The Lieberman-Warner Climate Security Act—S. 2191

A Summary of Modeling Results from the National Energy Modeling System

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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.

What are we all missing?

- None of the modeling to date has fully captured every provision in the bill (and some can't be modeled).
  - Efficiency provisions.
  - All the CCS money.
  - All the renewables and other technology funds.
  - The LCFS (for better or for worse).
  - Carbon FED
- Figuring out energy infrastructure costs over the near and long term is very difficult at best; i.e. how long do the high prices we see today last into the future.
- Availability and price of offsets may become an issue.
- Technological development. Think back 22 years? Or 42 years? Much has changed. Modeling can only employ technologies that at least exist today.
- Finally, a happy medium. Models tend to be a bit binary and unless forced, will produce a lot of one or two technologies (nukes, CCS etc.) The market is not binary, and will choose technologies for multiple reasons that will result in more of a happy medium. We would like to develop a "happy medium" case.

Summary of Results

- Our modeling of S.2191 shows:
  - Very small macro-economic impacts and robust economic growth, both GDP and per capita.
  - Reduced residential and commercial monthly 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 large incentive for reductions in non-covered sources of GHG emissions.
  - A large dispersion of funds to accelerate technology deployment and help affected communities.

Key Assumptions

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General Assumptions

- We used AEO 2007 as our reference case.
- We did not change any technology cost or penetration assumptions, except for placing a cap on the amount of biomass power that could be deployed (about 10.5 GW by 2030) in the policy case.
- We also added in the energy bill's CAFE provisions of 35MPG by 2020 in the policy case.

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Cap Levels

- This model run uses caps that CATF calculated to reflect changes that were made to the bill at the subcommittee level. They are slightly higher than the caps contained in the bill that was passed out of the full EPW committee. We assumed a linear decline between the following target years:
  - 5,798 million metric tons CO2-equivalent by 2012
  - 4,968 million metric tons CO2-equivalent by 2020
  - 3,927 million metric tons CO2-equivalent by 2030
  - 1,764 million metric tons CO2-equivalent by 2050

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Offsets and Banking

- Covered entities can satisfy up to 30 percent of their annual allowance obligation by purchasing CO_2 offset credits. Assumptions for the cost and availability of offsets were used by EIA in its July analysis of the McCain Lieberman S.280 bill (and its new work on S 2191).

- Allowances in excess of annual compliance requirements can be banked for use in future years.

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Energy Efficiency

- A portion of the funds raised through allowance auctions is used to stimulate technology development and deployment. This was represented by using EIA's AEO 2007 Residential and Commercial Best Available Technology case assumptions which result in consumers purchasing the most efficient end-use equipment available for new and replacement equipment, regardless of cost.
- Efficiency improvements were assumed for building shells and energy-related equipment such as furnaces, air conditioners, computers and lighting.
- While all the efficiency funds are discretionary, assuming proportional allocation of funds would provide over $175 billion for energy efficiency just through 2030.

Generation Incentives

- Incentives for electric generators to build CCS coal and new wind turbines were also included.
- They were structured in the model as production tax credits to be paid annually to each qualifying plant for the first 10 years of operation.
- They are available for the first 120 GW of coal with CCS and the first 50 GW of new wind capacity built by 2030.
- The payment for coal with CCS plants was set to 1.25 cents per KWh (2005$), and the existing wind production tax credit of 1.9 cents per KWh (2005$) was extended to 2030.

How We Didn't Model S. 2191

- 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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Modeling Results

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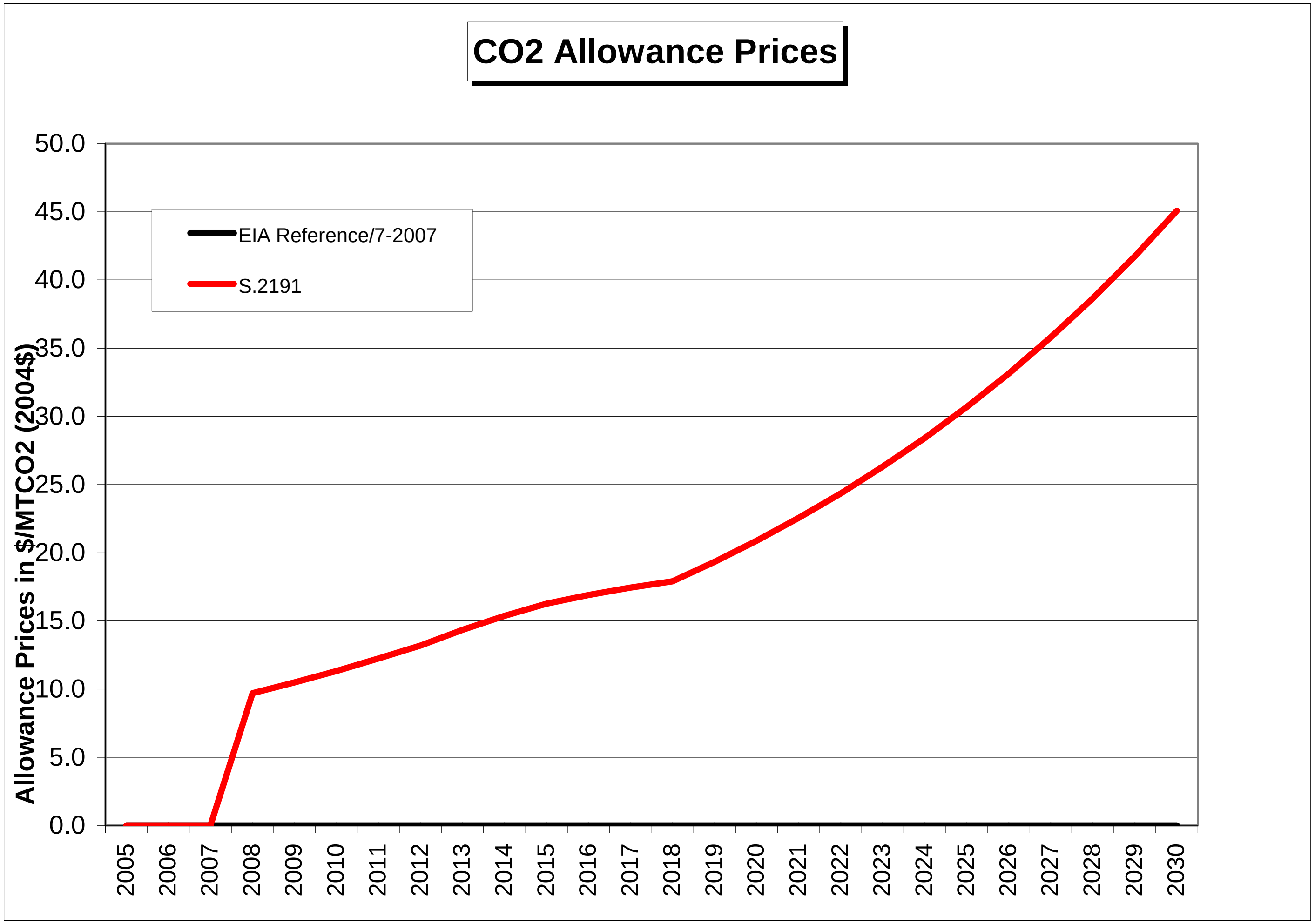
Allowance Prices



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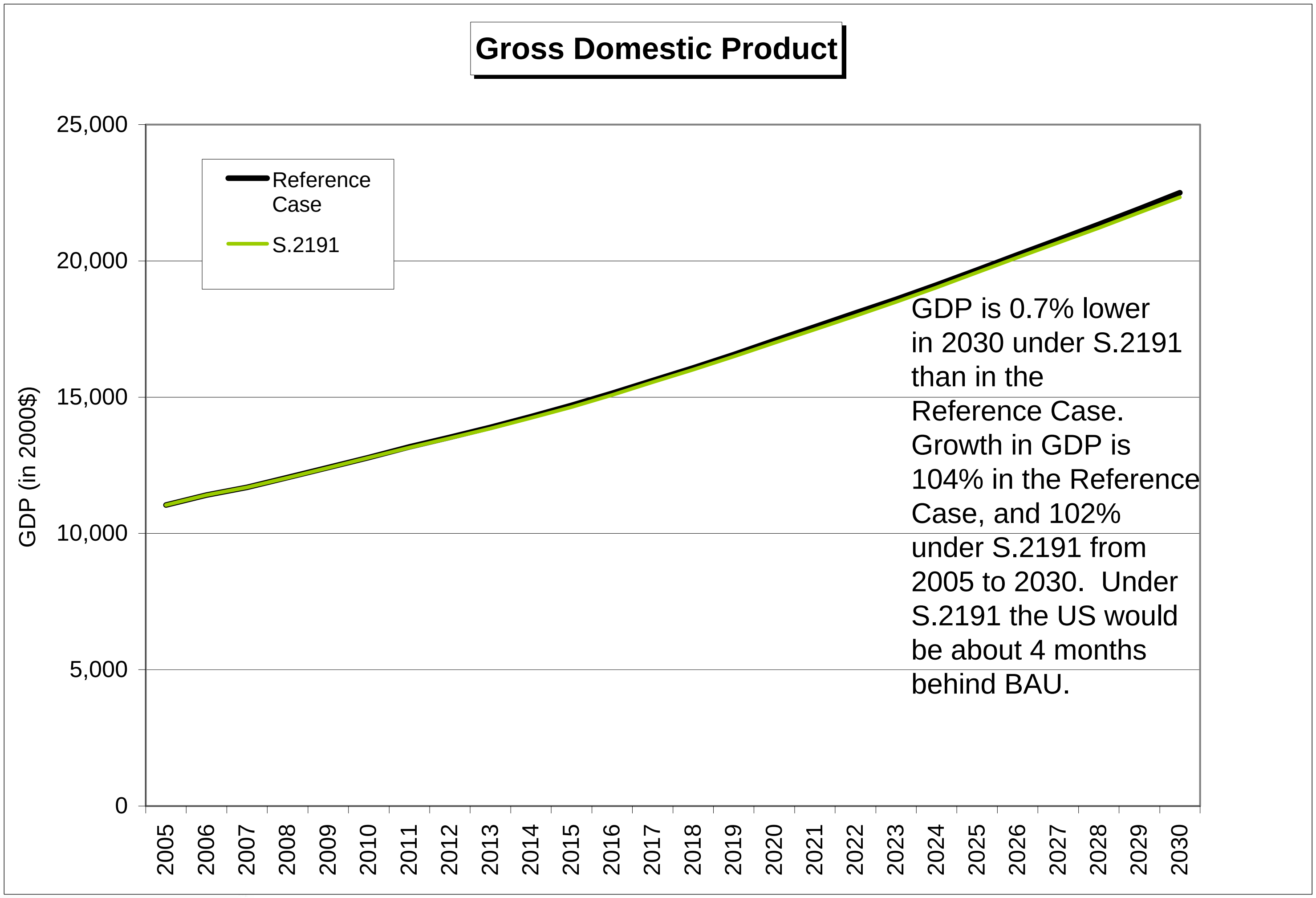
GDP Impacts



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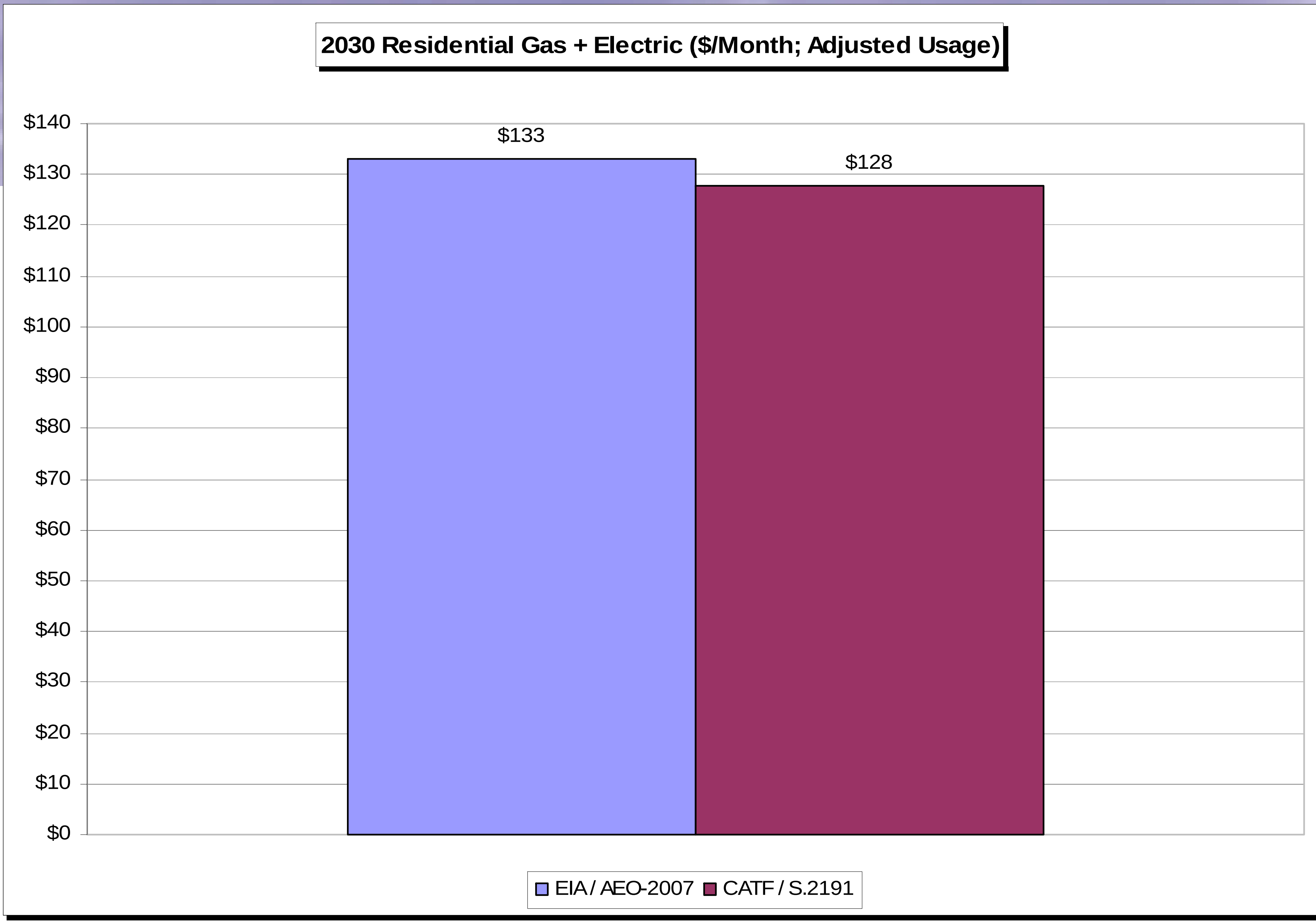
Electricity and natural gas rates increase but efficiency dampens the impact

- The average price per KWh of electricity increases from 8.2 cents per KWh in 2006 to 9.5 cents per KWh in 2030, while the average price per MMBTU of natural gas increases from $9.64 per MMBTU in 2005 to $9.92 per MMBTU in 2030.
- Energy usage however drops considerably, due to S. 2191's energy efficiency provisions (modeled via the BAT case) and price response (20% drop in generation from BAU in 2030).
- This drop in energy consumption results in lower monthly electrical bills (residential and commercial) and fairly stable monthly natural gas bills relative to the reference case (regional impacts will vary see below).
- EIA's BAT scenario does not include industrial energy equipment efficiency.



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A Safety Net for 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). All but one region (upper plains and Midwest) show a small increase in monthly natural gas bills.
- Sec. 3401 sets aside 9% of allowances and sec. 3501 sets aside 2% of allowances to be used as rebates to low and middle income electricity and natural gas consumers and to promote energy efficiency.

  By 2030, these funds will contain nearly $213 billion and $47 billion respectively.
- 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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Gas Generation

- In our past modeling of climate policies, gas generation was relied on as an interim power source prior to CO2 allowance prices reaching the point where carbon capture and sequestration became economic (@ $30-35 and usually near the end of the NEMS horizon).

- 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 in our runs.

- Natural gas generation drops from about 16% (under BAU) down to about 14% by 2030.

- 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 fill the gap.

Nuclear Generation

- Nuclear power in a carbon constrained world will have an economic advantage that it does not currently have.

- NEMS sees nuclear as the lowest cost, low carbon baseload power generation choice, and thus builds large amounts of new nuclear generation- 104 GWs by 2030 in our run.

- We chose not to artificially constrain nuclear power within the model because EIA does not.

- As of April 2008, 41 GWs of new plants were "on order or proposed" in the US, according to the World Nuclear Association.

- Building a further 63 GWs would require less than the build rate the US had in the nuclear heyday (1971-1990) when we built approximately 5GWs a year.

- That said, we would be the first to admit that building this much nuclear capacity in the next 22 years is not likely to happen.

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.
- By 2030 renewables make up almost 19% of generation.

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:**
  1. **A bonus allowance program for CCS**
  2. **A fund for deploying the first 20GWs of new IGCC/CCS**
  3. **A fund for deploying new fossil and retrofit technologies with CCS**
  4. **A fund for demonstrating geologic carbon storage at power plants; and**
  5. **A 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, a total of $216 billion by 2030 (not including the low and no carbon fund), 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 the first 120 GWs of coal generation with carbon capture and storage; enough to change the cost difference between CCS and nukes and notably at costs dramatically less than the bonus allowance program (@ $20 billion for a PTC at 1.25 cents).
- This is of course not how the CCS bonus allowance program is structured. However when we run our allowance values through the bonus allowance language of the bill, we build @ 42 GWs of CCS power with the bonus allowance pool (for about $88 billion). That leaves us with $128 billion to build the remaining 91 GWs that we show (@ $1.4 billion/plant).

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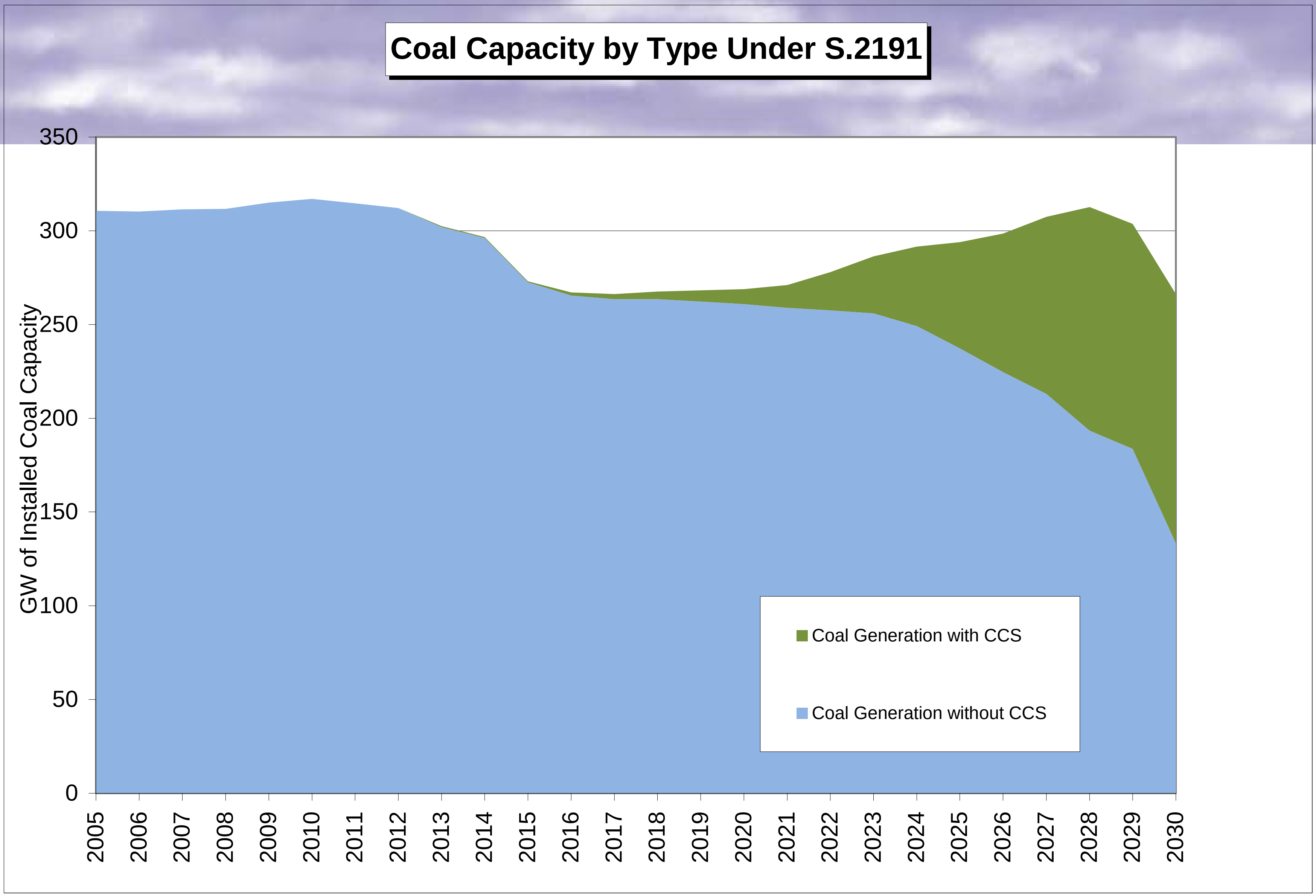
Coal Generation Under S. 2191, contd.

- **Most modeling to date has at most attempted to model only the bonus allowance pool *and ignored the 3 additional auction funds for CCS*. As a result, those runs shows far less CCS deployment and result in more dramatic drops in coal generation.**
- **To partially capture some of the additional funds available for CCS power we used the PTC. While this method does not capture all of the funds available for CCS in the bill, we know they are not zero (as others have assumed).**
- **While coal generation in our case drops somewhat as a percentage of the power fleet, it still remains the number one source of power (tied with nuclear at 33% of generation).**
- **177 GWs of traditional coal retires, while 133 GWs of IGCC/CCS is built by 2030.**



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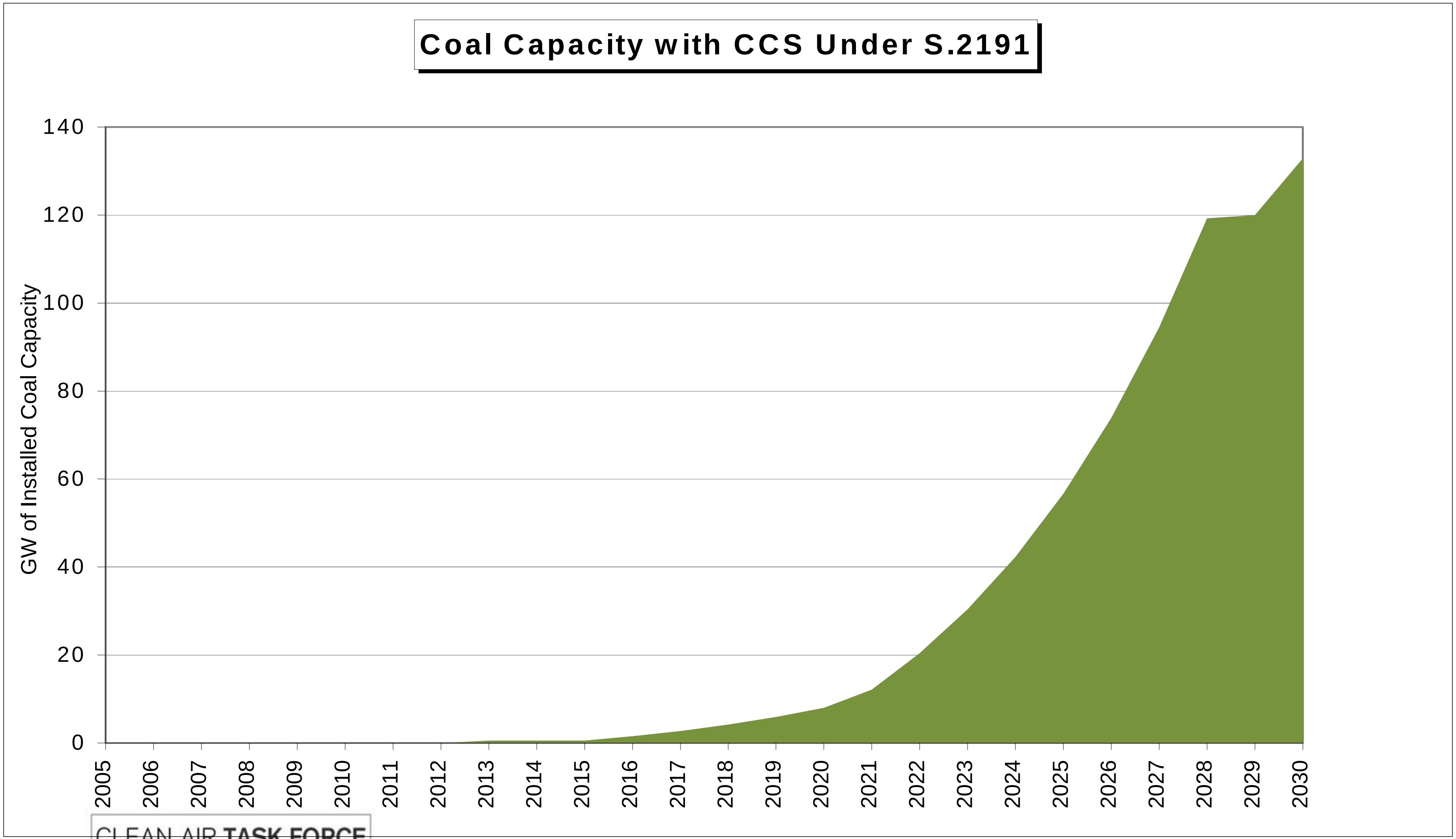
CCS Expands Dramatically



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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, with small reductions coming from the residential sector, and reduction in growth only coming from industrial, commercial and transportation.

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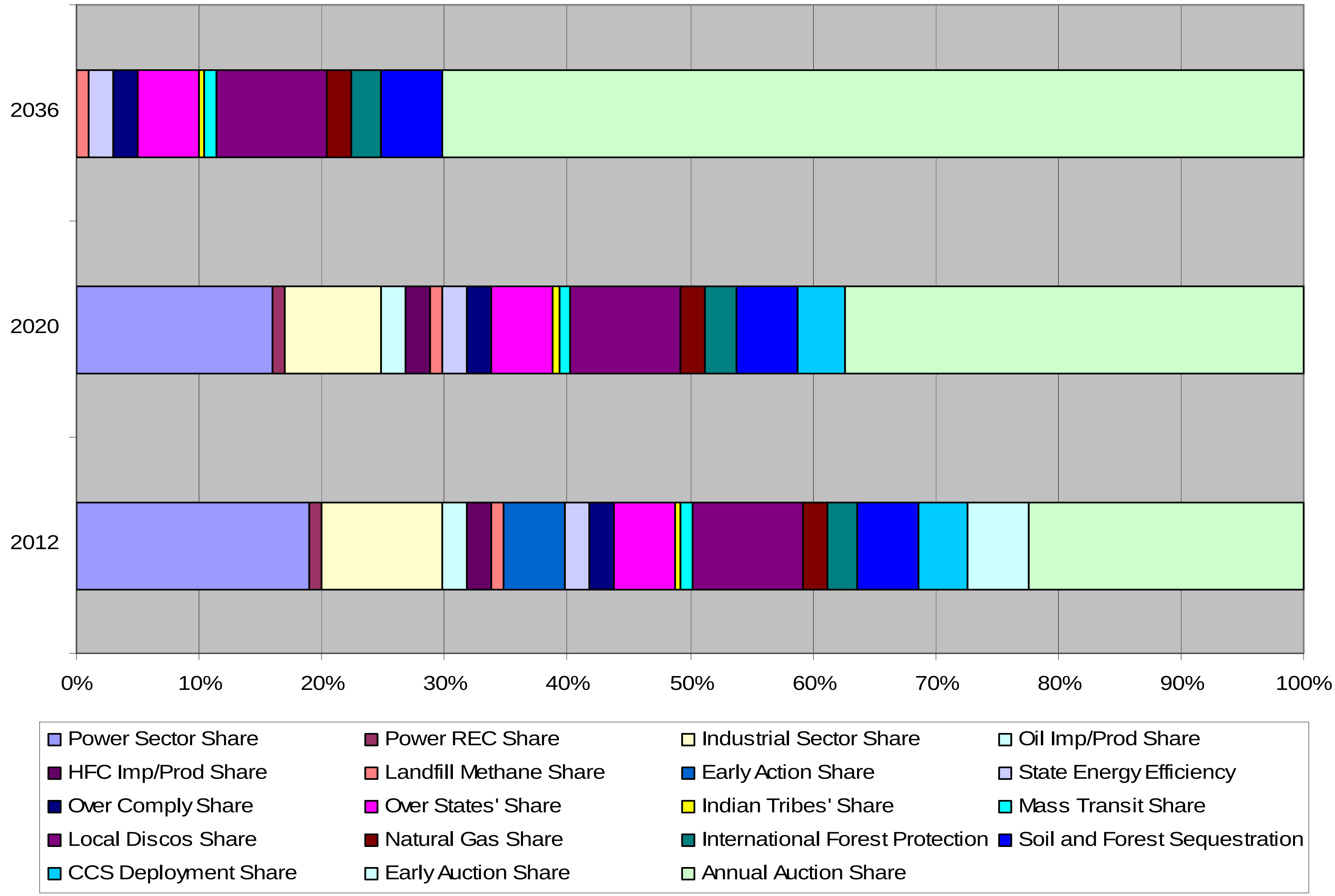
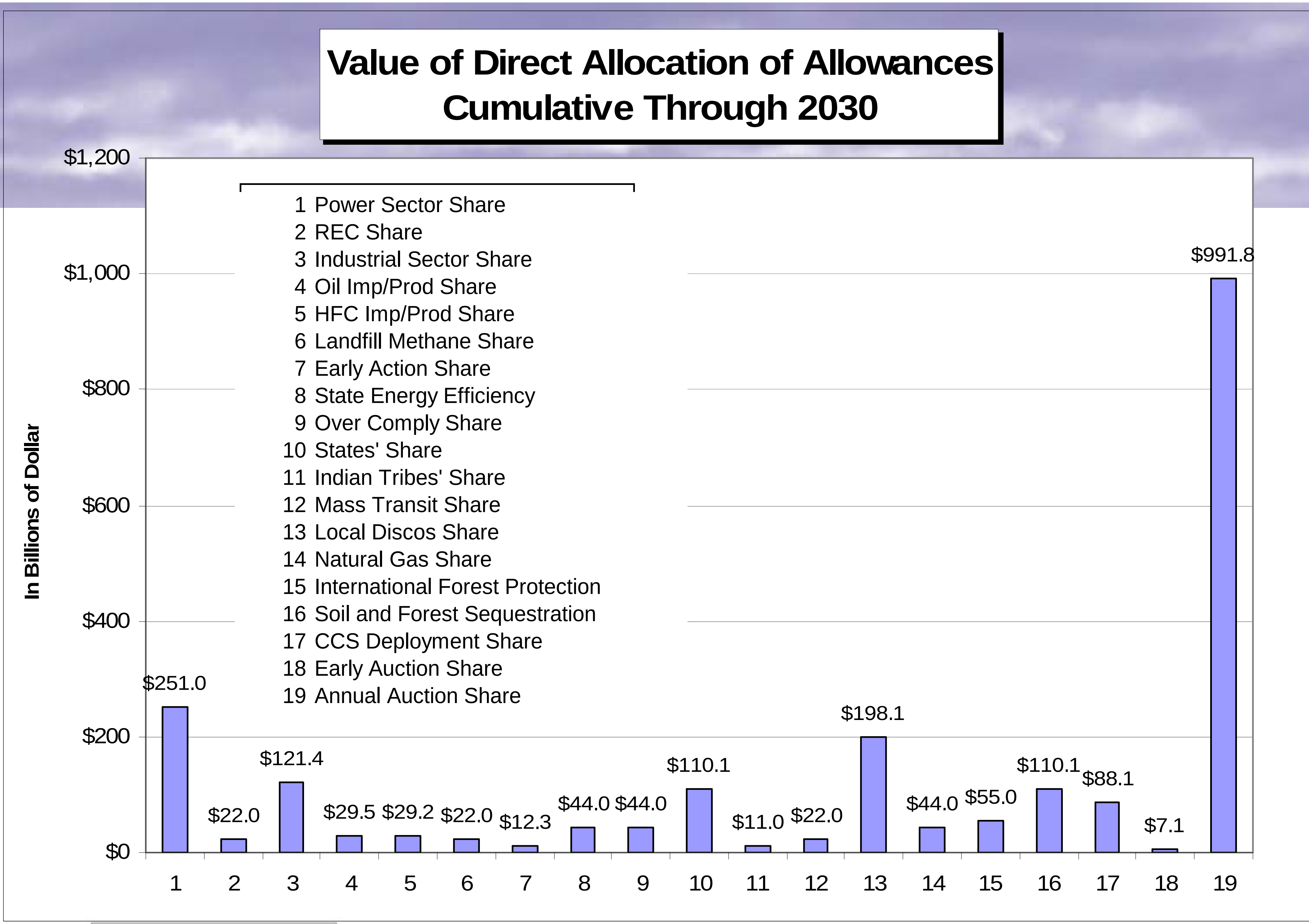
Allowance Distribution





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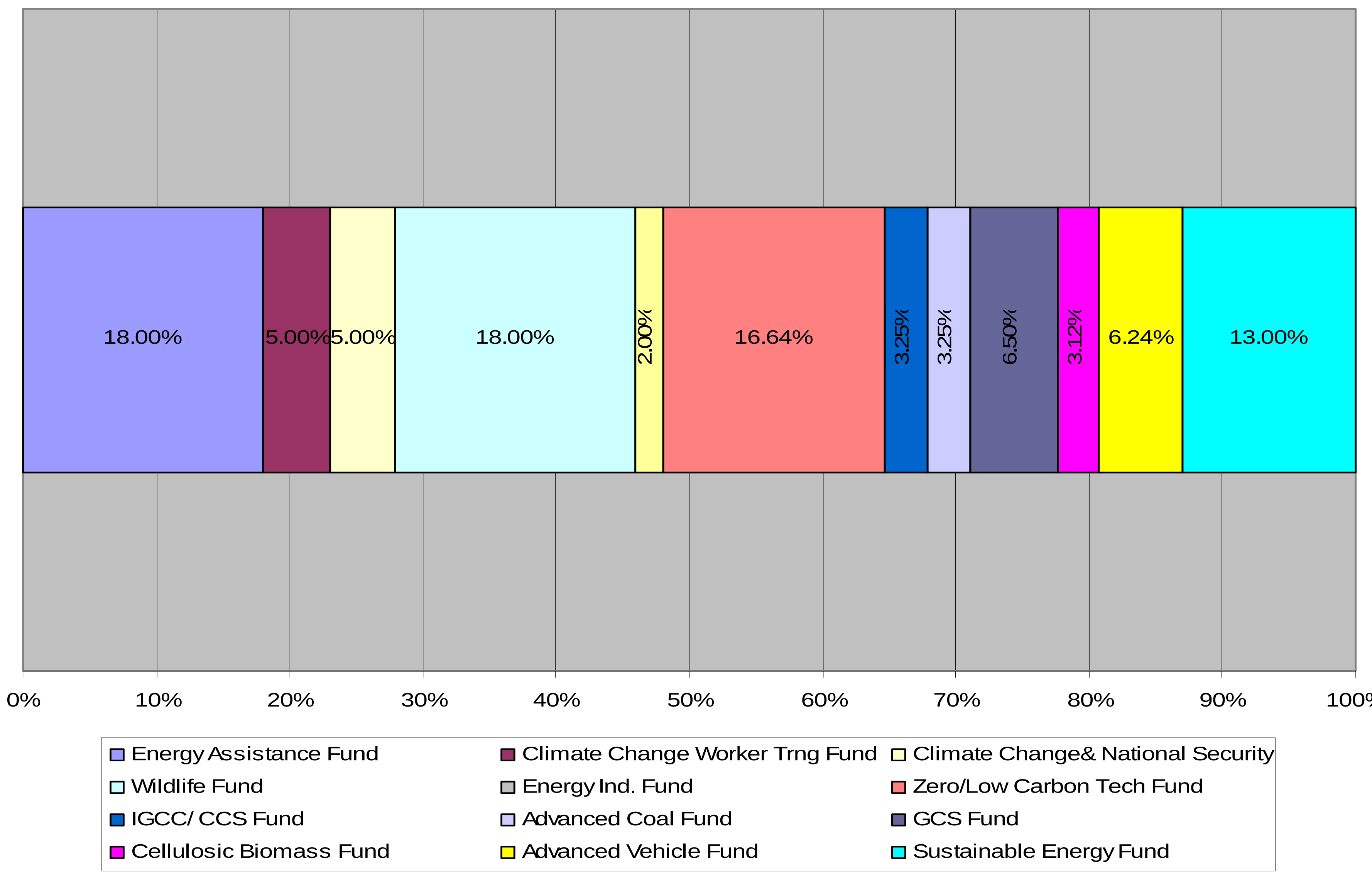
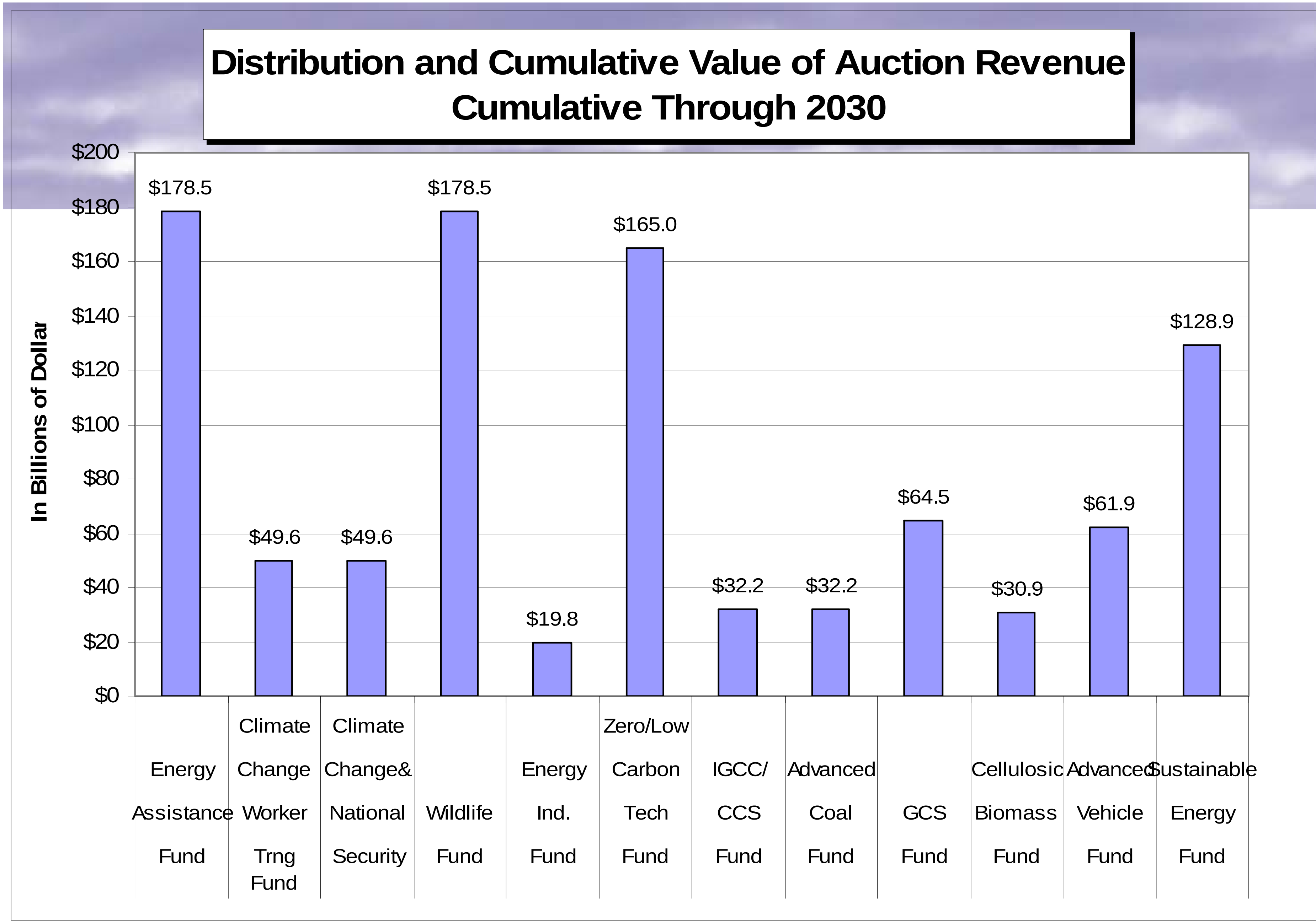
Auction Distribution: 2012-2050





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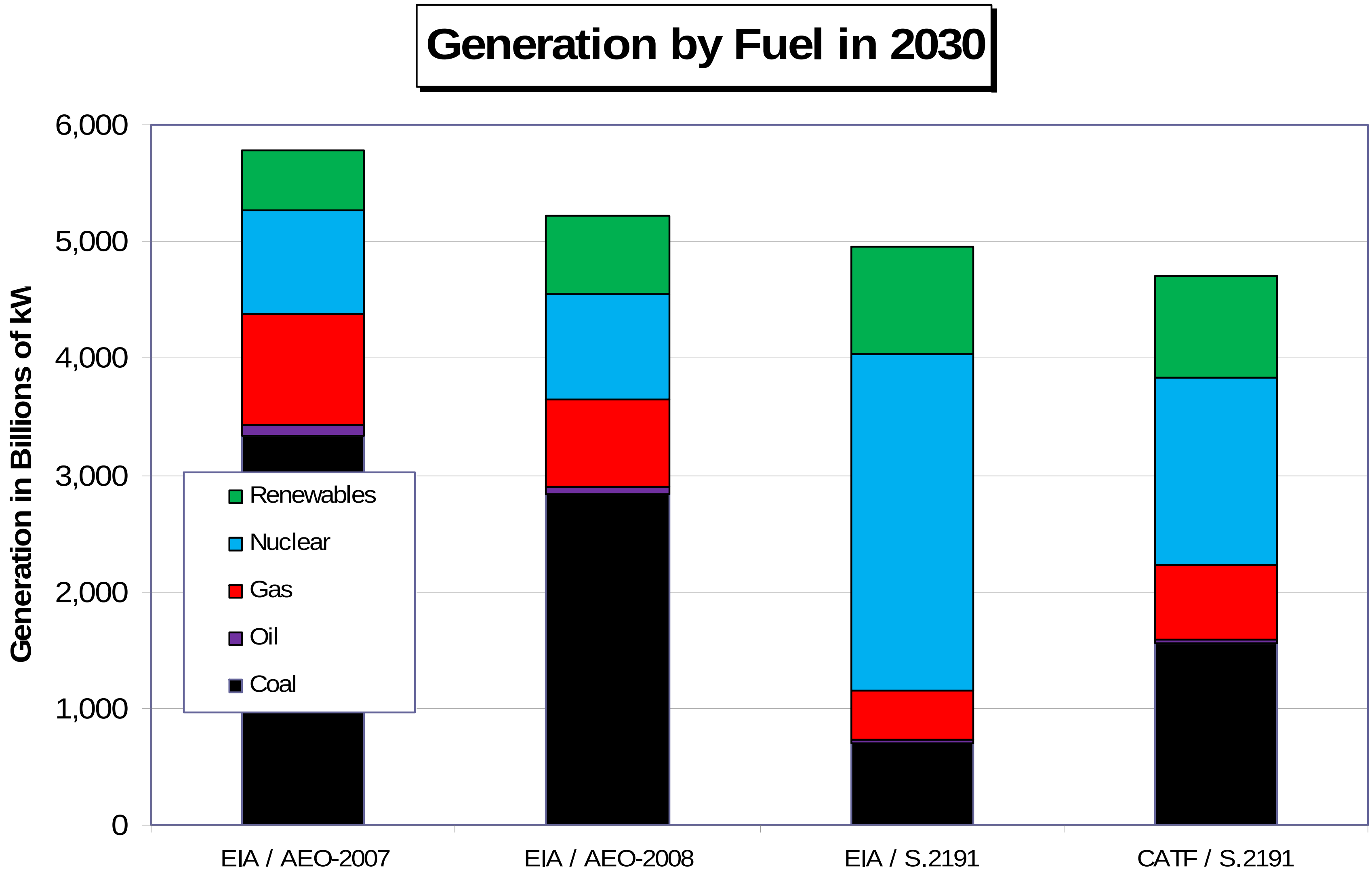

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Gasoline Prices

- Gasoline prices gradually go up under S. 2191, to about 25 cents above BAU by 2030.
- The key piece to look at on gasoline prices is the incremental difference not the actual price. While EIA's projection for gas prices may look optimistic, the ***incremental impact*** that S. 2191 will have on actual future gasoline prices would remain roughly the same.

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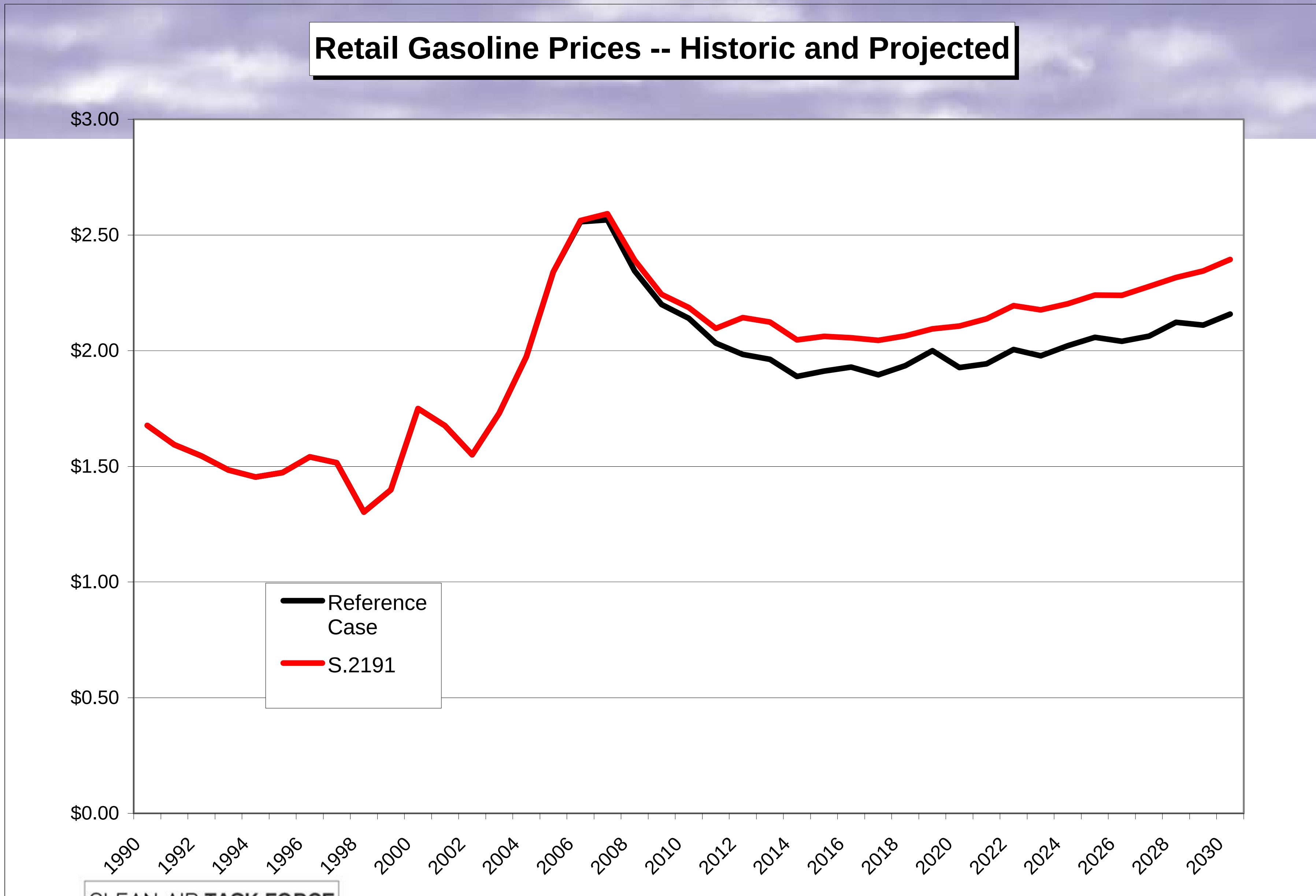

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