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Mr. Chairman and Members of the Committee, I appreciate the opportunity to come before you today to testify on the energy and economic effects of global climate change legislation as analyzed by EPA. To date, EPA has analyzed the following three bills for this Congress: S. 280, the "Climate Stewardship and Innovation Act" introduced by Senators McCain and Lieberman; S. 1766, the "Low Carbon Economy Act of 2007," introduced by Senators Bingaman and Specter; and S. 2191, the "Lieberman-Warner Climate Security Act of 2007," introduced by Senators Lieberman and Warner. I note that for this last bill, the analysis was based on the bill reported out by the Senate Environment and Public Works Committee this past December; the first two bills were modeled as introduced.

In all three bill analyses, EPA developed a set of scenarios in consultation with Senate staff to evaluate various provisions in the bills as well as gauge the importance of key enabling climate mitigation technologies. EPA's scenarios describe a wide range of possibilities but do not represent an EPA assessment of which scenarios are more likely to occur. The analyses do not attempt to estimate the benefits of reducing greenhouse gas emissions (GHGs) nor do they represent any formal position or opinion of the EPA or the Administration.

EPA's analyses covered all GHGs and key economic sectors, both domestically and internationally, and go out to 2050. For the broader impacts on the U.S. economy, EPA employed two economy-wide models to estimate a range of economic impacts and GHG reductions. Combined, these two models provide a more complete picture of possible impacts than can be provided from any single model. These models take different approaches to estimating technological development and macroeconomic effects. Since the electricity sector plays a key role in GHG mitigation, and the near-term response in the electricity sector is of particular interest, EPA also used a detailed electricity sector model to shed further light on the near-term impact of the bills and complement the broader picture presented by the economy-wide models.

It is worth noting that in projecting significant policies such as global climate change legislation, there is significant amount of uncertainty about what that future will look like (e.g. uncertainty with regards to economic growth and technological advances). Our analysis contains a number of sensitivity analyses that help show the impact that key assumptions have on future projections. This uncertainty increases the further into the future one is making projections. It is also worth noting that EPA did not separately assess or judge the "workability" of the legislation from an implementation standpoint. For example, the Agency did not assess whether various provisions would be able to be implemented or enforced.

The following responses to the questions posed by the Committee in its letter of invitation to this hearing are based on EPA's analyses of the bills indicated above.

(1) What do the analyses show about impacts of global climate legislation on GDP and the overall economy?

The economic impacts of the bills EPA analyzed depended on the level of greenhouse gas reductions sought and percentage of U.S. GHG emissions that are from sources that are covered and would thus be required to hold allowances under the cap. The following estimates are from the main bill scenarios in EPA's analyses of the three bills that incorporate the assumptions agreed upon with Senate staff. All of these scenarios assume that there is a widely available portfolio of enabling mitigation technologies. However, it does not assume major breakthroughs in technology over the next 40 years. Additionally, the analyses assume that there are no significant regulatory or litigation obstacles to the infrastructure needed to support a massive scale-up of low carbon energy, such as new interstate transmission lines, new pipelines and liability concerns surrounding CCS, access to natural gas (domestic production or new LNG terminals), and adequate long term storage for spent nuclear fuel. In EPA's Reference Scenario, the size of the U.S. economy is projected to increase an average of 97% from 2007 ($13.4 trillion) to 2030 ($26.3 trillion) and by an average 215% by 2050 ($42 trillion).

- For the Lieberman-McCain bill which would cover about 73% of U.S. GHG emissions (based on the 2005 GHG inventory), GHG emissions in 2030 were projected to be approximately 25% below what they are projected to be in the reference scenario without a climate policy in 2030. The estimated reduction in GDP is between 0.6% and 1.6% (between $146 and $419 billion) in that same year. GHG emissions in 2050 were projected to be approximately 44% below what they are projected to be in the reference scenario without a climate policy in 2050. The estimated reduction in GDP is between 1.1% and 3.2% (between $457 and $1,332 billion) in that same year.

- For the Bingaman-Specter bill which would cover about 83% of U.S. GHG emissions, GHGs also were projected to be approximately 23% below reference emissions in 2030. The estimated reduction in GDP was slightly lower estimated at between 0.5% and 1.4% (between $124 and $370 billion) in 2030. GHG emissions in 2050 were projected to be approximately 40% below what they are projected to be in the reference scenario without a climate policy in 2050. The estimated reduction in GDP is between 0.9% and 2.9% (between $401 and $1,199 billion) in that same year. The small difference in GDP impacts between the two bills was due to the broader coverage in the Bingaman-Specter bill and the slightly higher allowance prices under the Lieberman-McCain bill.

- For the more recent Lieberman-Warner bill which would cover about 87% of U.S. GHG emissions, GHGs were projected to be approximately 40% below reference

emissions in 2030 with an estimated impact on GDP of between 0.9% and 3.8% (between $238 and $983 billion) in 2030. GHG emissions in 2050 were projected to be approximately 56% below what they are projected to be in the reference scenario without a climate policy in 2050. The estimated reduction in GDP is between 2.4% and 6.9% (between $1,012 and $2,856 billion) in that same year. The coverage of GHGs is slightly more than the Bingaman-Specter bill, and the level of GHG reductions is greater than the other two bills.

Please see Figures 1 and 2 from our Lieberman-Warner analysis for a comparison of the bills projected GHG emission reductions.

(**2) How does the impact on energy prices vary from region to region under these analyses?**

Our detailed power sector analysis provides insight into regional electricity price changes. Retail electricity price impacts vary by region, depending on a host of factors. The most important factors determining electricity price impacts are the types of existing power generating technologies and the electricity market structure for each region. Generally, the Central and Midwestern portions of the country, which are more dependent upon coal-fired generation for electricity production, will see higher price impacts than the Western and Northeastern portions of the country, which rely less on coal. In the South, prices increase somewhat less than in the Midwest even though the South is reliant on coal-fired generation. This is largely due to the fact that much of the

South is a regulated market, and the value of allowances allocated directly to utilities at no cost must be passed along to customers, which will dampen price increases.

(3) Why do the analyses contain such a broad range of projected economic impacts?

The response to question #1 explains some of the key differences in the results of EPA's analyses. When considering the range of results from various analyses of a given bill, there are a number of factors that lead to such a broad range of estimated economic impacts.

- The projected reference case economic growth rate will affect both the level of GDP and projected levels of U.S. GHG emissions. In general, a higher projected level of reference GHG emissions will make it more costly to meet GHG reduction targets. This is highlighted in EPA's analysis using an alternative reference scenario which is more consistent with recent projections of GHGs related to lower projected economic growth and also emission reductions attributed to the Energy Independence and Security Act of 2007 (EISA). For example, in the Lieberman-Warner bill the estimated reduction in GDP would be smaller, estimated at between 0.6% and 3.6% in 2030 ($158 and $947 billion). Allowance prices also would be 15% lower on average ($60/t$CO_2$ vs. $72/t$CO_2$).

- Assumptions about the development and deployment of key enabling technologies such as nuclear power, advanced coal-fired power with carbon capture and storage,

and more efficient renewable power have a significant effect on projected economic impacts. The greater the extent of the development and deployment of key enabling technologies, the lower the costs of achieving GHG emission reductions. (To the extent the development and deployment of key enabling technologies do not occur in the timeframe assumed by the analysis, the costs of achieving GHG emissions reductions will undergo a corresponding increase.)

- The use and amount of allowable offsets, that is, reductions made outside of the covered sectors as specified in the bills, will influence the estimated economic impacts. In general, greater use of offsets, both domestic and international, can reduce costs, while providing commensurate environmental benefits. However, the costs and benefits need to be considered in the context of issues related to the implementation of an offset program. The models assumed that an offsets program could be managed efficiently and generate additional reductions in emissions and increases in carbon sequestration with no discounting and minimal transaction costs. If offsets are not truly additional they will lessen the expected reductions in GHGs achieved through a cap. If international offsets are fully utilized, the total payments for international credits are approximately $12 billion in 2030 and $22 billion in 2050.

(4) What are the 5 most influential assumptions made in these analyses?

Five of the more influential assumptions in our analyses were:

- On modeling: In all the policy scenarios, we assume that there is a well functioning market for the trading of emission allowances, that once technologies are commercially available they are deployed, and that the agents in the models know the future prices of allowances hence there is no market volatility.

- Nuclear Power: The main bill scenarios assume a substantial growth in nuclear power reflecting possible future policies to promote this technology in the bills and elsewhere. Our assumption is that nuclear power generation increases by 150% from 2005 to 2050. This would require the construction of approximately 60 new or expanded nuclear plants by 2030 and 150 new or expanded nuclear plants by 2050. These assumptions are based on a study conducted by the U.S. Climate Science Program on long-term scenarios.

- CCS: The main bill scenarios assume advanced coal-fired power with carbon capture and storage is deployable as soon as it is projected to be commercially available. Where bonus allowances for CCS are available, this helps advance the deployment of this technology from 5 to 10 years in our analysis. The assumption of widespread deployment of CCS is critical to the continued use of coal in the U.S. for electric power generation under any of the three bills analyzed. In our analyses, we constrain the rate at which CCS technology can be deployed considering historic capital turnover rates given the existing capital investments and infrastructure of the electricity sector. It is also worth noting, however, that in absence of a carbon price,

there are zero coal fired power plants with CCS in operation today and that there are only a handful of applications for commercial scale coal fired power plants with CCS to be built in the next 10 years. In addition, deployment of CCS will be contingent upon the ability to site new pipelines as well as addressing the liability concerns surrounding underground storage of CO2. Please see Figure 3 from our Lieberman-Warner analysis.

- International action: In the main bill scenarios, we assume the following: High-income countries in the Kyoto Protocol fully comply with the treaty. After 2012, Kyoto countries, with the exception of Russia, follow an emissions path that falls gradually from simulated Kyoto levels in 2012 to 50% below 1990 levels in 2050. Low-income countries adopt a policy in 2025 that returns emissions and holds them at 2015 levels through 2034 and returns emissions to and maintains them at 2000 levels from 2035 to 2050.

- Offsets: In the main bill scenarios we assume that both domestic and international offsets are available up to the amounts allowed in the bills and that there are systems in place to ensure the environmental integrity of those offsets, that do not result in the benefits being heavily discounted or high transaction costs.

(5) What are the most significant factors contributing to price uncertainty in the analyses?

In our analyses, the two most significant factors affecting the projected allowance prices are the availability of enabling technologies and the use of offsets. For example, in our analysis of the Lieberman-Warner bill for the scenarios that limit the availability of enabling technologies, the projected allowance prices increase by over 80% (from \$61/tCO_2 to \$112/tCO_2 in 2030). We did not run scenarios that assumed significant advances over current technologies. In scenarios that do not allow use of domestic offsets and international credits, costs increase by over 90%.

(6) What are the consequences if either new nuclear power plants or new coal-fired power plants that capture and sequester carbon dioxide, which are both assumed in many analyses, are not available at such significant levels?

EPA evaluated additional scenarios for the impact on GDP given the availability of these two key enabling technologies. In our analysis of the Lieberman-Warner bill under the scenario where nuclear power and biomass power do not exceed reference case growth and carbon capture and sequestration technology does not become commercially available until 2030, the impact on GDP is slightly more than double the impact estimated under the main bill scenario (\$603 versus \$238 billion). In sensitivity cases conducted as part of the analysis of the McCain-Lieberman bill where carbon capture and sequestration technology was not allowed and nuclear power growth was cut in half, there was a greater impact on GDP. The lower nuclear power case only slightly increased costs, as long as there is compensating increases in CCS generation to reduce the economic impact of the lower nuclear capacity. In the case where CCS is not

available, this results in almost a doubling of the impacts on GDP versus the main bill scenario.

(7) What conclusions are reached on American competitiveness in the global economy?

EPA did evaluate the potential impact on the trade of U.S. energy-intensive manufactured goods in the recent analysis of the Lieberman-Warner bill. The general conclusion is that in the case where developing countries also take on mandatory reductions of GHGs, the terms of trade for the U. S. are better than in the case where those countries do not take action.

In the main bill scenarios where the U.S. and all other countries are assumed to take action, imports of energy-intensive manufacturing goods from high-income countries to the U.S. fall as that group of countries also takes on emission targets.

In the same scenario, there is an increase of U.S. exports of energy-intensive manufacturing goods to developing countries, particularly after 2030 as that group of countries is assumed to take on mandatory reductions in GHGs starting in 2025. This is due to the greater energy-efficiency in the production of U.S. manufactured goods relative to those goods being manufactured in lower income countries.

In the case where developing countries do not adopt any additional policies or measures to reduce GHGs, the terms of trade for the U.S. are substantially worse. . In 2030 there is a 6.3% decrease of U.S. exports of energy-intensive manufacturing goods to developing countries, and a 1.5% increase of U.S. imports of energy-intensive manufacturing goods from developing countries. However, the use of an International Reserve Allowance Requirement limits imports from those countries.

(8) What impact does domestic climate change legislation have on global concentrations of greenhouse gases?

In EPA's analysis of the Lieberman-Warner bill, there is a reference scenario for global CO_2 concentrations that increases from today's levels of about 380 parts per million (ppm) to about 720 ppm by the end of the century. If the US adopts the Lieberman-Warner bill the concentration is reduced by between 7 – 10 ppm in 2050 and by 25 – 28 ppm in 2095. In the scenario where the U.S. adopts the Lieberman-Warner bill and the international community takes on mandatory GHGs reductions as described above, global CO_2 concentrations would be reduced by about 50 ppm in 2050 and 230 ppm in 2095 with US action under Lieberman-Warner accounting for about 10 ppm in 2050 and 25 ppm in 2095, leading to global CO_2 concentrations of 458 ppm in 2050 and about 490 ppm at the end of the century. It is important to note that while CO_2 concentrations would be significantly reduced in this scenario with international action; they are not on a stabilization trajectory since this scenario assumes that emissions are held constant after 2050 which results in continued increases in CO_2 concentrations.

In summary, based on the analyses of the three bills, I would like to make the following points:

- The analyses illustrate the value of a portfolio of technologies and confirm that there is no silver bullet. Although the absence of certain technologies, or availability of offsets would significantly increase cost.

- If we assume that CCS technology will be successfully developed at the commercial scale, the overall price signal plus specific incentives in the bills push deployment of technology earlier, and incentives for CCS, in particular, help maintain the use of coal as a source of energy for the next several decades.

- The offset provisions are also very important for cost containment. Although costs are reduced with larger offset programs, it will be important to ensure that offsets do not lessen the GHGs reductions achieved through the cap and that the offsets program is efficient and the benefits are fully recognized.

- There will be economic costs associated with the bills. However, in all cases the U.S. economy grows over time. In EPA's Reference Scenario, the size of the U.S. economy is projected to increase approximately 97% from 2007 to 2030 and 215% higher by 2050. Under the Lieberman-Warner bill, that growth is projected to decrease by between 0.9% and 3.8% in 2030 and 2.4% and 6.9% in 2050.

- The ability of models to forecast major changes in technology or the invention of new responses to the climate challenge which may significantly reduce costs is limited and are therefore not a part of this analysis.

- Our analyses indicate that there will be ancillary benefits under the Lieberman-Warner bill in the form of greater SO_2 and NOx emissions reductions from the power sector under current regulations. This will facilitate the achievement of the fine particle and ozone air quality standards.

The impact of any of these bills, as would action by any one country alone, on the concentration of GHGs in the atmosphere is not enough to address the global climate challenge, but this is not surprising. Clearly, global participation is needed.

In closing, we believe that EPA has provided valuable technical input to the U.S. climate policy debate. We look forward to working closely with members of Congress as this process continues.

Thank you, Mr. Chairman, and Members of the Committee for this opportunity. This concludes my prepared statement. I would be pleased to answer any questions that you may have.

Figure 1: Policy Comparison:

Lieberman-Warner (S. 2191) – Bingaman-Specter (S. 1766)

Total U.S. GHG Emissions ($MtCO_2e$) (ADAGE)

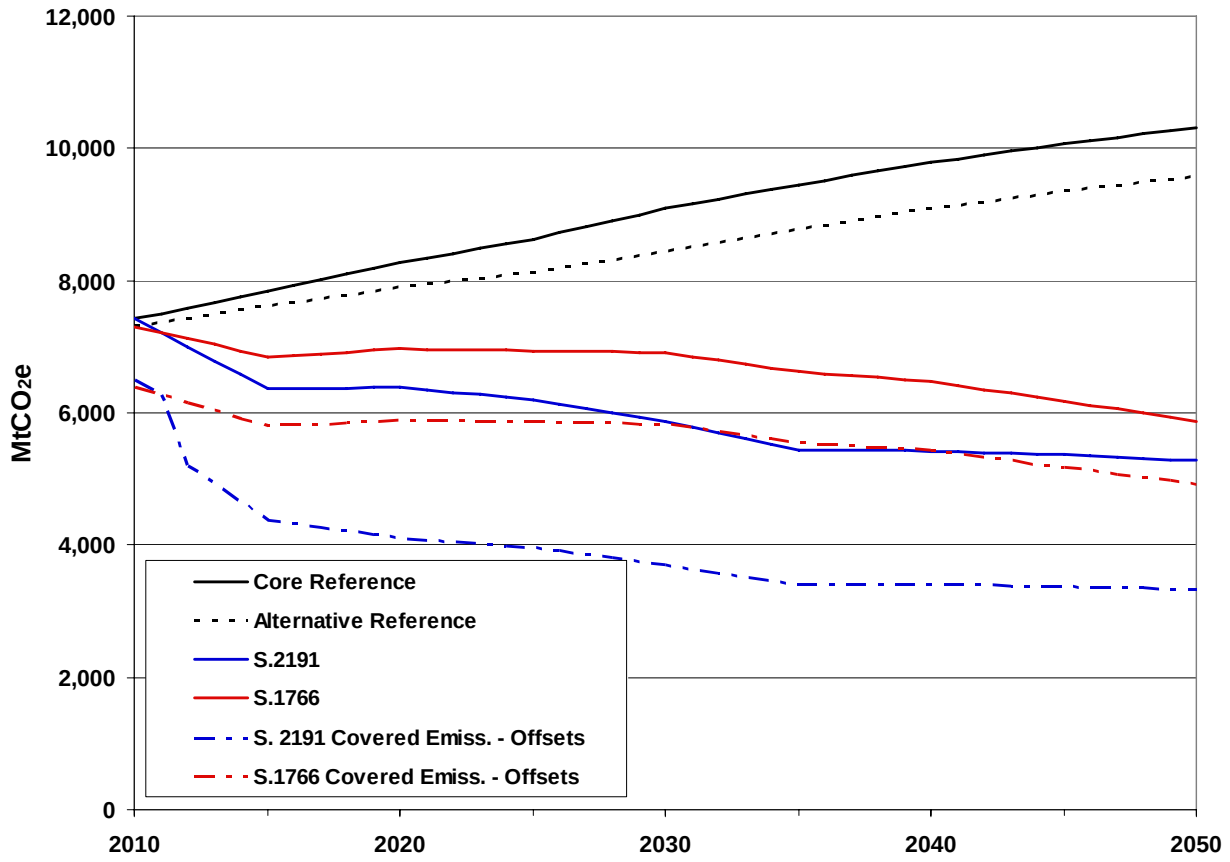
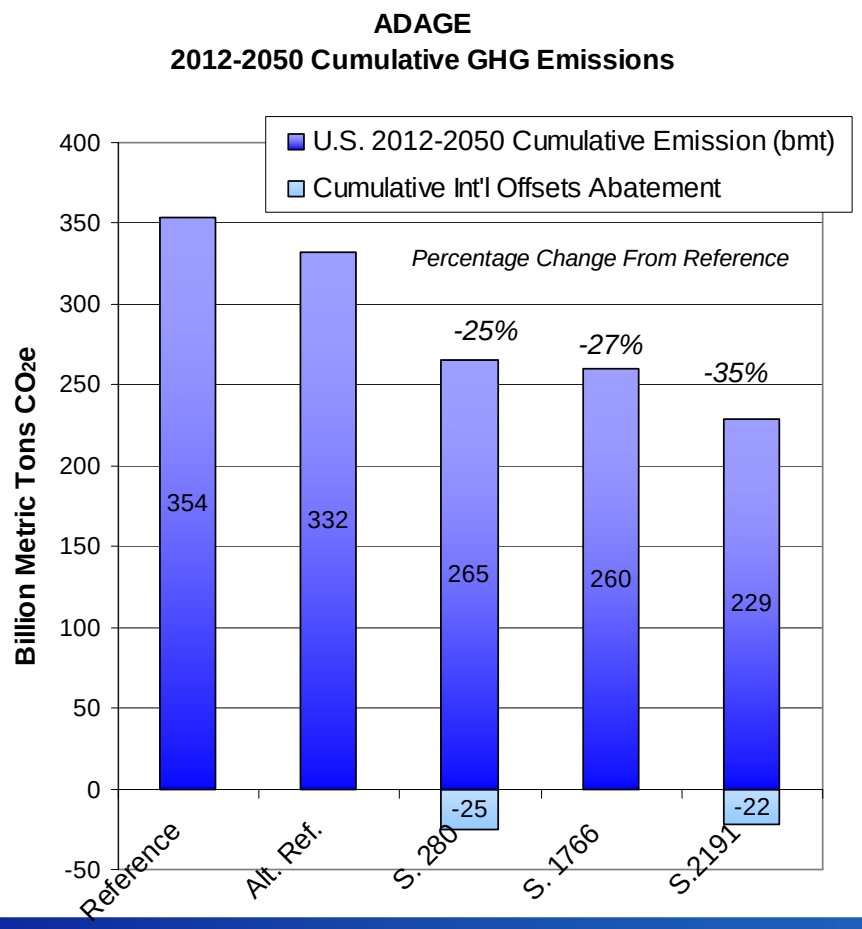


Figure 2: Policy Comparison

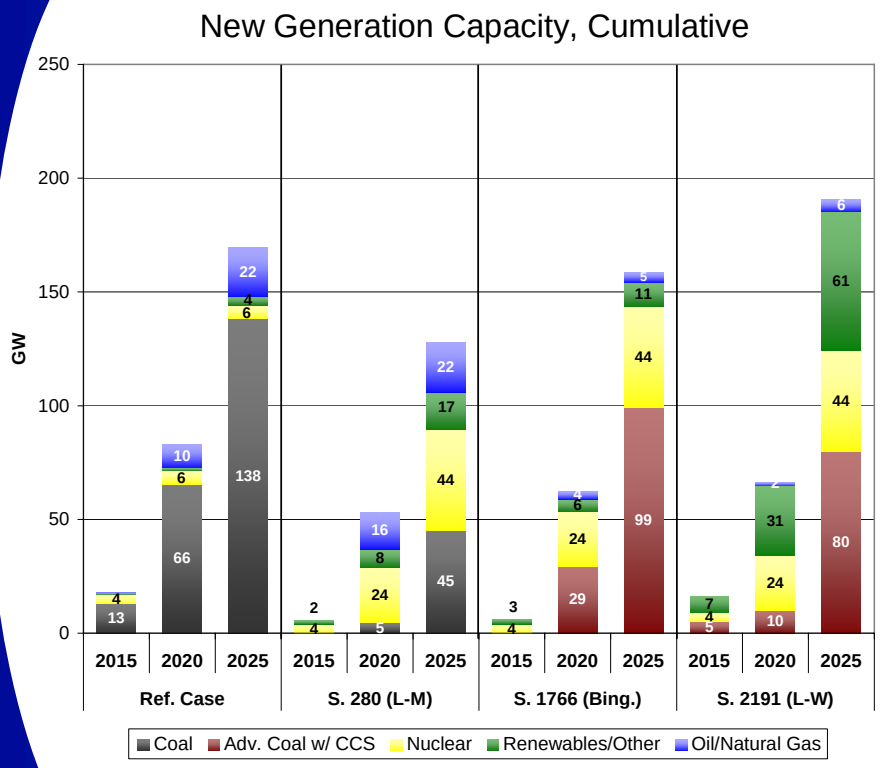
Lieberman-Warner (S. 2191) – Bingaman-Specter (S. 1766) – Lieberman-McCain (S. 280)

2012 – 2050 Cumulative U.S. GHG Emissions (Billion Metric Tons CO_2e)



EPA Analysis of S. 2191

Figure 3: New Generation Capacity (IPM)



Note: New capacity additions less that 1 GW of capacity are not indicated.

- S. 2191 contains an allowance bonus provision, which is capped, for CO_2 emissions that are captured and sequestered, resulting in significant penetration of new coal capacity with CCS technology (S. 1766 has a similar provision).
  - Bonus allowances go unused in 2015 only, when there is a 5 GW constraint on new adv. coal with CCS (the bonus is used entirely in all years post-2015).
- In 2025, adv. coal with CCS is economic even without the bonus.
- S. 2191 also results in significant penetration of new nuclear and renewable capacity.
- More capacity is built under S. 2191 because a significant amount of the existing fossil infrastructure is not economical to operate and must be replaced.

New Capacity Limitations in IPM (Incremental/Cumulative)				
GW	**2010**	**2015**	**2020**	**2025**
Nuclear	N/A	4	20 / 24	20 / 44
Adv. Coal w/ CCS	N/A	5	70 / 75	70 / 145
Renewables *(Cumulative Only)*	4	24	44	64