# The Lieberman-Warner Climate Security Act—S. 2191

# A Summary of Modeling Results from the National Energy Modeling System

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**Clean Air Task Force**
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# Caveats on Modeling

- **Models are useful tools, but do not reliably predict the future with great accuracy – in part because:**
  - **They rely on a great many assumptions including long-range fuel price forecasts.**
  - **Energy technology performance and cost assumptions typically do not range far from current conditions in the model.**
  - **They necessarily simplify reality – for example, the complex power system consisting of several thousand different generating units is reduced in NEMS to about 200 "model" power plants that attempt to statistically reflect reality.**
- **Models will not capture the potentially significant psychological changes that might occur with enactment of climate policy – "we are really moving into a carbon constrained world" – that could materially impact investor behavior.**
- **Models cannot capture political opposition to certain technologies. If the tools to meet the caps modeled in this policy are not available due to local or national political opposition, obviously these results would be very different.**
- **While models produce "exact" numbers, care should be taken to focus on the trends and the directionality of the model results.**

# Summary

- **Our modeling of S.2191 shows:**
  - **Almost imperceptible macro-economic impacts.**
  - **Reduced residential and commercial electricity bills on average (with some regional increases).**
  - **Stable residential and commercial natural gas bills.**
  - **A future for coal in a carbon constrained world.**
  - **No "fuel switching" to natural gas.**
  - **A robust future for zero carbon sources of power such as renewables and nuclear.**
  - **A GHG reduction of 33% below 2005 levels by 2030.**
  - **A large incentive for reductions in non-covered sources of GHG emissions.**
  - **A large dispersion of funds to accelerate technology deployment and help affected communities.**

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# Background

- CATF, working through its consultant OnLocation, has modeled several scenarios of S. 2191.
- This is a summary of the results of our latest run which looks at the committee passed bill and includes the new corporate average fuel economy standards that were enacted in December 2007.
- The model runs simulate most but not all of the provisions of S. 2191.
- Some of the data in this presentation is based on calculations done after the model run, but using modeled outputs.

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# The Lieberman Warner Bill

- **“Cap and trade” system and some complimentary policies that covers about 86% of the economy wide emissions.**
- **Covers coal fired power plants and industrials downstream, all petroleum fuel use at the importer or refinery level, all natural gas emissions at the importer or processing facility, and importers or producers of sulfur hexafluoride, perfluorocarbon, and hydrofluorocarbon.**
- **Would reduce covered GHG emissions through a cap and trade system by ~70% by 2050; return to 2005 levels by 2012; 15% below by 2020.**
- **Economy wide emissions levels have been estimated to be between 62-66% below 2005 levels by 2050.**

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# Lieberman Warner Contd.

- 22.5% auction phasing to 69.5% by 2030
- 30% offsets (half international)
- Cost containment through banking, borrowing, and “Carbon Fed.”
- Pots of money and allowances are reserved for dozens of different programs including:
  - Bonus allowances for CCS
  - Money for building first 20GWs of CCS
  - Money for demonstrating GCS at power plants
  - Money for renewables and other low to no carbon power sources.
  - Money for VMT reductions, mass transit and advanced vehicles.
  - Money for energy efficiency.
  - Money to offset electricity and natural gas price increases.
  - Money for states, wildlife, international adaptation, worker training, forest fire fighting…

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# How we modeled S. 2191

- Covered sector emissions include: coal fired electrical and industrial boilers, petroleum use in transportation (upstream), residential, commercial and industrial natural gas and petroleum use (upstream).
- Offsets are allowed up to 30% (the 15-15 split is not possible in NEMS, but the resulting output is close).
- Unlimited banking.
- We did not change any technology assumptions in NEMS, except to constrain the deployment of biomass power.
- To partially simulate the use of auction revenue and direct allocation of allowances for low and no carbon power technologies, we used a production tax credit for CCS power and extended the wind production tax credit to 2030.
- To simulate S. 2191's technology and efficiency provisions and the money dedicated to deploying efficiency and new technologies, we used EIA's "Best Available Technology" case. Our runs do not take into account the fact that some of the energy efficiency provisions in S. 2191 were actually enacted in the energy bill in late 2007. We are waiting on EIA to incorporate the full energy bill into its AEO 2008 baseline before we do any additional analyses.

# How We Didn't Model S. 2191

- In our modeling we chose to adhere as closely as possible to the way EIA would model the bill.
- As such, we did not try to produce a "plausible" generation mix or generation expansion schedule.
- We think that that work is necessary and we are exploring putting that case together.
- We did not model the low carbon fuel standard that was added in the committee passed bill.
- We did not model the Carbon Market Efficiency Board.
- We have not fully captured the impact the various auction revenue and allowance allocation funds would have in the market place.

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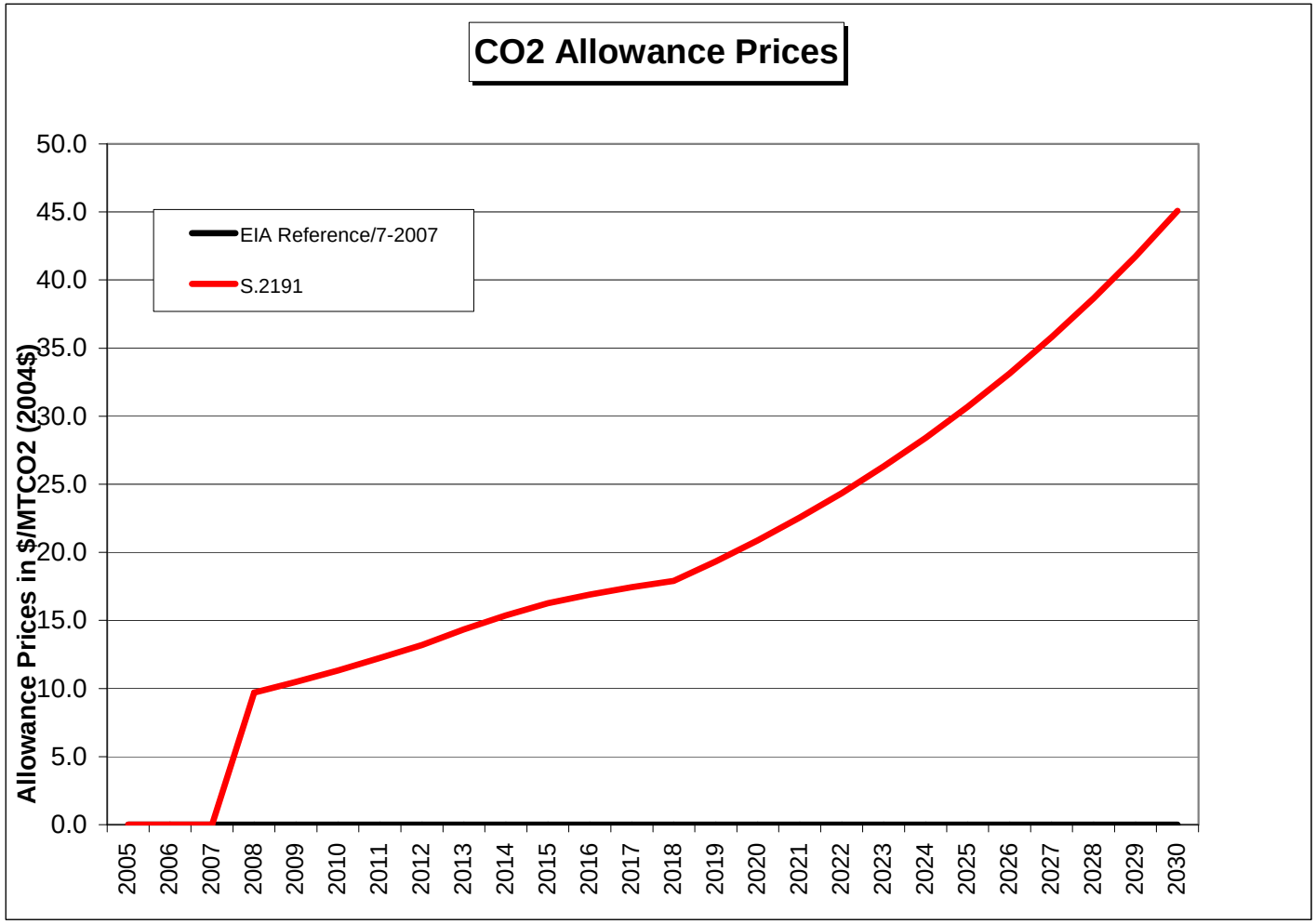
# The price of the allowance drives both the economic and technology response

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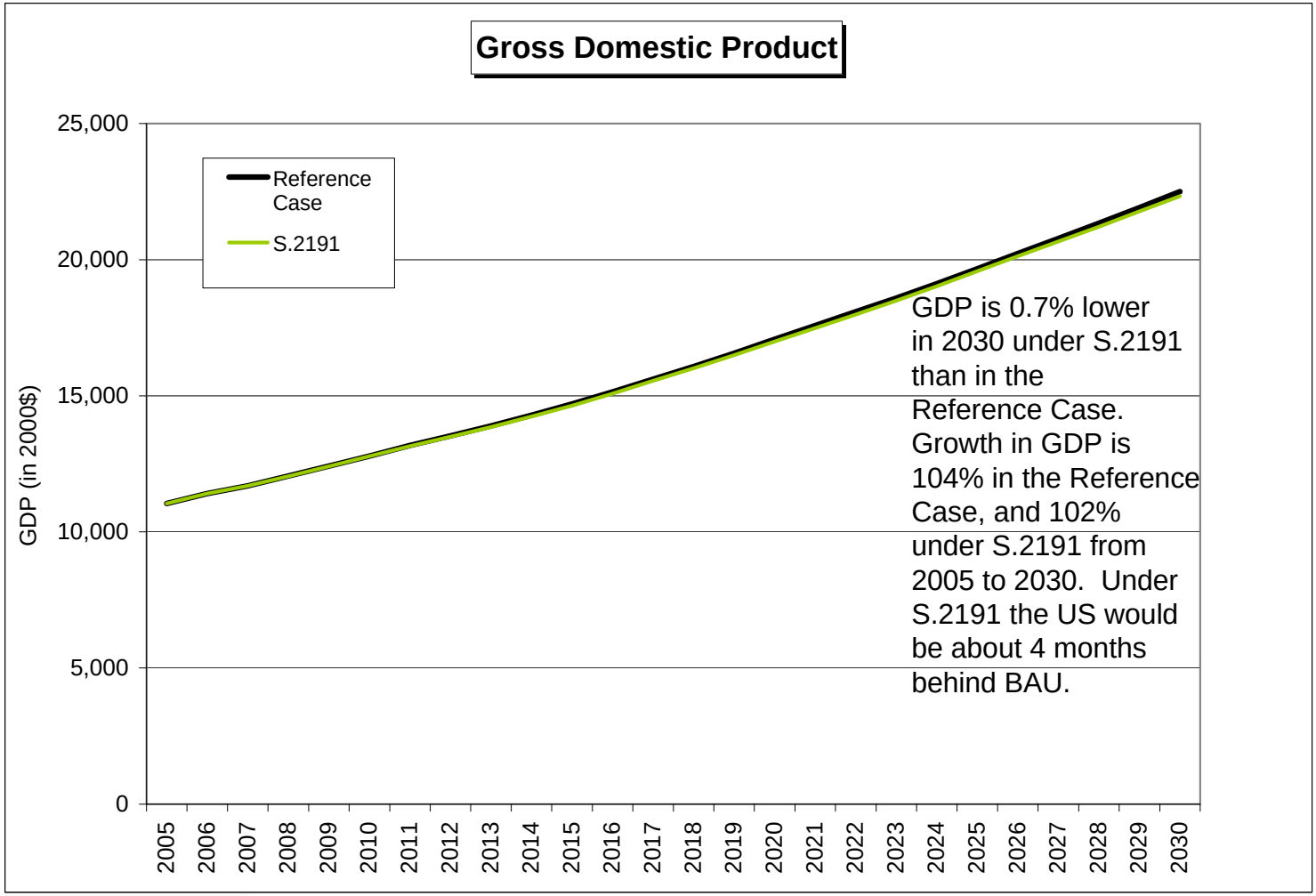
# At the macro-economic level there is very little difference

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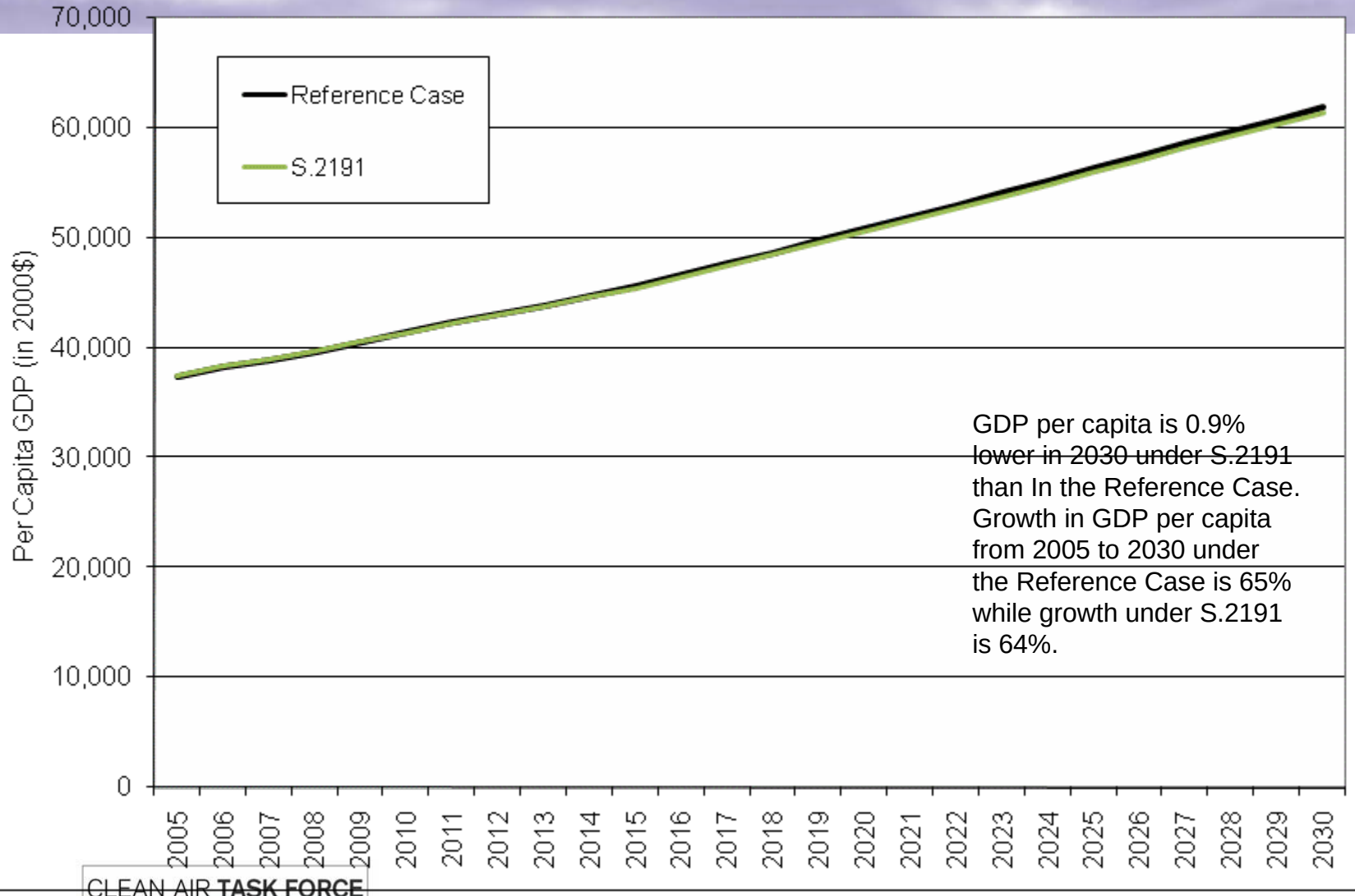
# Per Capita Gross Domestic Product




GDP per capita is 0.9% ~~lower in 2030 under S.2191~~ than In the Reference Case. Growth in GDP per capita from 2005 to 2030 under the Reference Case is 65% while growth under S.2191 is 64%.

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# Electricity rates increase but monthly bills drop due to efficiency

- The average price per KWh of electricity increases from 8.2 cents per KWh in 2006 to 9.5 cents per KWh in 2030.
- However energy usage drops considerably, due to S. 2191's energy efficiency provisions and price response (20% drop in generation from BAU in 2030).
- This drop in energy consumption results in lower monthly electrical bills for residential and commercial customers relative to the reference case (regional impacts will vary see below).
- EIA's BAT scenario does not include industrial energy equipment efficiency. Most of the major gains in efficiency in the industrial sector would be through major process changes, so the impact of S. 2191's efficiency provisions would not be seen as much as in the commercial and residential sectors where relatively cheap reductions are readily available.

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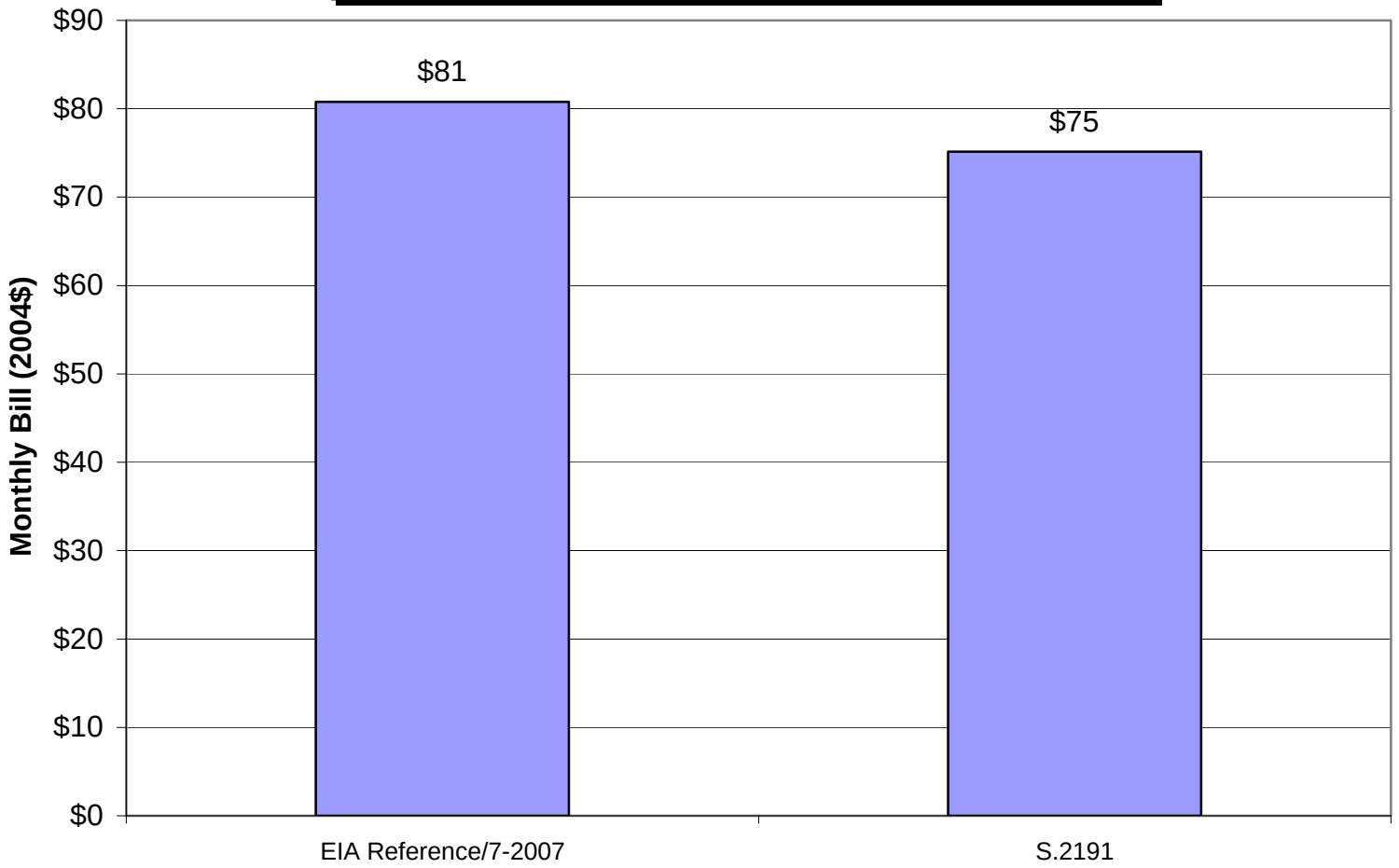
## Typical Residential Bill
## (Based on 2030 Rates and Adjusted Usage)

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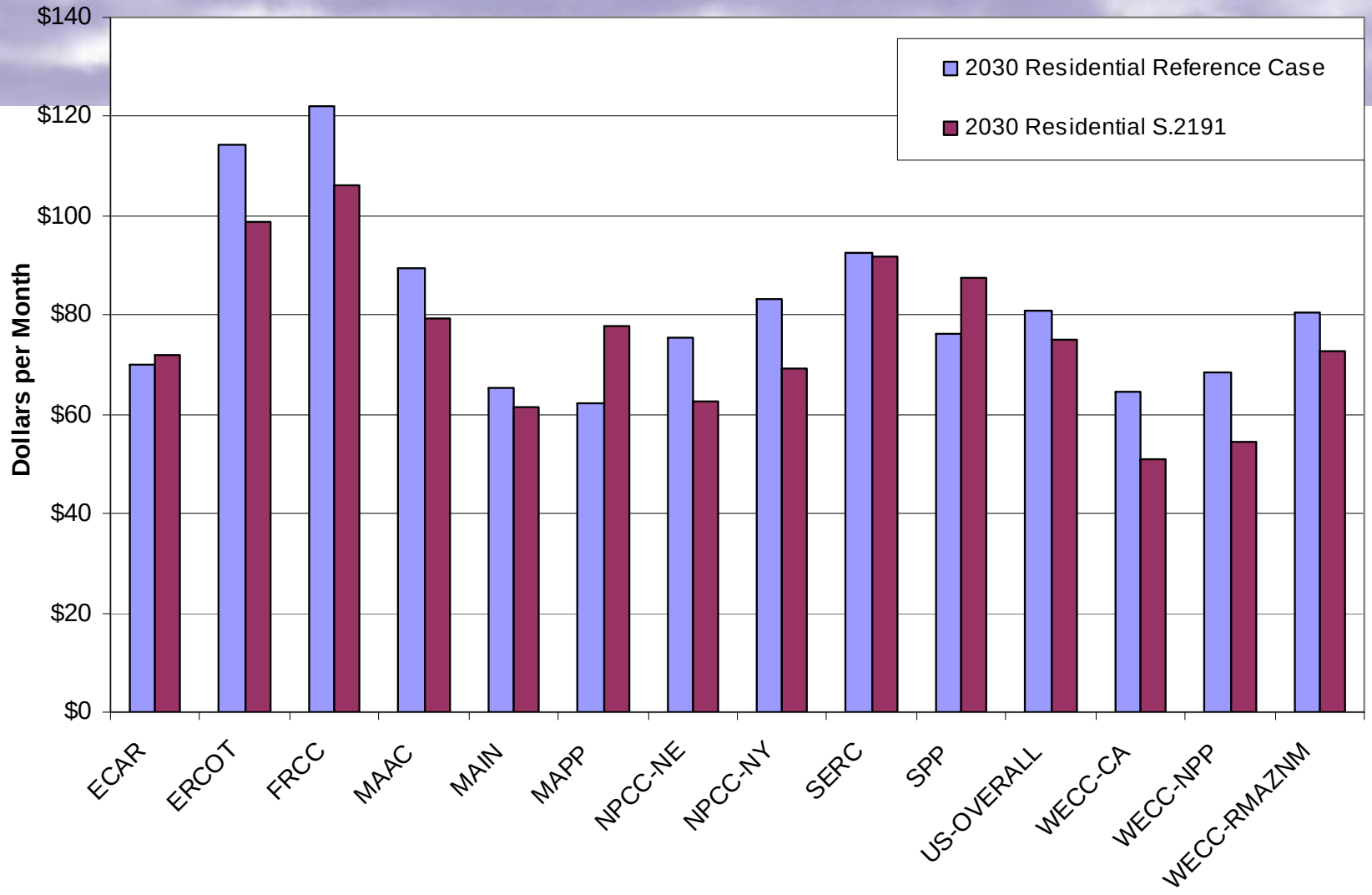
# Typical Residential Monthly Bills In 2030 with Adjusted Usage

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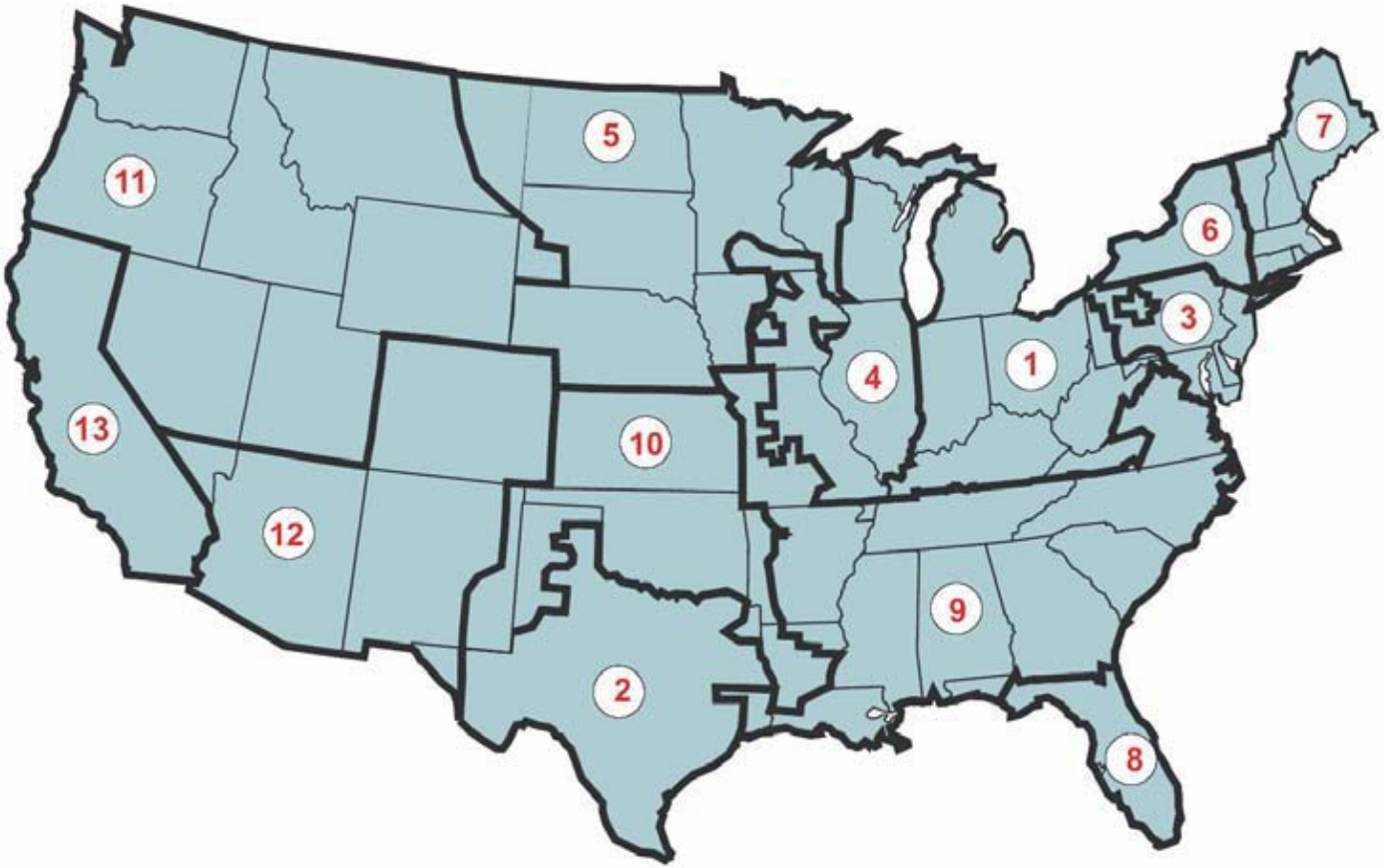
# NERC Regions

1. ECAR
2. ERCOT
3. MAAC
4. MAIN
5. MAPP
6. NPCC-NY
7. NPCC-NE
8. FRCC
9. SERC
10. SPP
11. WECC-NPP
12. WECC-RMAZNM
13. WECC-CA

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# A Safety Net for Electricity Price Increases

- Three electricity regions show monthly bill increases: ECAR-2$ (OH, IN, KY, MI, WV and parts of WI, VA, and PA); SPP-12$ (KS, OK and parts of TX and LA); and MAPP-16$ (MN, ND, SD, NE and parts of IA and WI). However, S. 2191 does create a safety net to protect low and middle income consumers from these increases.

- Sec. 3401 sets aside 9% of the total allowance pool to be used as rebates to low and middle income energy consumers and to promote energy efficiency. This fund could benefit from language that directs the money to the states that need the money most.

  By 2030, this fund will contain nearly $213 billion.

- Sec. 4101, 4501and 4502 establish the Energy Assistance Fund that provides additional funding to LIHEAP, the Weatherization Assistance Program, and a new Rural Energy Assistance Program.

  By 2030, this fund will contain over $193 billion.

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# Natural gas prices increase but monthly bills remain steady due to efficiency

- The average price per MMBTU of natural gas increases from $9.64 per MMBTU in 2005 to $9.92 per MMBTU in 2030.
- However, due to S. 2191's energy efficiency provisions and price response, energy usage drops considerably.
- This drop in actual energy needed, reduces price impacts on monthly natural gas bills for residential and commercial customers. The monthly impact is not as great as with electricity prices because of the cost difference in natural gas efficiency gains (i.e. replacing a light bulb vs. replacing a water heater).
- EIA's BAT scenario does not include industrial energy equipment efficiency. Most of the major gains in efficiency in the industrial sector would be through major process changes, so the impact of S. 2191's efficiency provisions would not be seen as much as in the commercial and residential sectors where relatively cheap reductions are readily available.

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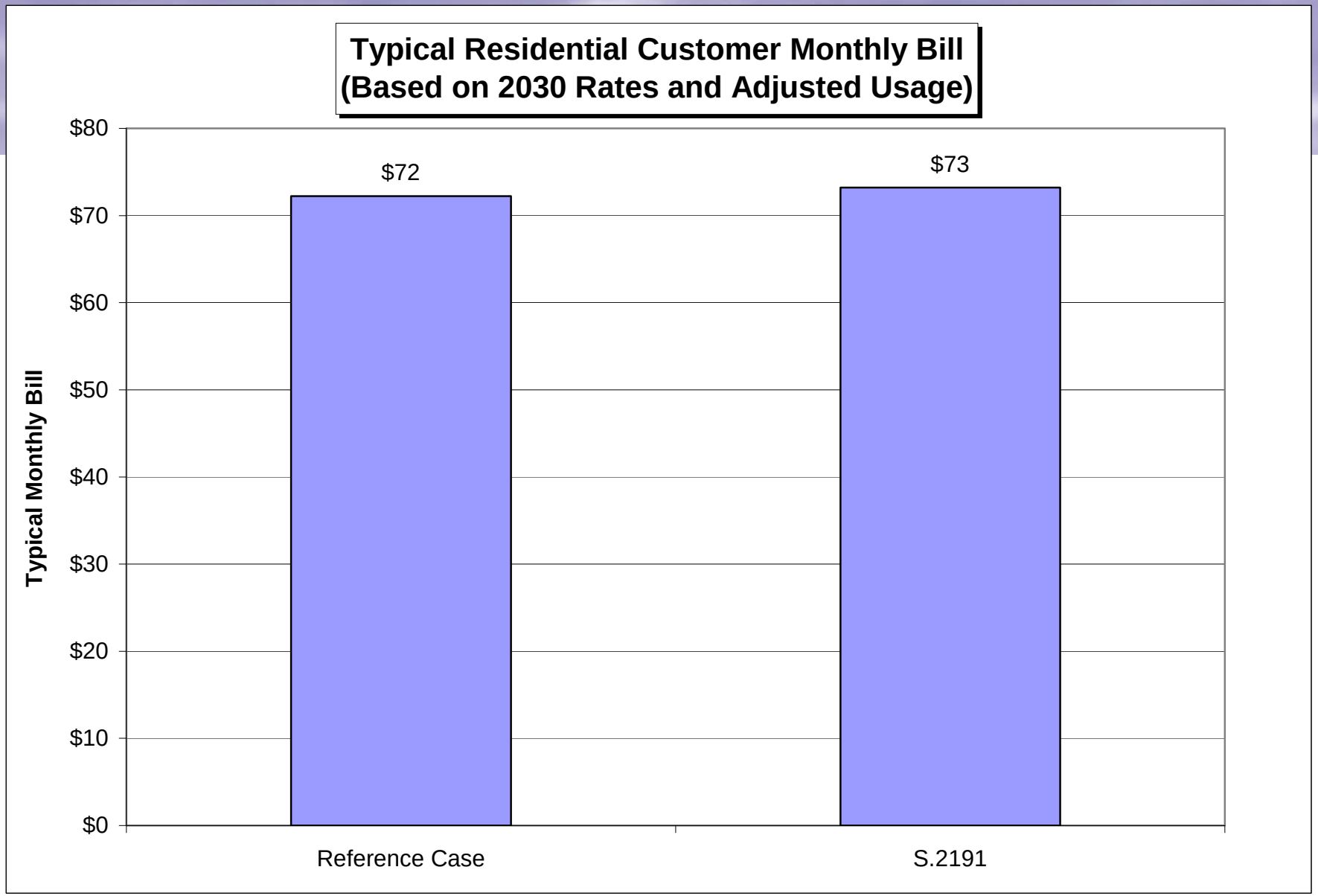


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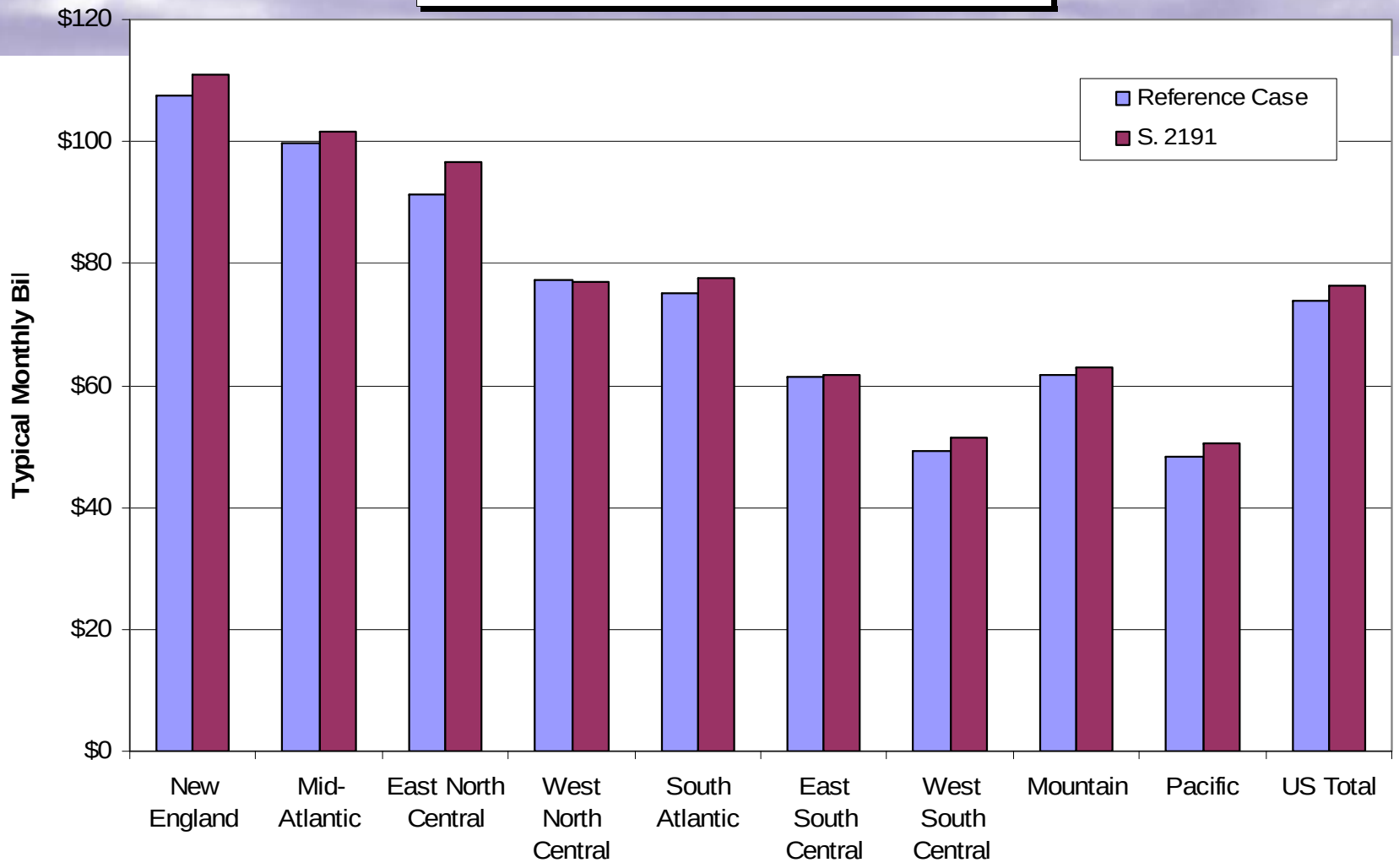
# Typical Monthly Natural Gas Bills
# Residential -- 2030

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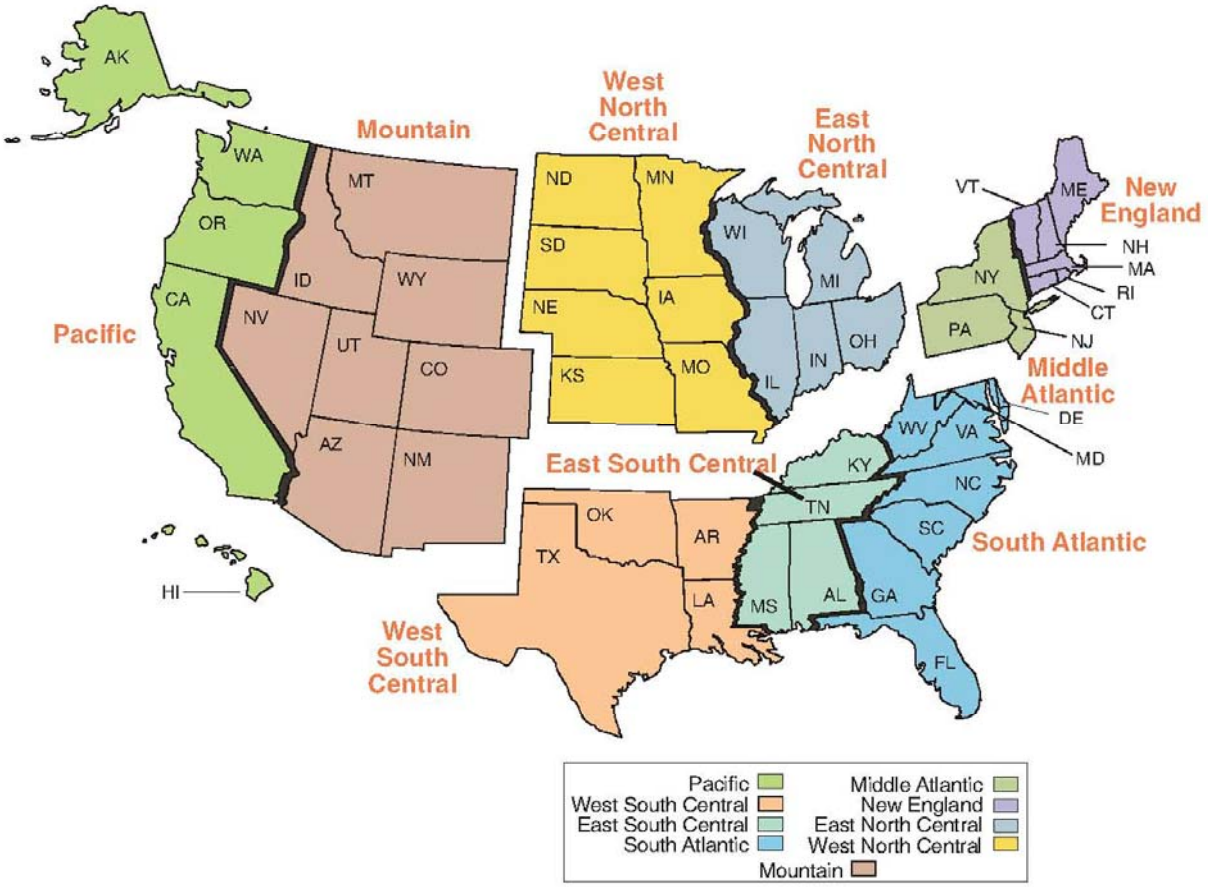
# Census Region Breakout



# A Safety Net for Natural Gas Price Increases

- Even though monthly natural gas bill impacts for residential customers are expected to be quite small when compared to BAU, S. 2191 creates a safety net to protect low and middle income consumers.

- Sec. 3501 sets aside 2% of the total allowance pool to be used as rebates to low and middle income energy consumers and to promote energy efficiency. As with the fund for electric power consumers this fund could benefit from language directing it to states that need it most.

  By 2030, this fund will contain nearly $47 billion.

- Sec.'s 4302, 4501 and 4502 establish the Energy Assistance Fund that provides additional funding to LIHEAP, the Weatherization Assistance Program, and a new Rural Energy Assistance Program.

  By 2030, this fund will contain over $193 billion.

- LIHEAP funds, as well as the Rural Energy Assistance Funds could be used to offset any price impacts that low and middle income natural gas customers might see.

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# Gasoline Prices

- **Gasoline prices gradually go up under S. 2191, closely tracking the CO2 allowance price (i.e. 10$ a ton CO2= @ 10 cents on a gallon).**
- **While EIA's projection for gas prices, even for the AEO 2007 case may look optimistic, the *incremental impact* that S. 2191 will have on actual future gasoline prices would be similar to that projected in this analysis.**
- **Gasoline prices under S. 2191, reflect almost 100% pass-through cost of the CO2 allowance price.**

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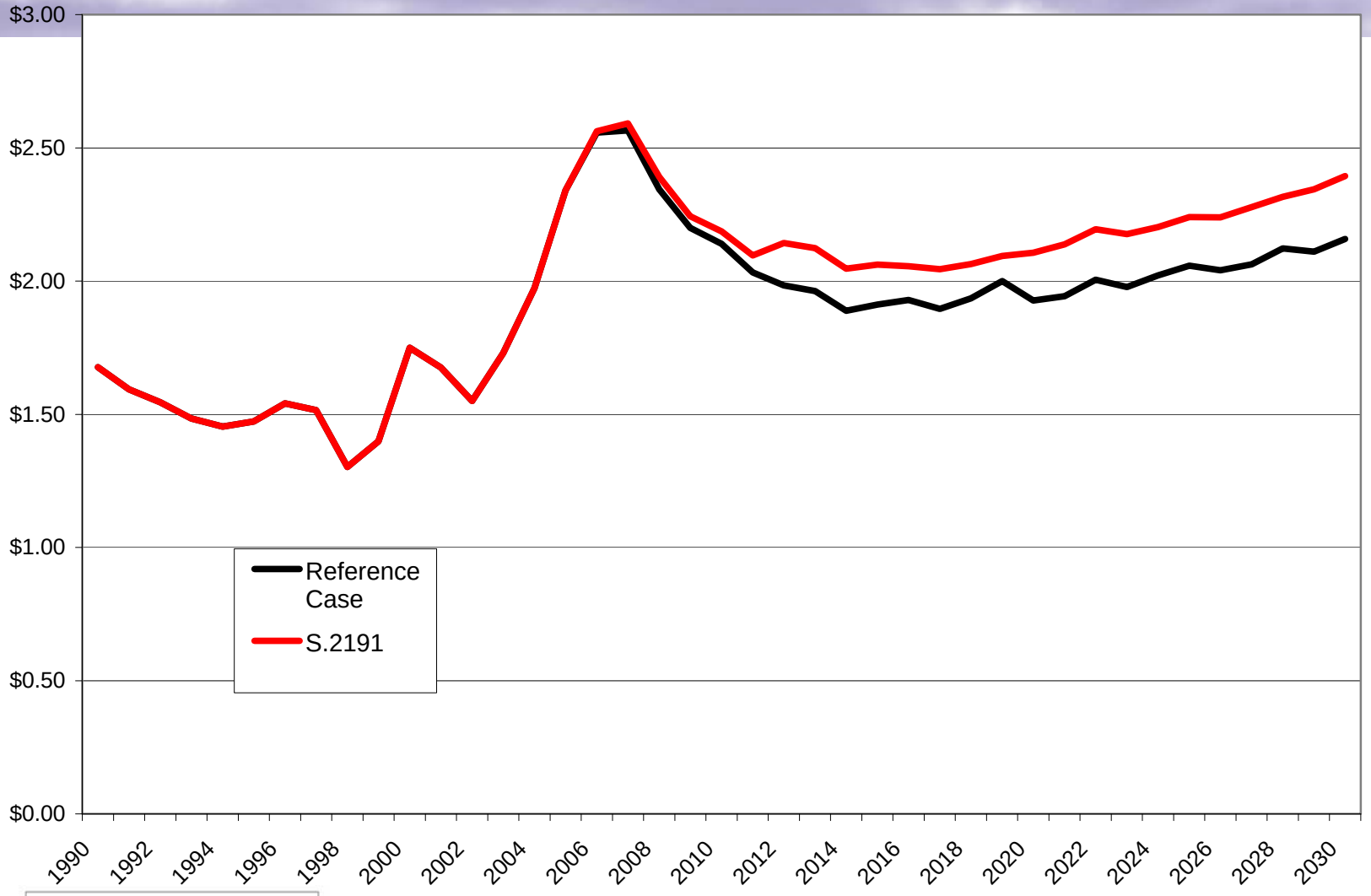
# Retail Gasoline Prices -- Historic and Projected

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# Electricity Generation

- Due to the technology and efficiency incentives and the standards in the bill, overall electricity generation declines by 20% as compared to projected 2030 growth in BAU generation.
- This is equivalent to not building 170 1000Mw power plants.
- This combined with the GHG cap reduces the role that traditional fossil fuels play in the power sector.
- However, new low carbon fossil technologies and renewable technologies, spurred by the incentives in S. 2191, along with nuclear increase dramatically.

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# Gas Generation

- In most climate policies, gas generation is relied on as an interim power source prior to CO2 allowance prices reaching the point where carbon capture and sequestration becomes economic (@ $30-35).

- Because of the incentives for CCS, and the reduction in overall energy use through the energy efficiency provisions, natural gas generation does not show up as a “bridge” fuel.

- If CCS or nuclear is constrained below projected expansion levels in the real world, or energy efficiency doesn’t deploy as we have forecasted, gas generation would likely fill the gap.

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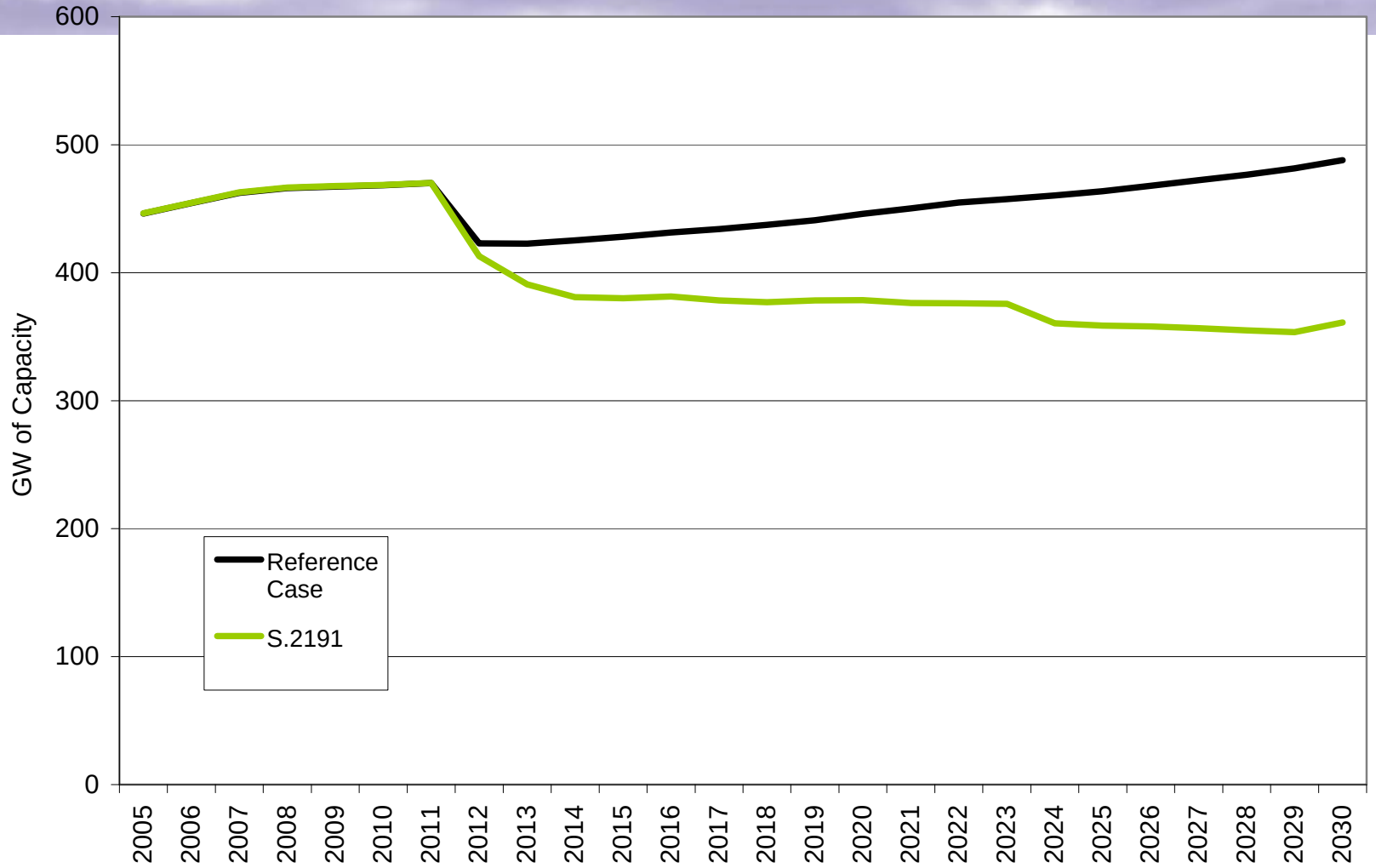
# Oil and Gas-Fired Generating Capacity

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# Nuclear Generation

- **Nuclear power in a carbon constrained world will have an economic advantage that it does not currently have.**
- **NEMS sees nuclear as a low cost, no carbon power generation choice, and thus builds large amounts of new nuclear generation- 104 GWs by 2030.**
- **We chose not to artificially constrain nuclear power within the model because EIA is not likely to do so.**
- **As of *early 2007*, 27 GW of new plants were on order or proposed in the US, according to the World Nuclear Association.**
- **Building a further 77GWs would require the build rate the US had in the nuclear heyday (1971-1990) when we built approximately 5GWs a year.**

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# The ‘inherent’ nuke incentive

- Because nuclear power is a zero emitting technology, passage of a climate policy (absent direct incentives) provides a huge incentive to new and existing nuclear power plants.
- The size of the incentive is driven by the allowance price and will vary by NERC region.
- For S.2191, each new plant in the country would see additional revenues of $265 million through 2030 (depending on when it’s built).
- Existing plants would see even more.

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# Renewable Generation

- The large expansion of renewable generation is due to both the GHG cap as well as the incentives in S. 2191 for low and no carbon technologies.
- Sec. 4406 dedicates approximately $129 billion to “sustainable” energy sources. Renewables could also qualify for Sec. 4402, the Zero or Low Carbon energy technologies deployment fund which has $165 billion.
- We extended the production tax credit for wind power to 2030 within the model to mimic the benefit of just some of these funds.
- In addition, we suppressed the amount of biomass power due to the many competing uses that biomass faces (i.e. ethanol and other biofuels), as well as questions about net climate impacts and costs.
- Between 2012-2030, nearly 54 GWs of new wind generation is deployed.

# Coal Generation Under S. 2191

- **The Lieberman-Warner bill includes massive incentives to move CCS power into the market faster than it would otherwise.**

- **S. 2191 contains a 4% bonus allowance for CCS, a fund for deploying 20GWs of new IGCC/CCS, a fund for deploying new fossil and retrofit technologies with CCS, a fund for demonstrating geologic carbon storage at power plants, and the zero and low carbon generation fund which CCS power plants could qualify for.**

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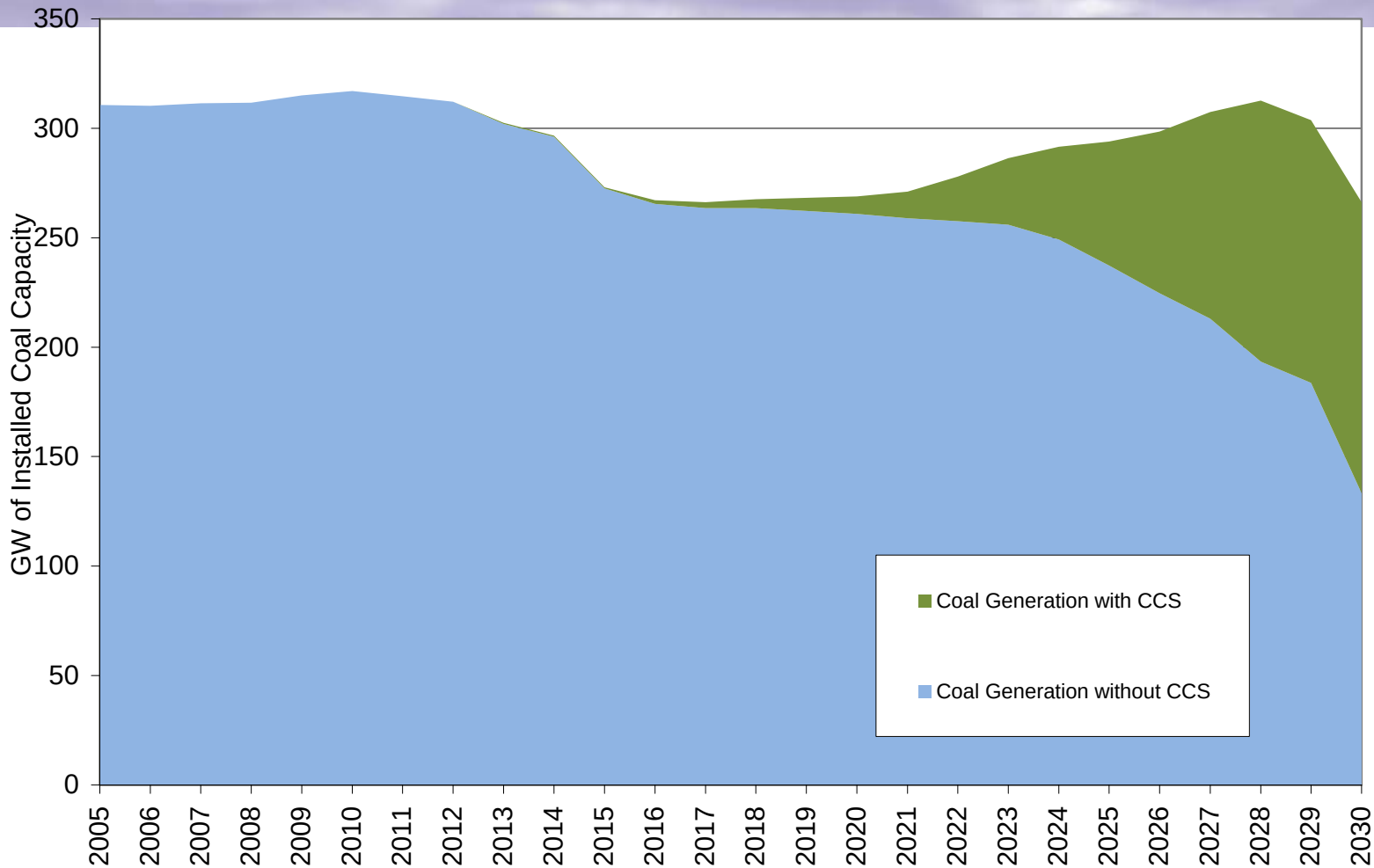
# Coal Generation Under S. 2191, contd.

- These funds change the future for coal in our analysis of the Warner-Lieberman bill.
- In modeling S. 2191, we used a production tax credit of 1.25 cents/KWh for coal generation with carbon capture and storage.
- This was used to mimic just the 4% bonus allowance, and does not reflect the rest of the incentives.
- While coal generation drops as a percentage of the power fleet, it still remains the number one source of power (tied with nuclear).
- 177 GWs of traditional coal retires, while 133 GWs of IGCC/CCS is built by 2030.

# Coal Capacity by Type Under S.2191

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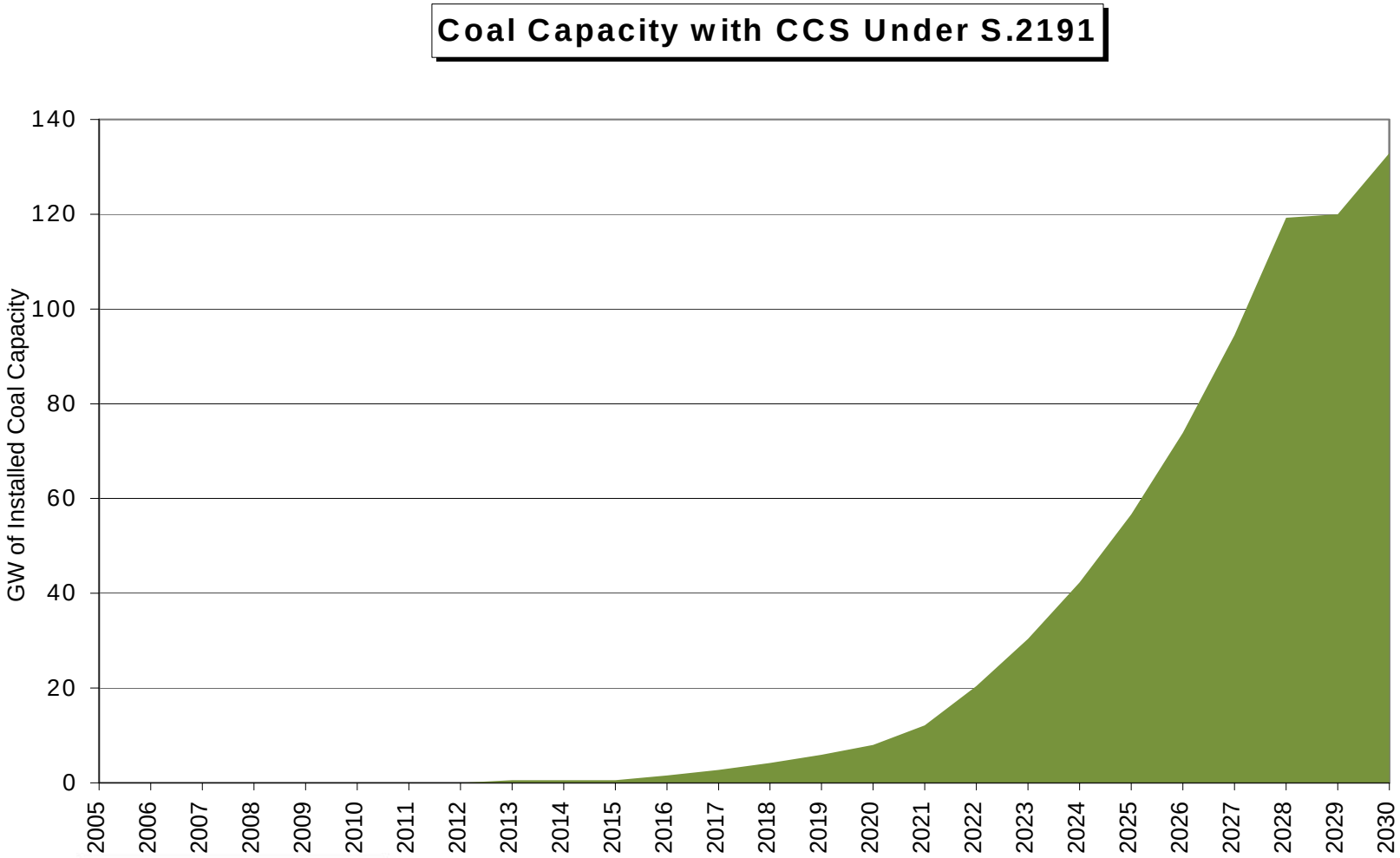
# CCS Expands Dramatically

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# CCS incentives in S.2191

## The Bonus allowance pool:

- Each year, from 2012-2030 4% of the total allowance pool is set aside to provide incentives for facilities to put CO2 in the ground.
- The annual value of these funds starts at $3 billion in 2012 and rises to $7 billion by 2030.
- The cumulative value of the CCS bonus allowances is $88 billion.
- This provision was taken from the Bingaman Specter bill and is designed to bridge the gap between the allowance price and where it is economic to put CO2 in the ground.

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# CCS incentives in S.2191

## Advanced Coal/Retrofit CCS Demonstration program:

- The bill sets aside 3.25% of the auction proceeds for funding of CCS retrofits and other advanced coal based technologies that sequester CO2.
- This fund has a cumulative value of over $32 billion by 2030 but will continue to grow as it accrues funds all the way through 2050.

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# CCS incentives in S.2191

## First 20GWs of CCS Deployment Program:

- **The bill also sets aside 3.25% of the auction proceeds for funding the first 20GWs of CCS power.**
- **This fund has a cumulative value of over $32 billion by 2030 but will continue to grow as it accrues funds all the way through 2050.**

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# CCS incentives in S.2191

## Geologic Carbon Sequestration Demonstration Program:

- **The bill sets aside 6.5% of the auction proceeds for funding geologic carbon sequestration from power facilities (including facilities that received funds from either the 20GW fund or the Retrofit fund).**
- **This fund has a cumulative value of over $64 billion by 2030 but will continue to grow as it accrues funds all the way through 2050.**

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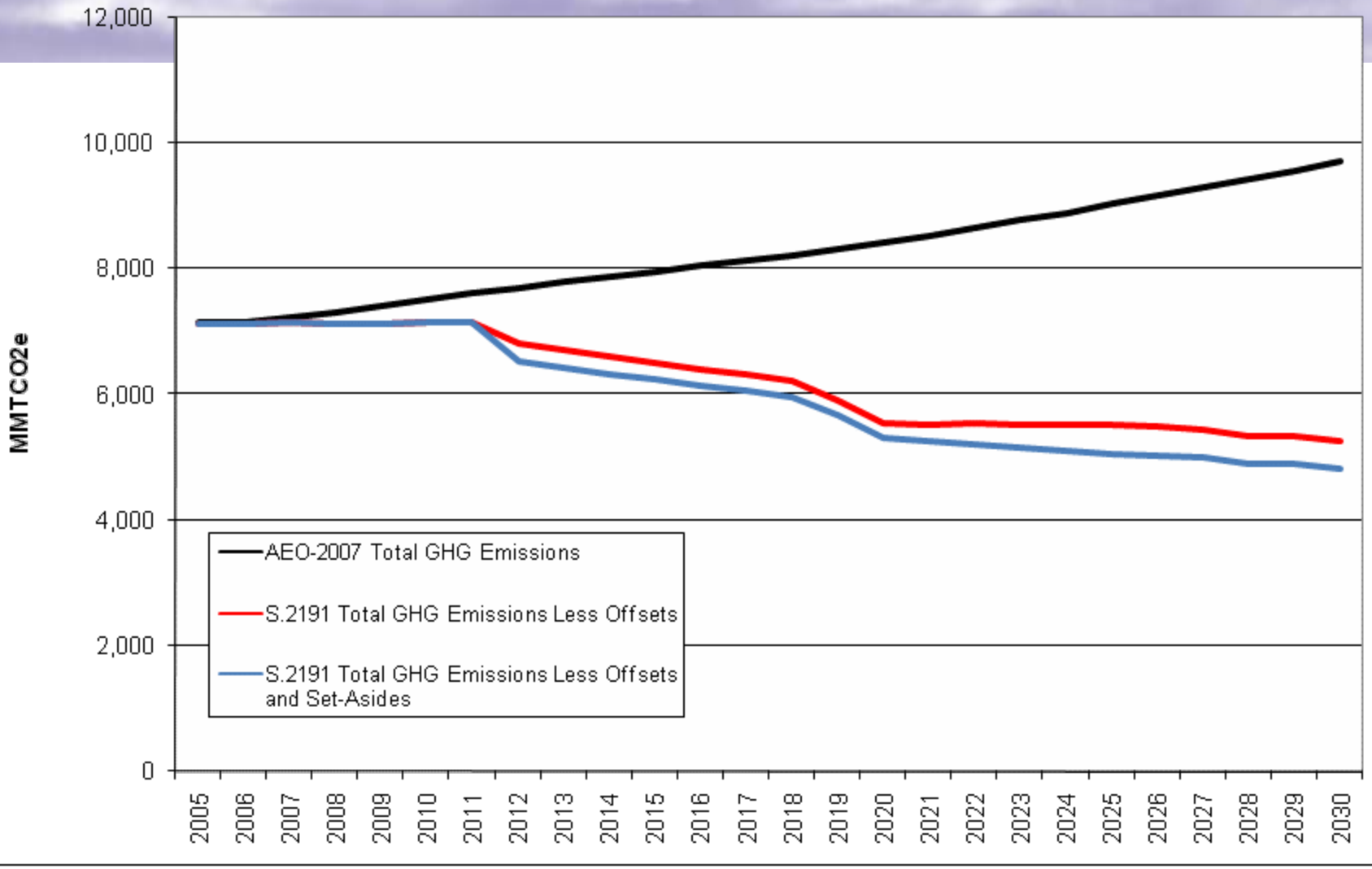
# Greenhouse Gas Emissions

- **Total greenhouse gas emissions (including reductions through offsets) fall by 23% from their 2005 levels by 2020, and by 26% by 2030.**
- **When the domestic agriculture and forestry, international forestry, and coal mine and landfill methane set asides are taken into account, total emissions drop by 25% by 2020, and by 33% by 2030.**
- **The power sector makes up the majority of the energy system reductions (because reductions are the most economical in this sector), with small reductions coming from the residential sector, and reduction in growth only coming from industrial, commercial and transportation.**

# Total GHG Emissions Less Offsets and Set-Asides

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# Agriculture and forestry emission reduction incentives

- S. 2191 allows 15% domestic offsets and 15% international offsets.
- These offsets provide an economic incentive to farmers, foresters, non-regulated entities, and foreign countries to reduce their GHG emissions.
- They also provide the most effective cost containment mechanism that is readily accepted and available (see below).
- The cumulative value of all categories of offsets through 2030 is over $330 billion.
- The bill also sets aside 5% of the total allowance pool to fund emission reduction projects in the domestic agricultural and forestry market. These allowances have a cumulative value of $110 billion by 2030.
- Another important feature of the bill to point out for agriculture is Sec. 1202 (e) which provides credits to “feedstock” industries (fertilizer companies) to attempt to hold them harmless.

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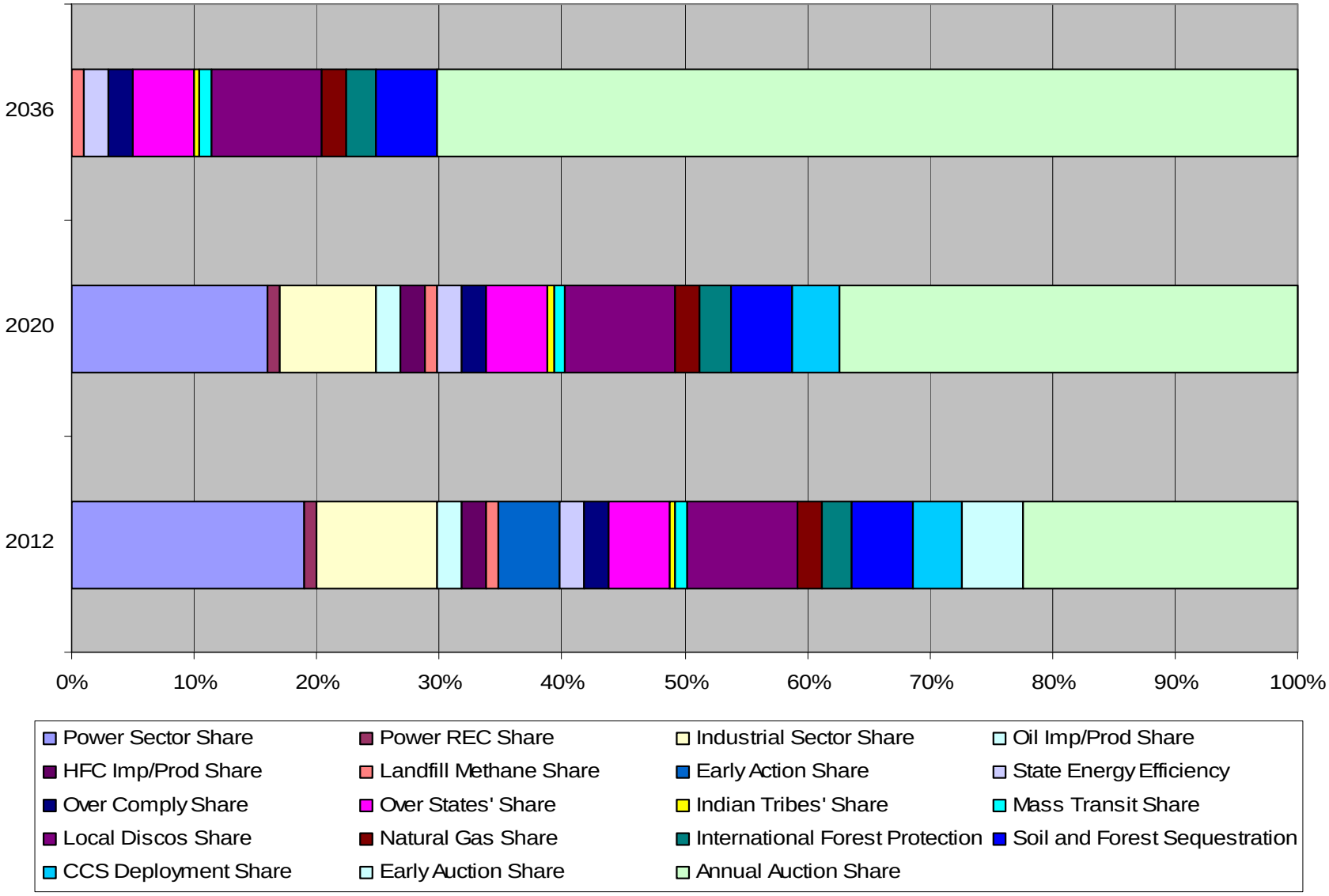
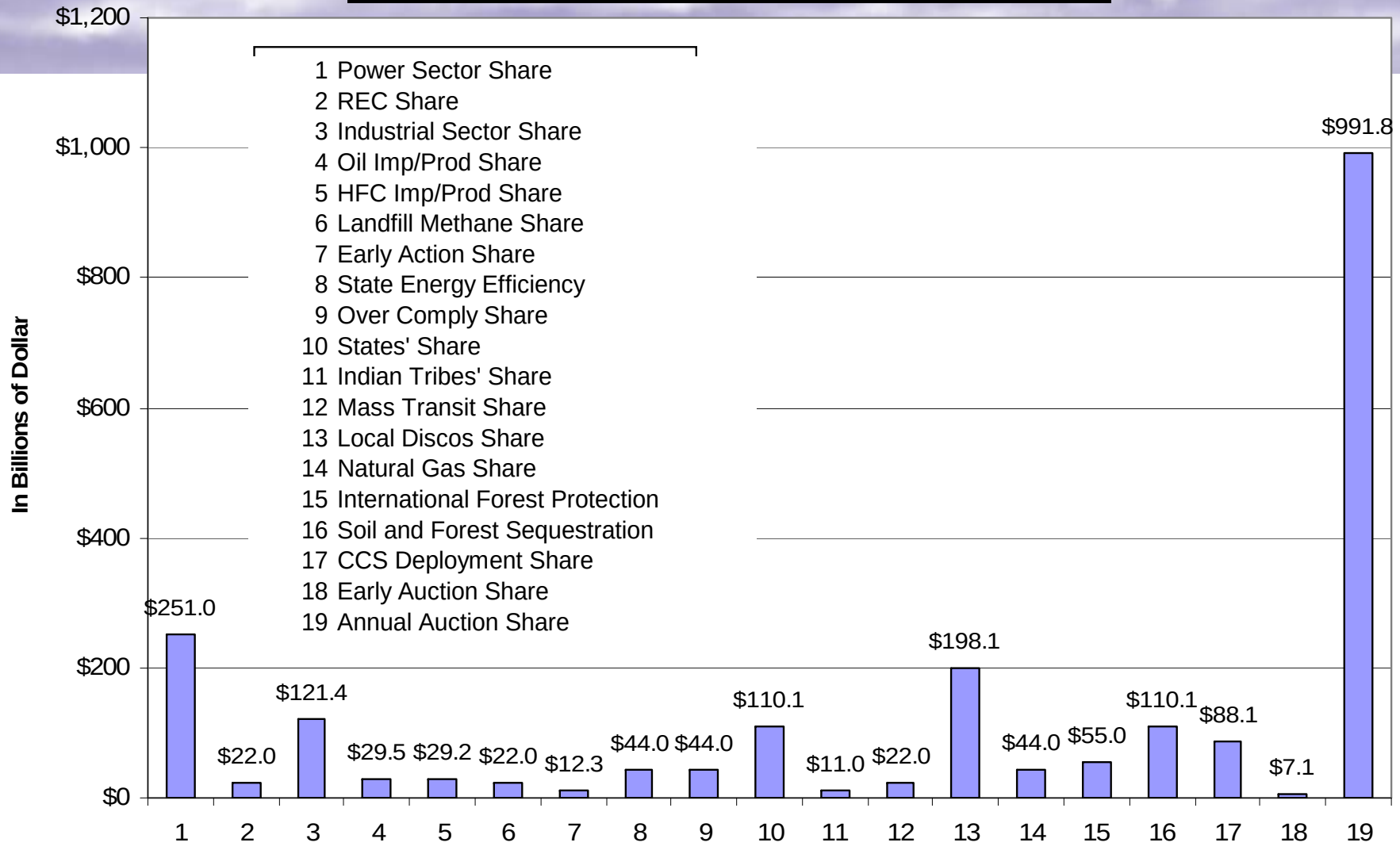
# Allowance Distribution



# Value of Direct Allocation of Allowances Cumulative Through 2030

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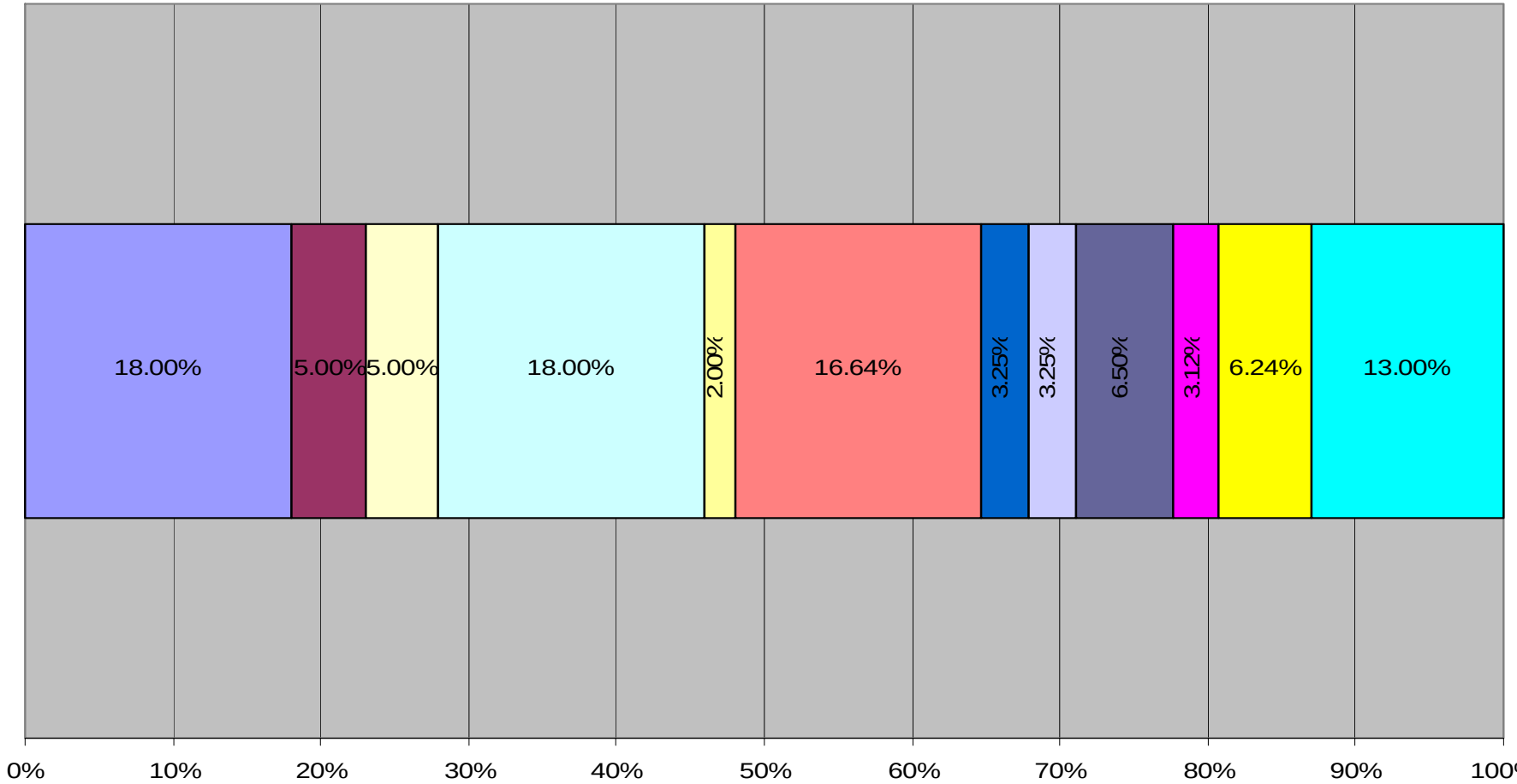
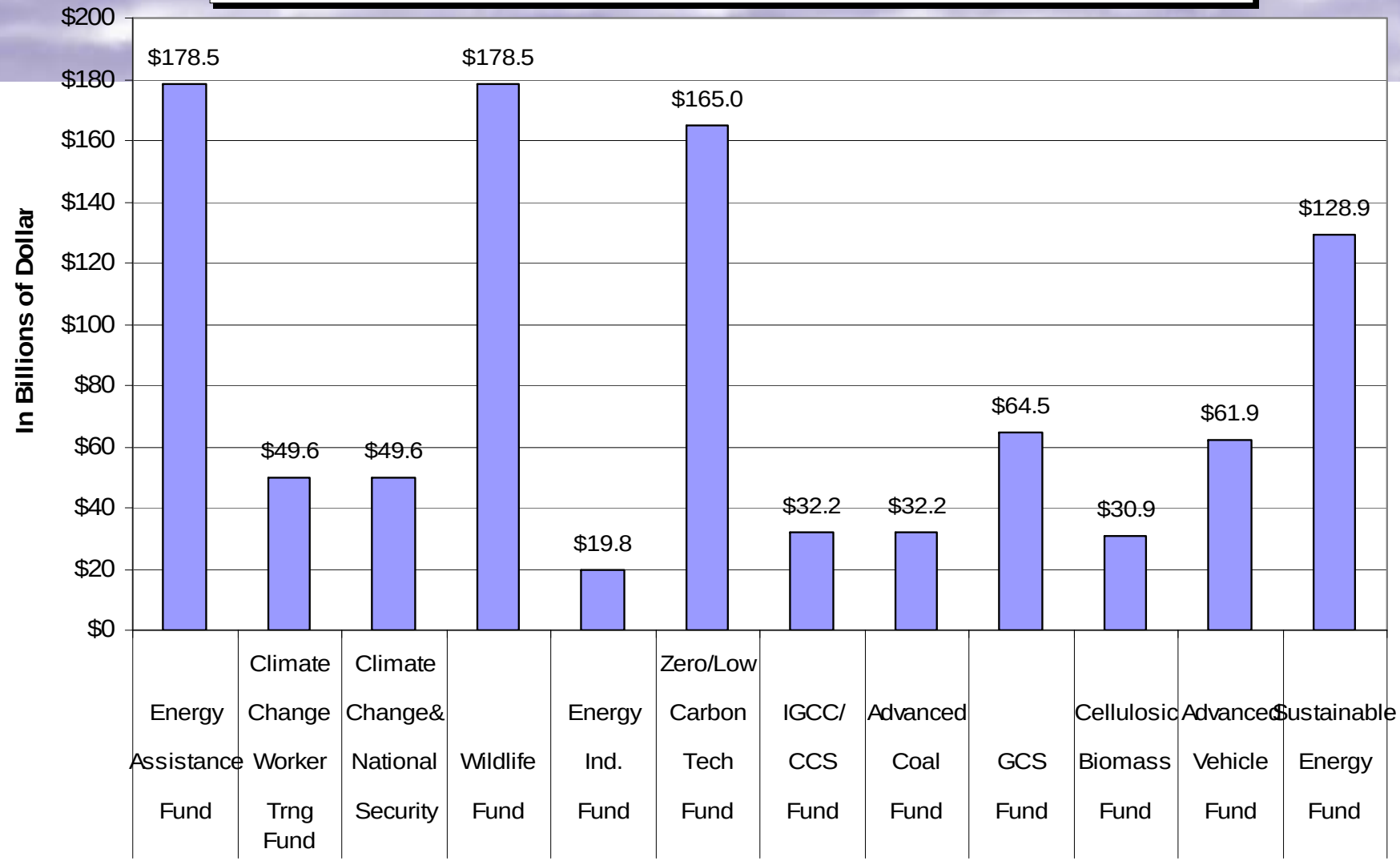
# Auction Distribution: 2012-2050



# Distribution and Cumulative Value of Auction Revenue Cumulative Through 2030

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# About NEMS

- The National Energy Modeling System (NEMS) is a detailed computer-based, energy-economic modeling system of U.S. energy markets. NEMS projects energy supply, demand, imports, conversion, and prices to the year 2030, subject to market assumptions such as macroeconomic and investment factors, world energy markets, fuel availability, technology cost and performance characteristics of energy technologies, and more.

- The model was developed and is maintained by the Energy Information Administration (EIA) for use in developing annual projections (in particular the "Annual Energy Outlook") and for evaluating energy policies.

# About OnLocation

- OnLocation, Inc./Energy Systems Consulting, founded in 1984, is a consulting firm specializing in energy and environmental policy analysis. Their analysis supports government, non-governmental organizations, and corporate decision makers. OnLocation has been involved in the development and maintenance of NEMS since its inception and assists multiple clients by using the tool to examine proposed government policies and their associated impacts on the energy system.

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# EIA's Best Available Technology Case and Why We Used It

- **EIA's Best Available Technology (BAT) case assumes that consumers choose the most efficient equipment (from light bulbs to boilers) available, regardless of costs within residential and commercial buildings, when replacing end-use energy equipment in residential and commercial buildings.**

- **EIA's BAT scenario was used as a *useful proxy* for S. 2191's massive energy efficiency investment provisions, as well as S. 2191's new building and energy equipment efficiency regulations.**

- **Through 2030, S. 2191 'directs' as much as $170 billion to energy efficiency and new product development, and sets efficiency standards for buildings and residential boilers.**

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