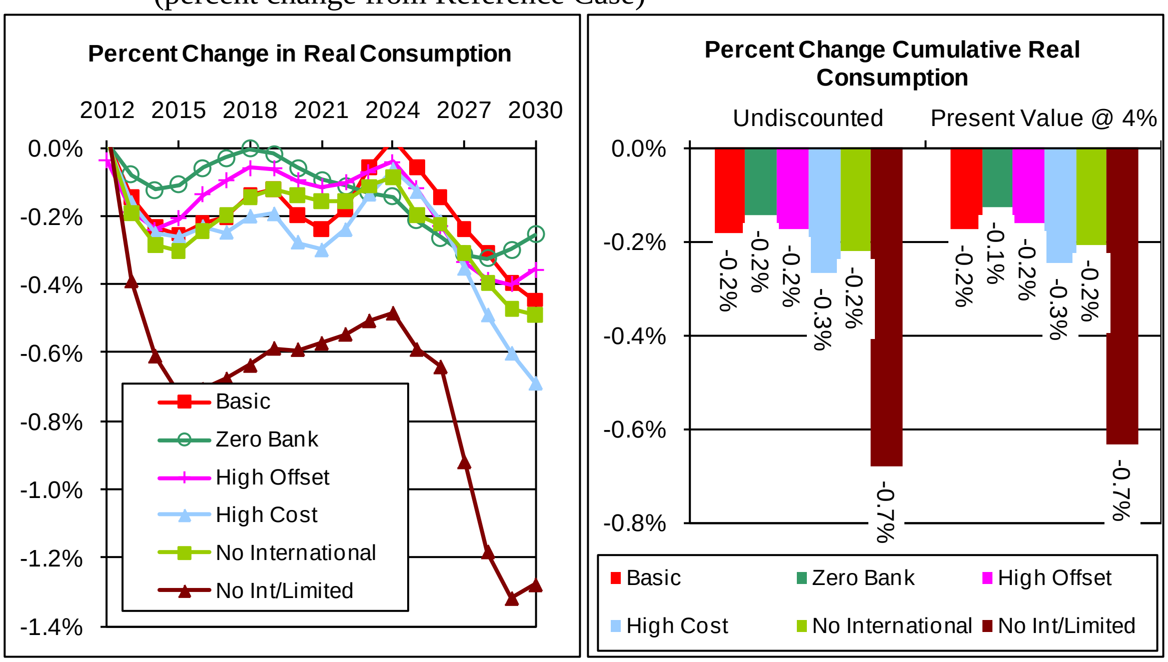
Over time, the pattern of GDP impacts mirrors the change in energy and allowance prices. GDP losses are fairly small for the first 10 years as energy prices increase initially and then stabilize. Real GDP impacts actually decline as prices stabilize, but then increase again as energy prices start to escalate after 2025 as allowance prices continue to rise and the allocation of allowances used to mitigate the impacts on electricity, natural gas, and heating oil consumers is phased out. In 2030, the last year explicitly modeled in this analysis, GDP losses range from $104 billion to $453 billion (-0.5 to -2.3 percent), with the losses in the ACESA No International/Limited Case, at the top of these ranges, again more than twice as large as those in the case with the next highest level of impacts.

While real GDP is an overall measure of what the economy produces, the components of GDP, consumption, investment, government, and net exports, may change considerably. In the ACESA cases, consumer expenditures, one indicator of consumers' welfare, show smaller relative losses than overall GDP. Figure 32 shows consumption impacts over time and the cumulative discounted percent change in consumption over the 2012 to 2030 time period relative to the Reference Case. The cumulative percent losses for real consumption range from 0.1 percent ($196 in billion 2000 dollars) in the ACESA Zero Bank Case to 0.7 percent ($988 in billion 2000 dollars) in the No International/Limited Case. As with GDP, consumption losses during the first 10 years of the projection period are relatively small because consumer energy prices increase by half of the change in industrial energy prices and remain relatively steady until 2026 and roughly 15 percent of total nominal allowance revenue is returned to low-income consumers. In fact, until 2026, the value of increased residential energy expenditures (including transportation costs) is roughly equal to the amount of allowance revenue transferred to low-income consumers. After 2026, the consumer climate change funds rebates in personal taxes, allowing for muted consumer impacts of the rising energy costs.

By 2030, real consumption losses reach 0.4 percent ($63 billion in 2000 dollars) in the ACESA Basic Case.

Figure 32. Change in Real Consumption in ACESA Main Cases, 2012-2030

(percent change from Reference Case)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Table 3. Macroeconomic Impacts of ACESA Main Cases Relative to the Reference Case
(billion 2000 dollars, except where noted)

	Basic	Zero Bank	High Offsets	High Cost	No International	No Int / Limited
Cumulative Real Impacts 2012-2030 (present value using 4-percent discount rate)						
GDP						
Change	-566	-432	-523	-781	-717	-1897
Percent Change	-0.3%	-0.2%	-0.2%	-0.4%	-0.3%	-0.9%
Consumption						
Change	-273	-196	-252	-384	-323	-988
Percent Change	-0.2%	-0.1%	-0.2%	-0.3%	-0.2%	-0.7%
Industrial Shipments (excludes services)						
Change	-910	-753	-480	-958	-1720	-2877
Percent Change	-1.0%	-0.8%	-0.5%	-1.1%	-1.9%	-3.2%
Nominal Revenue Collected 2012-2030[a]	2971	1292	1332	2299	3462	6350
2020 Impacts (not discounted)						
GDP						
Change	-50	-19	-26	-70	-34	-112
Percent Change	-0.3%	-0.1%	-0.2%	-0.5%	-0.2%	-0.7%
Consumption						
Change	-21	-7	-11	-30	-15	-64
Percent Change	-0.2%	-0.1%	-0.1%	-0.3%	-0.1%	-0.6%
Industrial Shipments (excludes services)						
Change	-68	-54	-32	-69	-108	-186
Percent Change	-1.0%	-0.8%	-0.5%	-1.0%	-1.6%	-2.8%
Nominal Revenue Collected[a]	71	44	46	79	118	215
2030 Impacts (not discounted)						
GDP						
Change	-161	-104	-120	-214	-226	-453
Percent Change	-0.8%	-0.5%	-0.6%	-1.1%	-1.1%	-2.3%
Consumption						
Change	-63	-36	-50	-97	-69	-180
Percent Change	-0.4%	-0.3%	-0.4%	-0.7%	-0.5%	-1.3%
Industrial Shipments (excludes services)						
Change	-183	-125	-87	-198	-338	-506
Percent Change	-2.5%	-1.7%	-1.2%	-2.7%	-4.6%	-6.8%
Nominal Revenue Collected[a]	330	205	211	367	556	1030

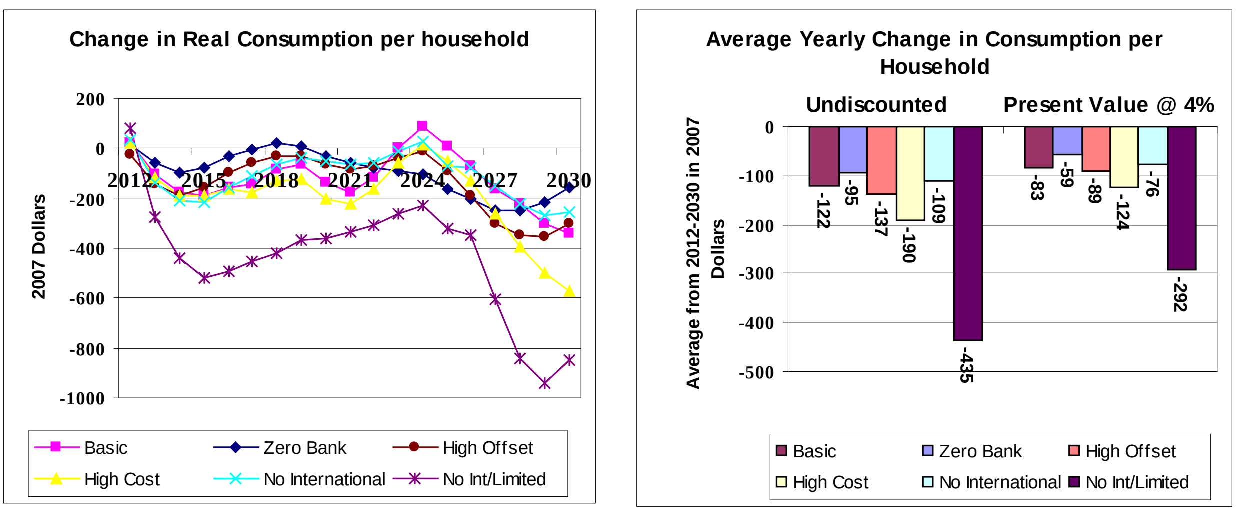
[a] Includes revenues from allowance auctions and revenues generated by the resale of allowances distributed to non-emitters. These values are not discounted.
Note: All changes shown are relative to the Updated *AEO2009* Reference Case.
Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

On a per-household basis, average non-discounted consumption losses ranges from $95 to $435 (in 2007 dollars) over the 2012 to 2030 period in the ACESA cases. When discounted, the yearly losses average from $59 to $292 (in 2007 dollars) per household. The consumption losses escalate starting in 2025 as the allowance prices increase to meet the more stringent emission cap. Therefore 2020 household consumption costs are smaller than the losses in 2030 (Figure 33). The household consumption losses grow over time as energy prices escalate. The 2030 consumption losses per household are larger than the losses in 2020 as both the carbon allowance price and electricity prices increase rapidly post-2025 (Figure 34). In 2020, household consumption losses range from $30 to $362; while in 2030, the range in consumption losses is from $157 to $850 per household.

Industrial Impacts

Industrial energy prices increase more than consumer energy prices because of the allowance revenue used to ameliorate energy price impacts for consumers. On average, wholesale energy prices increase by double that of consumer energy prices. Figure 35 indicates that industry[13] shows larger percentage losses than consumption. By 2030, industrial shipment losses range from 1.2 percent in the High Offset Case to 6.8 percent in the No International/Limited Case. Manufacturing industries show slightly larger percentage losses than the total industrial sector.

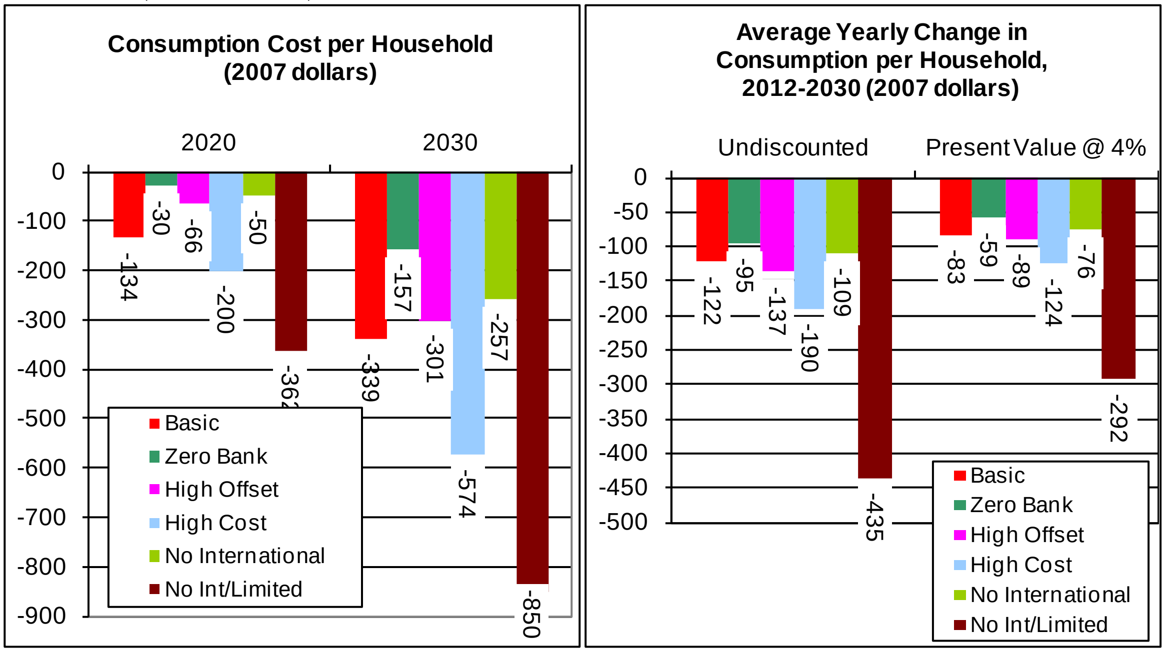
Figure 33. Household Consumption Cost in ACESA Main Cases
(2007 dollars)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

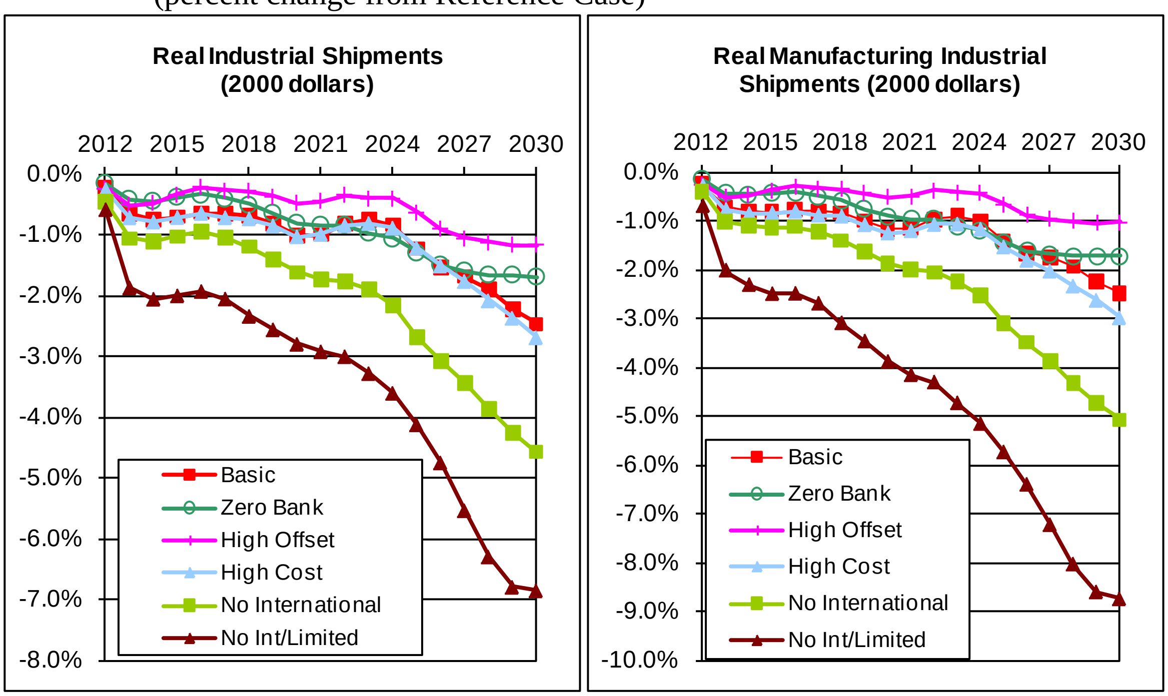
[13] In this section, industry is defined as non-service output. Industry includes manufacturing, agriculture, construction, and mining, which are the industries used by the NEMS industrial demand module.

Figure 34. Change in Household Consumption in ACESA Main Cases, 2020 and 2030
(2007 dollars)



Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

Figure 35. Industrial Impacts in ACESA Main Cases, 2012-2030
(percent change from Reference Case)

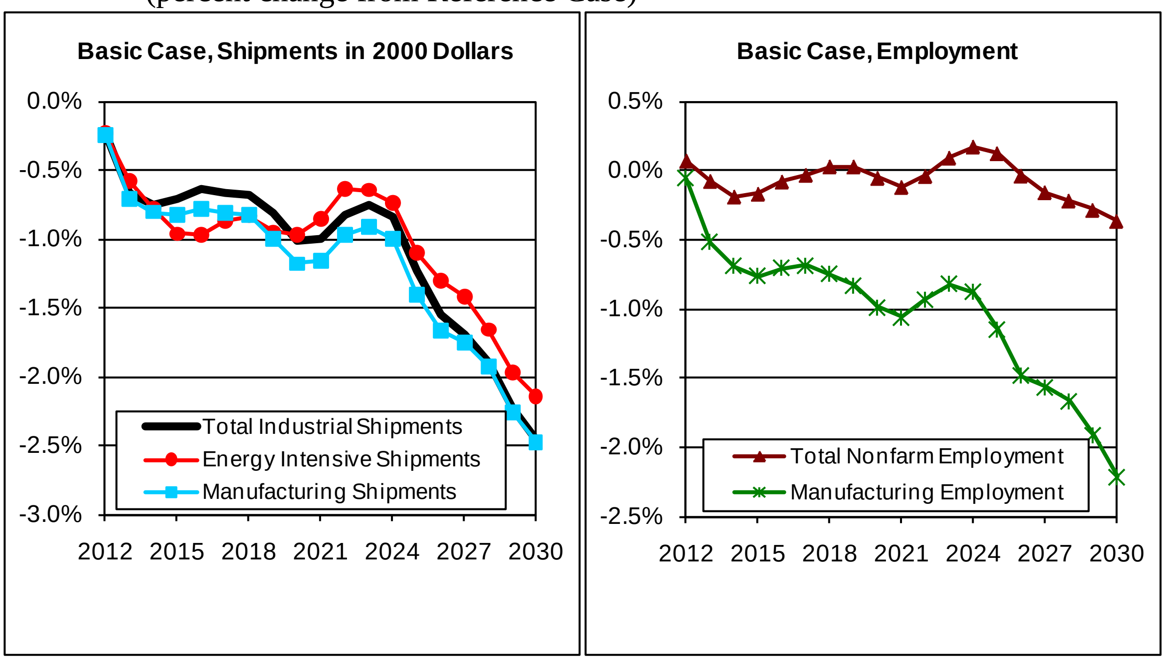


Source: National Energy Modeling System runs, STIMULUS.D041409A, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.

As allowance prices increase, the energy-intensive sectors, including bulk chemicals, glass, cement, steel, and aluminum, receive permit allocations of roughly 15 percent of the total allocated in 2013. Their allocation share gradually declines over time, such that by 2030 trade- and energy-vulnerable industries obtain just under 7 percent of the allocated permits. Receiving these permits ameliorates the impact of increased energy prices and therefore industries face energy prices that are not impacted by the permit values.[14] As a result, when energy prices increase, the reductions in output of these trade- and energy-vulnerable industries are less than overall manufacturing impacts and mirror the impacts (in terms of percentage change from the Reference Case) of total industrial shipments. In past EIA analysis of industrial impacts of energy price increases, these energy-intensive industries typically experience larger losses compared to overall manufacturing (Figure 36).

Total non-farm employment percentage losses are smaller than manufacturing primarily because gains in employment in the service sectors (Figure 36). The pattern of manufacturing employment losses over time mirrors the pattern shown by real manufacturing shipments in all cases.

Figure 36. Industrial and Employment Impacts in the ACESA Basic Case, 2012-2030
(percent change from Reference Case)



Source: National Energy Modeling System runs, STIMULUS.D041409A and HR2454CAP.D072909A.

The main ACESA cases give a wide range of industrial impacts depending on which technology (and its costs) the electricity sector uses and the availability of international offsets. One additional source of uncertainty in the macroeconomic model is how exchange rates will react to the imposition of a carbon allowance price. Given no information on how other countries would implement carbon emission caps and that the macroeconomic model used in NEMS focuses on primarily domestic economic impacts, the exchange rates were not allowed to change from

[14] See Appendix B for detailed methodology of incorporating these industrial output-based rebates.

Reference Case levels. See Appendix B for a description of the assumptions used in the macroeconomic model for the ACESA cases.

Comparison to Earlier EIA Analysis

EIA has analyzed a number of cap-and-trade bills and policies in recent years. In 2008 EIA evaluated S. 2191, the Lieberman-Warner Climate Security Act of 2007, which was introduced in the 110th Congress.[15] S. 2191 included an economy-wide cap-and-trade provision covering about 87 percent of GHG emissions, with those emissions capped at 40 percent below the 2005 level in 2030 and 72 percent below the 2005 level in 2050. The caps in ACESA are more stringent than those under S. 2191, requiring reductions of 58 percent reduction from 2005 levels in 2030 and 83 percent in 2050 and beyond; however, ACESA allows greater use of offsets as a compliance measure compared to S. 2191.

For S. 2191, EIA estimated allowance prices in 2030 of between $62 to $160, including $62 in the Core Case and $80 in the High Cost Case (prices in 2007 dollars per metric ton CO_2-equivalent). This compares to EIA's range of $41 to $191 for ACESA, including $65 in the ACESA Basic Case which is most similar to the S. 2191 High Cost Case in terms of electricity cost assumptions. EIA's S. 2191 analysis was based on the *Annual Energy Outlook 2008* (*AEO2008*) that included different energy price paths and macroeconomic growth assumptions from *AEO2009*, among other differences. In the *AEO2009*, long-run economic growth is slightly lower at 2.4 percent between 2008 and 2030, compared to *AEO2008*'s projected growth at 2.5 percent. Short-run growth is substantially lower in the *AEO2009* relative to *AEO2008* as a result of the current recession. Compliance costs as reflected in the estimated allowance prices would tend to be lower under the *AEO2009* Reference Case than under the *AEO2008* Reference Case,[16] suggesting somewhat closer compliance costs between ACESA and S. 2191, at least as reflected in allowance prices.

The ACESA allowance allocations and rebates help compensate energy consumers and energy-intensive businesses for higher energy costs and play a key role in the estimated energy market and macroeconomic response, relative to the projected allowance prices. For energy-intensive industries, output and employment impacts are less than under S. 2191 since, under ACESA, energy-intensive industries are assumed to be compensated for higher energy costs due to allowance prices. Under S. 2191, energy-intensive industries were assumed to face the full cost of allowance in higher energy prices.

Similarly, consumer and wholesale energy price increases are mitigated under ACESA through 2025 as rebates from local distribution companies offset the effect of rising allowance prices on electricity and natural gas prices. After 2025, these energy prices grow more rapidly as rebates

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[15] Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007*, SR/OIAF(2008-01) (Washington, DC, April 2008), web site www.eia.doe.gov/oiaf/servicerpt/s2191/index.html.

[16] For the published *AEO2009*, EIA included as a side case an updated S. 2191 Case, called the "LW110" Case, with assumptions similar to the S. 2191 High Cost Case from the 2008 Service Report. The estimated 2030 allowance price in the *AEO2009* LW110 was $74 per metric ton, compared to $80 allowance price in the original S. 2191 High Cost Case based on *AEO2008*.

are phased out, a different pattern than under S. 2191. Under ACESA, energy prices increase immediately in 2012 and then stabilize until 2025, allowing the economy to recover from the initial price increase. After 2025, the rapid increase in energy prices causes the economy to contract.

This effect of rebates on energy prices under ACESA accounts for the different time paths of GDP and consumption losses in the two studies. Under S. 2191, the losses are immediate and increase gradually over time. Under ACESA, real GDP and consumption losses are relatively small until 2025, but escalate rapidly late in the projection period. As a result, the cumulative macroeconomic impacts estimated under S. 2191, relative to the estimated allowance prices, were greater than those observed under ACESA, even though the 2030 impacts are less. For example, in the S. 2191 Core Case, with a 2030 allowance price of $62, the average undiscounted loss in real consumption from 2012 to 2030 was estimated to be $47 billion (2000 dollars). In the ACESA Basic Case, with a 2030 allowance price of $65, the average undiscounted loss in real consumption from 2012 to 2030 was $22 billion. The pattern of carbon allowance recycling in S. 2191 and H.R. 2454 differed. Revenue recycling to consumers did not have a sudden increase post-2025 in S. 2191 as it does in H.R. 2454. In H.R. 2454, since the consumer climate change fund is rebated to the consumer in the form of lower personal taxes post-2025, consumption impacts in S. 2191 and H.R. 2454 are similar, $68 billion for S. 2191 and $63 billion for H.R. 2454 in 2030.

Appendix A: Analysis Request Letter

ONE HUNDRED ELEVENTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON ENERGY AND COMMERCE

2125 RAYBURN HOUSE OFFICE BUILDING

WASHINGTON, DC 20515–6115

MAJORITY (202) 225–2927
FACSIMILE (202) 225–2525
MINORITY (202) 225–3641

energycommerce.house.gov

March 17, 2009

Mr. Howard K. Gruenspecht
Acting Administrator
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Gruenspecht:

One of the top priorities of the Committee on Energy and Commerce is to pass comprehensive climate change legislation. To facilitate this effort, we are requesting technical assistance from the Energy Information Administration (EIA). In particular, we request that EIA estimate the economic impacts of our draft legislation as it is developed. EIA's analysis of the draft legislation would prove useful to us and other members of the House as we craft measures to combat global climate change.

We ask that EIA begin this process by meeting with our staff to discuss the parameters, methods, and duration of the analysis. Please call Alexandra Teitz, Lorie Schmidt or Joel Beauvais at (202) 225-4407.

Sincerely,

Henry A. Waxman
Chairman

Edward J. Markey
Chairman
Subcommittee on Energy and Environment

Appendix B: Representing H.R. 2454 in the National Energy Modeling System

Emissions Modeling

The analysis of energy sector and economic impacts of the various greenhouse gas (GHG) emission reduction measures in the American Clean Energy and Security Act of 2009 (ACESA) is based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) which is used for projections in the *Annual Energy Outlook 2009* (*AEO2009*), including an updated Reference Case that reflects provisions of the American Recovery and Reinvestment Act (ARRA) and recent changes in the economic outlook.[17] The updated *AEO2009* Reference Case is used as the baseline for the analysis in this report.

The projection horizon for NEMS extends to 2030, while the emissions policies in the bill extend to 2050 and beyond. As a result, this analysis is limited to addressing the bill's impacts through 2030; however, some expectations of post-2030 changes affect the modeling, such as assumed allowance banking behavior through 2030 and an assumed continuance of allowance price trends beyond 2030 when simulating electric power capacity decisions through 2030.

NEMS endogenously calculates changes in energy-related carbon dioxide (CO_2) emissions in the analysis cases. The cost of using each fossil fuel includes the costs associated with the GHG allowances needed to cover the emissions produced when they are used. These adjustments influence energy demand and energy-related CO_2 emissions. The GHG allowance price also determines the reductions from projected baseline emissions of other covered GHGs based on assumed abatement cost relationships, as well as the potential supplies of domestic and international offsets. With emission allowance banking, NEMS solves for a starting allowance price and trend such that cumulative emissions match the cumulative emissions target, including cumulative bank allowances, with a constant-growth trend in allowance prices consistent with the average cost of capital to the electric power sector.

The NEMS Macroeconomic Activity Module (MAM), which is based on the IHS Global Insight U.S. Model, interacts with the energy supply, demand, and conversion modules of NEMS to solve for an energy and economy-wide equilibrium. In an iterative process within NEMS, MAM reacts to changes in energy prices, energy consumption, and allowance revenues, solving for the effect on macroeconomic and industry level variables such as real gross domestic product (GDP), the unemployment rate, inflation, and real industrial output.

Title III Cap–and-Trade Provisions

Title III of ACESA modifies the Clean Air Act by adding Titles VII and VIII to limit emissions of most GHGs through an allowance cap-and-trade system (Title VII) and to impose and modify emissions standards affecting other GHGs (Title VIII). Title III of ACESA also establishes various financial regulations on allowance markets. EIA's modeling of Title III provisions was limited to the allowance cap-and-trade system. EIA's analysis does not reflect a separate cap-and-trade system on certain hydrofluorocarbons (HFCs) used primarily as substitutes for ozone-

[17] Energy Information Administration, *Annual Energy Outlook 2009*, DOE/EIA-0383(2009)(Washington, DC, February 2009), web site www.eia.doe.gov/oiaf/aeo/index html, and *An Updated AEO2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook*, DOE/EIA-SR-OIAF/2009-03 (Washington, DC, April 2009).

depleting substances. Nor does it address the emission standards on other GHG sources not covered by the cap-and-trade system, such as methane emissions for landfills and coal mines.

Establishing the Cap and Coverage Assumptions

Sec. 721 establishes the overall cap on GHGs by specifying the number of allowances to be created each year under certain assumptions about overall 2005 emissions and the coverage fractions in 2012, 2014, and 2016 as additional coverage is phased in. The yearly allowance quantities are based on specific percentage reductions in 2012, 2020, 2030, and 2050 relative to the applicable emissions from covered sources in 2005. The bill sets the reductions targets at 3 percent in 2012, 17 percent in 2020, 42 percent in 2030, and 83 percent in 2050. See Table B1.

Table B1. Revisions to the GHG Cap for Emissions Accounting and Limitations in Modeling Detail

(million metric tons CO_2-equivalent)

	Assumed in Bill		As Modeled	
	Emission Level	Percentage of Total	Emission Level	Percentage of Total
2005 Total Emissions	7206	100.0	7303	100.0
2005 Covered emissions, 2012 coverage	4770	66.2	4975	68.1
2005 Covered emissions, 2014 coverage	5455	75.7	5589	76.5
2005 Covered emissions, 2016 coverage	6089	84.5	6128	83.9
Year	**Specified Cap**	**Percentage of 2005 Covered Emissions**	**Revised Cap as Modeled**	**Percentage of 2005 Covered Emissions**
2012	**4627**	**97.0**	**4826**	**97.0**
2013	4544	95.3	4739	95.3
2014	5099	93.5	5225	93.5
2015	5003	91.7	5128	91.8
2016	5482	90.0	5515	90.0
2017	5375	88.3	5408	88.3
2018	5269	86.5	5301	86.5
2019	5162	84.8	5194	84.8
2020	**5056**	**83.0**	**5086**	**83.0**
2021	4903	80.5	4933	80.5
2022	4751	78.0	4780	78.0
2023	4599	75.5	4627	75.5
2024	4446	73.0	4474	73.0
2025	4294	70.5	4320	70.5
2026	4142	68.0	4167	68.0
2027	3990	65.5	4014	65.5
2028	3837	63.0	3861	63.0
2029	3685	60.5	3708	60.5
2030	**3533**	**58.0**	**3554**	**58.0**
2050	**1035**	**17.0**	**1042**	**17.0**

The bill establishes a procedure for revising the cap based on any changes in the emissions accounting affecting the relative emissions by covered entities or the total 2005 emissions. Accordingly, EIA has revised the assumed cap slightly to conform to EIA GHG accounting practices and the level of emissions accounting incorporated into NEMS, while adhering to the percentage targets for 2012, 2020, and 2030 set forth in the bill. Targets for intervening years are established by using a uniform annual decline in the amount of emissions between the years specified. Table B1 presents the original and revised caps as assumed in this analysis through 2030.

The bill phases in the allowance requirements for some emission sources. Emissions from petroleum combustion and electric power companies are covered at the onset of the program starting in 2012. In 2014 and 2015, it is estimated that approximately 72 percent of the natural gas used in the industrial sector is subject to the allowance holding requirement. The allowance obligation for local distribution companies (LDCs) supplying natural gas to non-covered entities begins in 2016. It was assumed that CO_2 emissions from natural gas that is not consumed by covered industrial and electric power companies will be supplied by LDCs. Therefore all CO_2 emissions from natural gas are assumed to be covered beginning in 2016. By 2016, all energy-related CO_2 emissions, other than those attributed to a small amount of residential and commercial sector coal usage, are assumed to be covered.

A small amount of emissions from other industrial emissions are also subject to the allowance holding requirement. These gases include nitrous oxide from adipic acid and nitric acid production, non-energy process emissions of carbon dioxide, and emissions of fluorinated gases other than those HFCs used as substitutes for ozone-depleting substances (a separate cap on the latter group of gases is established in the bill but is not treated in the modeling conducted for this report). Due to model limitations, the coverage of emissions of these gases is programmed to begin in 2012, rather than in 2014 as required in the bill.

Limits on Offset Credits

H.R. 2454 establishes an overall limit on international and domestic offset credits of 2 billion metric tons (BMT) of the allowance requirements, with each source limited to half the total. The domestic and international offset limits are applied on a pro-rata basis on individual covered entities. The pro-rata limit is a maximum percentage of the allowance obligation that can be met using offsets. The pro-rata limit can therefore restrict offset usage independently of the overall 2-BMT limit. The pro-rata limit is calculated as follows:

$MaxOffSetPct_y = 100 * (2000 / (2000 + CAP_y))$, where

$MaxOffSetPct_y$ is the maximum percentage of the allowance obligation that can be met through offsets in year y, and

CAP_y is the emissions cap, or number of allowances issued, for year y, in million metric tons CO_2-equivalent.

The pro-rata limit would restrict the aggregate use of offsets below the overall 2-BMT limit unless covered emissions exceeded the cap by 2 BMT, assuming all covered entities used the maximum allowable percentage. As with the overall limit, domestic and international offsets under the pro-rata limit can each be no more than half the total, with one exception which can be triggered by the Environmental Protection Agency (EPA) Administrator. If the EPA Administrator expects the availability of domestic offset credits to be less than 900 million metric tons (MMT) in any year given expected allowance prices, the maximum percentage of international offsets is increased, and the domestic offset percentage decreased. The maximum offset percentage is changed to reflect an increase in the international offsets by an amount equal to 1,000 MMT less the expected domestic offset availability, up to an increase of 500 MMT of additional international offsets.

Domestic offset credits substitute for allowances on a 1-for-1 basis. International offset credits are exchanged for allowance requirements on a 1-for-1 basis through 2017. Beginning in 2018, 1.25 international offset credits are required to substitute for one allowance.

Assumptions for Non-CO_2 Emissions Abatement and Offset Supplies

Assessing ACESA requires an analysis of energy-related CO_2 emissions and non-CO_2 GHG emissions. NEMS represents U.S. energy markets and the associated CO_2 emissions and abatement opportunities endogenously. Non-CO_2 GHG emissions and international offsets are represented using exogenous baseline emissions projections and schedules of abatement opportunities over time and by price. To reflect the reduction in non-energy-related GHG emissions, EIA relies on these assumed economic relationships to quantify the potential emissions abatement and offset supplies that would occur over a range of allowance or offset prices.

To a great extent, EIA bases abatement and offset supply assumptions on research and analysis by EPA. EPA has provided EIA with estimates of baselines and domestic and international "marginal abatement cost curves," or MACs, for various sources of GHG emissions and biogenic carbon sequestration. The MACs reflect the estimated economic GHG abatements that could be achieved from emission reduction projects, given a price or value on GHG emissions reductions. Such estimates tend to reflect the technical potential for emissions reductions with positive rates of return and do not reflect institutional and market factors affecting adoption of abatement and offset options. As a result, EIA has incorporated discounting and market penetration assumptions to reflect these factors. Such estimates are naturally subject to a great deal of uncertainty, particularly with regard to international offsets.

The availability and price of international offsets from energy- and non-energy-related projects will depend on the global supply of and demand for emission reductions. The U.S. demand for offsets will compete with the demand for emissions abatement outside the United States, which, in turn, will depend on the emissions reduction commitments undertaken by other countries. Under ACESA, covered entities can submit project-level or sector-level offsets from developing countries that have established agreements with the United States to ensure that requirements for monitoring and verification are fulfilled. Under Sec. 728, covered entities may also submit allowances from approved countries that have established cap-and-trade systems of comparable stringency and scope. Allowances supplied under Sec. 728 do not count against offset limits and are not subject to any quantitative limits initially.

The potential supply of offset credits and allowances to the United States is derived based on the excess supply of potential abatement for the world, relative to the assumed demands for abatement based on stated or assumed emissions reduction commitments. Given that the capped sources of emissions under ACESA are primarily energy-related CO_2, the supply of CO_2 abatement from the Group 1 developed countries would potentially qualify as a source of comparable allowances. However, countries having equally stringent caps could face similar compliance costs at the margin, possibly limiting the potential for international allowance trading. Therefore, no net trade in international allowances was assumed.

International abatement supply is based on EPA-provided MACs for CO_2, other GHGs, and forestry/agriculture. In processing the MACs to obtain offset supply, EIA applies discounts and market penetration assumptions to reflect the market response to the technical abatement potential. EPA has disaggregated GHG abatements into two regional categories: Group 1 nations (Europe, Canada, Japan, Australia, and New Zealand) and Group 2 nations (the rest of world, excluding United States).

To reflect world competition for offset supplies, the international abatement market is assumed to establish a floor price, above which excess abatement supplies can penetrate the U.S. market in the form of offset credits from developing countries and, potentially, allowances from countries assumed to have comparable caps in place. A floor price, or international GHG abatement price excluding the United States, is estimated by combining annualized abatement supplies and abatement demand and solving for the market price each year. This approach allows the U.S. market for allowances to be treated somewhat independently from the world market and allows offset supplies to the United States to be restricted to developing countries, as specified in the bill.

The assumed international abatement demand is defined as international baseline emissions minus stated or hypothetical commitments to various emissions levels (Table B2). The reference emissions baseline shown is based on estimates originally provided by EPA and used in several previous EIA studies, but the non-U.S. energy-related CO_2 growth rates through 2030 have been updated to reflect the CO_2 projections in the EIA *International Energy Outlook 2009* (*IEO2009*) Reference Case, which does not reflect any international commitments to cap GHGs.

Table B2. Assumed International Abatement Demand, Excluding the United States
(million metric tons carbon dioxide equivalent)

	Reference Emissions		Policy Assumption		Cap		Abatement		
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Total
1990	8188	16268	Reference	Reference	8188	16268	0	0	0
1995	8403	18002	Reference	Reference	8403	18002	0	0	0
2000	8619	19736	Reference	Reference	8619	19736	0	0	0
2005	8848	21535	Reference	Reference	8848	21535	0	0	0
2010	8697	24778	5.0% below 1990	No Policy	7778	24778	919	0	919
2015	8851	27069	8.3% below 1990	No Policy	7508	27069	1343	0	1343
2020	9051	29503	16.6% below 1990	No Policy	6828	29503	2223	0	2223
2025	9089	31942	16.6% below 1990	2020 levels	6828	29503	2260	2439	4699
2030	9118	34303	26.6% below 1990	2020 levels	6010	29503	3108	4799	7908
2035	9214	36720	26.6% below 1990	2020 levels	6010	29503	3204	7217	10421
2040	9340	39196	36.6% below 1990	2020 levels	5191	29503	4149	9693	13842
2045	9471	41470	36.6% below 1990	2020 levels	5191	29503	4280	11967	16246
2050	9601	43743	46.6% below 1990	2020 levels	4372	29503	5229	14240	19470

Under ACESA, allowable sources of international offset credits are from developing countries that have established bilateral or multilateral agreements with the United States to ensure the offset requirements of the bill are fulfilled. For this analysis, it is assumed that the Group 2 countries will be deemed developing countries and that their participation will increase gradually over time as reflected by imposing a gradual market penetration function to their offset supplies. In the case of offsets from reduced deforestation, the bill specifies substantial additional regulatory requirements, such as agreements on national baselines, technical capacity to monitor, measure, report, and verify forest carbon fluxes, and institutional capacity to reduce deforestation, such as strong forest governance. These requirements will likely reduce the potential sources of forestry offsets to a subset of Group 2 countries. As a result, the technical potential of forestry-related abatement from Group 2 countries as provided by EPA has been discounted by 50 percent and a slower rate of market penetration has been applied than with other offset abatement supply sources.

Table B3 displays the assumed supply schedule of international offset credits, given these considerations. Both the gross Group 2 offset supply and the supply net of international abatement demand are shown, given the estimated international floor price for GHG abatement. The latter schedule (net supply) represents the supplies assumed to be available to the United States.

Depending on how international offsets are regulated and how fast the requisite international agreements or arrangements are formed, the potential availability of low-cost international offsets could be substantially different (greater or smaller) than assumed. In the ACESA High Offsets Case, the maximum allowable quantity of international offsets was assumed to be available in every projection year at the allowance price of that year.

Allowance Banking and Borrowing

To reflect banking incentives and trading arbitrage, allowance prices escalate at a rate no higher than 7.4 percent per year in real terms during intervals when allowance balances are held. This rate reflects the average cost of capital in the electric power sector, where a significant share of emissions reduction investments is expected to occur.

ACESA calls for increasingly stringent emissions caps beyond 2030, the forecast horizon for NEMS. Meeting these post-2030 caps will require significant emission reductions outside the electricity sector, the predominant source of early emissions reductions, and increase future price pressure, absent significant technological breakthrough in transportation and other uses that are dependent on fossil fuels. As a result, EIA assumes that covered entities and traders will amass a substantial allowance bank balance by the end of 2030. Based on recent modeling work by the EPA to evaluate ACESA impacts, an approximate average allowance balance of 13 BMT in 2030 was estimated across various scenarios they considered, an increase of cumulative abatement of roughly 50 percent above the minimum required under ACESA through 2030. This level of allowance banking is consistent with the greater difficulty of complying with the increasingly stringent post-2030 caps under continued growth in population and the economy. While the level of banking would also depend on other economic assumptions, such as the availability and cost of international offsets, the 13-BMT-balance assumption was applied in all but one of the cases analyzed. In the ACESA High Banking Case, where banked allowances were assumed to rise to 20 BMT, approximating the highest level observed in EPA's ACESA cases.

Table B3. Assumed Gross and Net Supply Schedule of International Offsets from Developing Countries

(million metric tons CO_2-equivalent)

Gross Group 2 Offset Supply					
	Potental Gross Quantity of Offsets Supplied (millon metric tons CO2 equivalent)				
Price (2000 dollars per tonne CO2)	2010	2015	2020	2025	2030
$0.0	0	0	0	0	0
$0.3	71	41	151	264	327
$3	131	97	294	684	992
$5	185	156	454	1106	1611
$8	229	234	622	1762	2630
$11	273	335	855	2578	3932
$14	322	459	1160	3578	5320
$20	388	727	1955	6120	8232
$27	455	1083	3062	9384	11361
$34	527	1507	4270	12248	14244
$41	603	2036	5602	14782	16206
$48	685	2680	6951	16922	17760
$55	772	3444	8248	18881	19263
$61	861	4208	9322	20521	20584
International Floor Price (2000 dollars per tonne CO2)	$13.15	$12.68	$11.81	$10.80	$15.81
International Abatement Demand at floor price (million metric tons CO2 equivalent)	308.3	404.2	937.1	2523.3	6200.3
Offset Supply, Net of International Abatement Demand					
	Potental Net Quantity of Offsets Supplied (millon metric tons CO2 equivalent)				
Price (2000 dollars per tonne CO2)	2010	2015	2020	2025	2030
$0.0	0	0	0	0	0
$0.3	0	0	0	0	0
$3	0	0	0	0	0
$5	0	0	0	0	0
$8	0	0	0	0	0
$11	0	0	0	55	0
$14	14	54	223	1054	0
$20	80	323	1017	3596	2032
$27	147	679	2125	6861	5161
$34	218	1103	3333	9725	8044
$41	295	1632	4665	12259	10005
$48	376	2276	6014	14399	11560
$55	464	3040	7311	16358	13062
$61	553	3803	8385	17998	14384

Treatment of Allowance Prices in Energy Prices

Under ACESA, the allowance obligations are imposed on an upstream basis, on producers and importers rather than end users, for all emissions from petroleum and a portion of natural gas sold by LDCs to uncovered entities. Allowance obligations for coal and natural gas covered entities in the industrial and electric power sectors are imposed on a downstream basis. This mixed regulatory approach has implications for how allowance costs are reflected in the modeling of delivered energy prices.

- The allowance holding requirement on covered entities for their coal-related and natural-gas-related CO_2 emissions is an incremental opportunity cost of using coal. For modeling purposes, the allowance cost was added to the delivered price of coal and natural gas to reflect the opportunity cost faced by these covered entities.

- For petroleum and uncovered natural gas regulated upstream, it is assumed that the allowance costs associated with the related CO_2 emissions are passed through in the delivered prices, with some exceptions.

- CO_2 emissions from refineries' direct fuel combustion of petroleum-based fuels would be subject to the allowance requirement. However, the incremental cost of these allowances is not explicitly reflected in delivered petroleum prices, as the Petroleum Market Module of NEMS is not structured to represent such costs explicitly.

- To reflect the bill's allowance allocations to electricity and natural gas LDCs for rebates to end users, average delivered prices are adjusted to reflect the rebates. Consumers receiving such rebates are assumed to treat their net average energy cost as the price basis for fuel-related decisions.

Additional details on modeling treatment of specific elements of the cap-and-trade provisions and other bill provisions are presented below for each modeling area.

Buildings Sector

The ACESA legislation contains several provisions designed to reduce energy use in buildings and to provide credit for buildings-related renewable electricity generation. The programs include codes and standards as well as direct funding from the sale of allowance aimed at increasing the energy efficiency in buildings. The buildings sector energy efficiency provisions directly modeled in NEMS include the following:

Building Codes (Section 201)

Section 201 establishes Federal building codes for both residential and commercial buildings, with provisions to improve the code every several years. This provision is funded with 0.5 percent of the total emissions allowances and is implemented in both the NEMS residential and commercial demand modules.

All of the improvements in commercial building codes are relative to the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) code 90.1-2004 and are assumed to be feasible. The building code efficiency improves by 30 percent upon enactment of the bill and by 50 percent in 2015, with 5-percent incremental improvements to the 2015 code every 3 years thereafter. It is assumed that the codes are phased in over 5 years following State adoption, reflecting the time it takes States to fully comply with each revision of the building code.

The improvements in residential building codes are relative to the International Energy Conservation Code (IECC) 2006. Similar to the commercial sector implementation, a 30-percent improvement in the code occurs with the enactment of the bill, with subsequent increments identical to those for commercial buildings over the projection period. Each code improvement, following State adoption, is assumed to require 5 years for all the States to fully comply; however, each of the nine Census divisions complies consistent with the historical level of building code compliance in each State.[18]

Existing Building Retrofit Program (Section 202)

Section 202 establishes the Retrofit for Energy and Environmental Performance (REEP) program which is funded by allowance allocation revenues as specified in section 782(g). Because individual States determine the amount of money to spend on various sectors of the economy (buildings, transportation, industry, etc) and the fact that allowance revenue streams and allocations for this provision change over the projection period, the energy savings impacts of this provision are subject to great uncertainty. For this analysis, it is assumed that $2 billion per year is available to retrofit residential buildings and that the investment and energy savings per house are comparable to EIA's previous analysis of the impact of weatherization funding included in ARRA.[19] For commercial buildings, it is assumed that funding is available to improve the shell efficiency of existing buildings by an additional 1 percent relative to the Reference Case by 2030.

Standards (Sections 211 and 212*)*

- Outdoor lighting standards effective 2011 to 2015
- Hot and cold water dispensers effective 2012
- Hot food holding cabinets effective 2012

The impact of the above standards is relatively modest. In the residential sector, the preponderance of lighting fixtures are located inside the house and many outdoor fixtures use traditional incandescent bulbs, which are already covered by aggressive efficiency standards under the Energy Independence and Security Act of 2007. The commercial sector accounts for outdoor stationary lighting such as roadway lighting, parking lots, billboards, airport runways, etc., which account for only about 8 percent of all lighting use in the United States.[20]

Rebates for Natural Gas and Oil Customers (Sections 782b and 782c)

Sections 782b and 782c allocate a relatively small portion of the overall emission allowances to oil and natural gas customers specifically for energy efficiency programs. In the buildings sector, these provisions are assumed to take the form of rebate programs for the purchase of energy-efficient furnaces and boilers.

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[18] Each State was given a "score" from 1 to 5 and weighted by housing permits to calculate a Census division average. The relative score for each State was derived from American Council for an Energy-Efficient Economy (ACEEE), *The State Energy Efficiency Scorecard for 2006*, June 2007.
[19] For more detail on the assumptions, see http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.
[20] Navigant Consulting Incorporated, *U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate*, September 2002.

Buildings sector participation in the Renewable Electricity Credit program that is part of the ACESA Clean Energy Title is directly modeled as discussed below.

Industrial Sector

Title I, Subtitle B, Section 115 promotes the commercial deployment of carbon capture and storage (CCS) technologies. After review of the state of the current technology, it was determined that the industrial CCS provision in the proposal would not be readily adopted by industry. This technology as it applies under the stipulations of the provision would require very large investments to retrofit existing facilities (or add new ones) and substantial land areas at an industrial site to capture the CO_2. Space is always limited at industrial facilities and the addition of new land would ultimately add a high "real-estate premium" to adoption of these systems. Many industries already producing pure CO_2 streams that could be supplied for CCS but these streams are already sold as a valued-added secondary product in the food industries and for enhanced oil recovery, among others. Consequently, it is assumed that industrial non-refining CCS would not penetrate that market through the projection period.

Title I, Subtitle C, Sections 123 and 125 provide financial assistance to automobile manufacturers to facilitate the manufacture of plug-in and other advanced technology vehicles. In the manufacture of vehicles, the platforms used and designed to manufacture standard vehicles are the same as those to manufacture plug-in and other advance technology vehicles. As such, the energy efficiency trends for the transportation equipment industry (NAICS 336) are assumed to be unchanged relative to the *AEO2009* Reference Case.

Title I, Subtitle H, Section 173, establishes several Centers for Energy and Environmental Knowledge and Outreach. Each center is to provide technical assistance, including energy savings assessments for industrial establishments. The proposed increased funding for energy savings assessments programs is expected to accelerate the penetration of energy efficiency measures and options in industries. To model this, the industrial demand module (IDM) of NEMS used the industrial sector high technology assumptions of *AEO2009*.

Title II, Subtitle D establishes various energy efficiency standards and programs for industries. The design and implementation of these standards and programs are yet to be decided. Due to this lack of information, no model changes were made to accommodate this part of the bill. Title II, Subtitle D, Sections 244 and 245 establishes a rebate and incentive programs designed to increase industrial motor efficiency. These were not adequately defined in the proposal and therefore no changes pertaining to the rebate and programs were made in the IDM. Nevertheless, the motor model remains an economic and technology choice system, and as such, any changes in industrial production and energy prices will impact the projected energy use in motors in industry.

The allocation of carbon allowances in the IDM has been applied as prescribed by the bill. These allowances are allocated to energy-intensive industries only, as indirect emissions allowances in 2012 and 2013 and full emissions allowances (direct and indirect) for the remaining timeframe. This allocation is, however, phased out beginning in 2025 as mandated in the proposal. To accurately reflect the lack of CO_2 emissions coverage for small industrial emitters in the early years of the cap-and-trade regime, a bifurcation of natural gas consumption was applied to the IDM for calendar years 2014 and 2015.

Transportation Sector

ACESA includes several provisions that are related to transportation, specifically, Sections 121-130 and Sections 221-224. However, none of these provisions have been incorporated into NEMS because they call for (a) analysis and not action, (b) the creation of programs without any specific measures that can be modeled in NEMS, or (c) are of such limited nature that they are not deemed large enough to impact transportation trends significantly.

- Section 121 mandates utilities to complete studies assessing the future electrification of the U.S. transportation fleet.

- Section 122 calls for the establishment of a program by which the Secretary of Energy can provide financial assistance to State or local governments for the demonstration of plug-in hybrid electric vehicles.

- Section 123 establishes a program by which the Secretary of Energy can provide financial assistance to automobile manufacturers to facilitate the manufacture of plug-in electric drive vehicles.

- Section 124 grants various emissions credits to the manufacture of alternatively-fueled vehicles.

- Section 125 provides loans to manufacturers of advanced vehicle technology.

- Section 126 amends the term ”renewable biomass.”

- Section 127 calls for the promotion of an open fuel standard and allows regulations to require each light-duty automobile manufacturer to produce a minimum percentage of fuel-choice-enabling automobiles.

- Section 128 amends diesel emissions regulations.

- Section 129 provides loan guarantees for the construction of renewable fuel pipelines.

- Section 221 calls for studies to propose changes to the emissions standards for heavy-duty vehicles, non-road vehicles, and aircraft engines.

- Section 222 calls for States to produce plans and create goals for the reduction of GHG emissions from transportation.

- Section 223 establishes within EPA a SmartWay Transport program to quantify, demonstrate, and promote transportation efficiency programs.

- Section 224 allows the Secretary of Energy to change State vehicle fleet requirements.

New Fuel Economy and Tailpipe Emissions Standards for Light-Duty Vehicles

President Obama unveiled a plan for tougher vehicle fuel economy standards that would require passenger cars to reach a fleet average of 39 miles per gallon and light trucks to reach a fleet average of 30 miles per gallon in model year 2016. The President has called for EPA and the National Highway Traffic Safety Administration to jointly produce these new standards as both a footprint based Corporate Average Fuel Economy and a tailpipe emissions standard. Since the policy change was only recently announced by the President and has not been formally implemented, the new fuel economy standards are only included in a sensitivity case for ACESA.

In the sensitivity case, the new fuel efficiency standards have been incorporated into NEMS that meet and slightly exceed the President's targets for model year 2016. The revised standards do not start in NEMS until 2012, as fuel economy standards for model year 2011 have already been promulgated by the National Highway Traffic Safety Administration. Standards are assumed to remain the same after model year 2016.

Macroeconomic

In all cases, MAM assumes exchange rates remain at the Reference Case levels. EIA assumes, as has been customary in several historical responses by the Federal Reserve, that the Federal Reserve will use a modified Taylor rule which will decrease interest rates in the face of rising unemployment. MAM takes all appropriate energy price and quantity variables from NEMS and converts them into IHS Global Insight aggregate energy measures.

Specific to the ACESA analysis, MAM implemented two major modeling changes: one pertaining to energy-intensive industries and the other to redistributing carbon allowance revenues back to the economy. As part of the H.R. 2454 bill, section 782 (e) allocates shares of allowances to trade- and energy-vulnerable industries. In MAM, these industries are impacted by various industrial fuel prices as well as overall changes in final demands. In the ACESA analysis, the energy-intensive industries react to pre-tax industry fuel prices, rather than post-tax prices under the assumption that when the industries receive the allocated allowances, the revenue will enable them to restructure their production processes to ameliorate the impact of rapidly rising energy prices.

MAM redistributes a certain portion of total allowance revenue. The following list includes the revenues being collected and redistributed by the model: Section 726 Strategic Reserve, Section 781, Supplemental Reserves, Section 782 (d) Low Income Allocation; Section 782 (g) Investment in Energy Efficiency and Renewable Energy; Section 782 (g) 1 f Investment in Energy Efficiency and Renewable Energy; Section 782 (g) Investment in Energy Efficiency and Renewable Energy (2) building codes; Section 782(h) Clean Energy Innovation Centers; Section

782(i) Clean Vehicle Technology; Section 782(k) Investment in workers; Section 782 (l) Domestic Adaptation; Section 782 (m) Wildlife and Natural Resource; Section 782 (m) Wildlife and Natural Resource; Section 782 (n) International Adaptation; Section 782 (o) International Clean Technology; and Section 782 (r) Consumer Climate Change Refund. MAM treated Section 782 (d) low income allocations as transfer payments, Section 782 (n) and (o) (international transfer of allocations) as other Federal government transfers to the rest of the world. Sections 782 (g) (h) (i) (k) (l) (m), Section 726 and Section 781 were treated as Federal government non-defense spending. Section 782 (r) which distributed funds post-2025 were treated as lump-sum personal tax rebates. All of the other allowances specified in H.R. 2454 went to energy-producing or -distributing entities or were given to energy-intensive industries and were not collected or redistributed by MAM. Changing the level of non-defense government expenditures insured that the Federal deficit at full employment was unchanged from the Reference Case across all ACESA cases. The uses of the carbon allowance revenues as stipulated by H.R. 2454 were modeled; however to the extent that the resulting change in government expenditures were lower than the actual amounts specified by the bill, other non-defense government expenditures would have to be reduced to insure unchanged Federal deficits over time.

Electric Power and Coal

Renewable Electricity Credits

Section 101 establishes a program requiring retail electric suppliers to submit renewable energy credits and electricity savings equal to a percentage of their annual electricity sales beginning in 2012. Distributed renewable generation facilities are issued 3 Federal renewable electricity credits for each megawatthour of renewable electricity generated with the granting of triple credits to be reviewed for adjustment in 2014 and every 4 years thereafter. It is assumed that the adjustment reviews result in an adjustment to 1 Federal renewable electricity credit per megawatt hour issued to distributed generation facilities starting in 2014. However, distributed renewable generators placed in service during a year when triple credit is granted continue to receive triple credit for 10 years. This provision is directly modeled in the buildings sector but is expected to have minimal impact on buildings sector renewable generation because the requirements of the cap-and-trade program in ACESA lead to sufficient renewable generation capacity in the power sector to meet the renewable electricity standard targets.

Carbon Capture and Sequestration

Section 114 outlines a CCS demonstration program that is to be run by the private sector, under the lead of the Electric Power Research Institute and funded by small fees on the distribution of fossil-fired electricity. The fees range from 0.22 mills per kilowatthour for natural-gas-fired electricity to 0.43 mills per kilowatthour for coal-fired electricity. The goal of this 10-year, $10-billion program is to support 5 commercial-scale CCS or conversion technology projects. The small fees on fossil-fired electricity distribution specified in this section are accounted for in the cases analyzed for this report and are assessed for the years 2010 through 2019.

Section 115 adds Section 786 "Commercial Deployment of Carbon Capture and Sequestration Technologies" to Section H of Title VII of the Clean Air Act. This section establishes a program to distribute bonus GHG emission allowances to new projects in the electricity and industrial sectors to help defray the costs associated with equipment and infrastructure needed to capture and sequester CO_2 emissions produced from the combustion of fossil fuels at these facilities. To be eligible for the bonus allowances allocated for this program, the project must derive at least 50 percent of its energy input from coal and/or petroleum coke. The first 6 gigawatts of approved capacity under this program are eligible to receive a $90 bonus allowance for each metric ton of CO_2 captured and sequestered. Beyond the initial 6 gigawatts of capacity with CCS, an additional 66 gigawatts are eligible for bonus allowances on the basis of a reverse auction administered by EPA or, at EPA's discretion, an alternative program for distributing the program's remaining bonus allowances. Only 1 gigawatt of retrofitted CCS capacity at existing plants is eligible for bonus allowances allocated under this section. Qualified CCS projects are eligible for 1.75 percent of allowances established according to section 721(a) for the years 2014 though 2017, 4.75 percent of allowances for the years 2018 and 2019, and 5.0 percent of allowances for the years 2020 through 2050.

This program is represented within the analysis for this report by reducing the estimated costs of new coal-fired generating capacity by the value of the bonus allowances that the plant would be eligible to receive. The amount of new coal-fired generating capacity projected within a given forecast scenario is determined by a number of factors such as the costs and availability of electricity from other generating technologies, the availability of international and domestic offsets, and the projected levels of electricity demand.

Section 116 adds a new Section 812 "Performance Standards For New Coal-Fired Power Plants" to Title VIII of the Clean Air Act, which specifies that new power plants authorized under State or Federal law to derive at least 30 percent of their energy input from coal and/or petroleum coke will initially be required to capture and sequester a minimum of 50 percent of their potential CO_2 emissions. The CCS requirement rises to 65 percent for plants built in 2020 or later. Additionally, based on reviews of the standards to be completed by the EPA Administrator at 5-year intervals, and beginning no later than 2025, CCS requirements would be increased to levels higher than 65 percent if higher capture and storage rates are determined to be reasonably achievable. In the analysis completed for this report, new coal-fired power plants with CCS are assumed to capture and sequester 90 percent of their potential CO_2 emissions.

Peak Demand Reductions (Section 143)

This section requires States to determine and publish peak demand reduction goals for load-serving entities with a baseline above 250 megawatts. The Secretary, with the Federal Energy Regulatory Commission (FERC) and the North American Electricity Reliability Council, will develop a methodology for measurement and verification of demand response. The FERC report 2009 National Demand Response Potential Assessment should be used to help determine peak reduction goals. The load-serving entities must reduce peak load by 2012 and further by 2015, by amounts determined by each State.

This program is represented in the analysis by assuming that peak demand will be reduced by 3 percent by 2020, instead of the 1 percent assumed in the Reference Case due to ARRA.

Allocation of Emission Allowances (Sec. 782)

Section 782 (a)(1) allocates allowances for the benefit of electricity consumers, starting at 44 percent of total allowances in 2012 and falling over time through 2029, after which no further allowances are given out. Section 782 (a)(2) allocates a separate 0.5 percent specifically to small load distribution centers. For modeling purposes, these allowances are added together and treated as one allocation. Section 783 describes the method of distributing the allowances, with the majority going to LDCs to be used exclusively for the benefit of retail ratepayers. Up to 10 percent of the allowances under this section can be given to merchant coal generators, based on their qualifying emissions through a base historical period.

These allocations are accounted for in the electricity pricing calculations. The allowances given to merchant coal generators are calculated based on historic emissions, and the value of the allowances in each year would offset the rising fuel costs in the affected regions. The remaining allowances are shared to the regions based on a combination of historic emissions and overall electricity sales, as described in Section 783(b)(2) and Section 783(b)(3). The revenue from this allowance allocation is assumed to go to reduced distribution costs, lowering the distribution component of electricity price to all consumers.