Using NEMS-BA and MARKAL for DOE-EERE Benefits Analysis

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Benefits Analysis

- Question 1: What benefit assessment activities has your organization undertaken?
  - DOE-EERE Benefits analysis examines the portfolio of EERE RD&D projects.

- Question 2: What did you measure?
  - Oil dependence
  - GHG reductions
  - Economic benefits

Benefits Analysis

- Question 3: How has your organization addressed attribution (public and private sector)?
  - Private sector assumed influenced by public policies
    - Learning by doing
    - Technology penetration
- Question 4: What are your future plans for benefits assessment?
  - This analysis has been completed

Purpose of Benefits Analysis

- Integrated benefits analysis provides a framework for:
  - Understanding how DOE R&D technologies interact with each other as well as compete with expected improvements to existing technologies.
  - Understand the implications of supply, demand and substitution and physical constraints in the energy system and capital stock turnover.
- Understanding future markets helps tailor technology R&D and deployment efforts for success
  - Select R&D portfolio mix that achieves desired results
  - Align portfolio with evolving needs
  - Adapt to future market and public policy uncertainties
- It also provides data useful to other studies and modeling activities
  - Cost, performance, market penetration, national benefits
- EERE has used the benefits analysis to support its annual budget submissions to OMB and Congress
  - Supports compliance with the 1993 Government Performance & Results Act (GPRA) and Presidential management initiatives

The Ground Rules

- Benefits = difference between how energy system evolves with and without realizing the program goal
- Prospective benefit estimates are based on stated program output goals that are achievable with requested funding levels
- Benefits are counted only for future program activities that start with the budget request year
- Current policies are included (such as CAFE standards), but no new policies (other than planned RD&D)

Use of Integrated Models

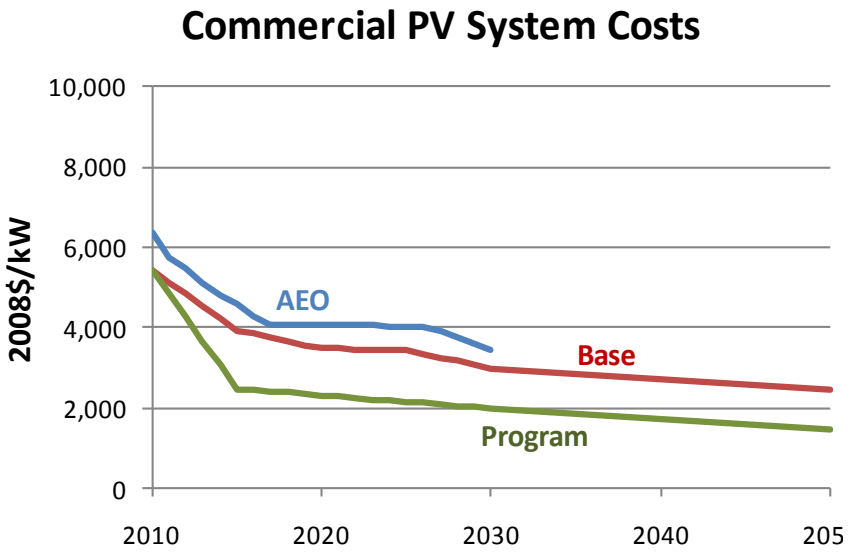
- NEMS-BA and MARKAL provide consistent economic frameworks for assessing program impacts
  - Different modeling techniques provide different perspectives and timeframes
- Models account for interaction and feedback effects
  - Programs may target similar markets and therefore interact directly (e.g., wind and solar target electricity generation market) or indirectly (e.g., buildings program reducing electricity demand decreases target market for new electricity generation)
  - Advanced technology deployment can lead to energy price reductions that in turn dampen the cost-effectiveness of the technologies
- Alternative scenarios can be constructed to look at benefits of R&D portfolios under alternative conditions (energy prices, environmental policies)

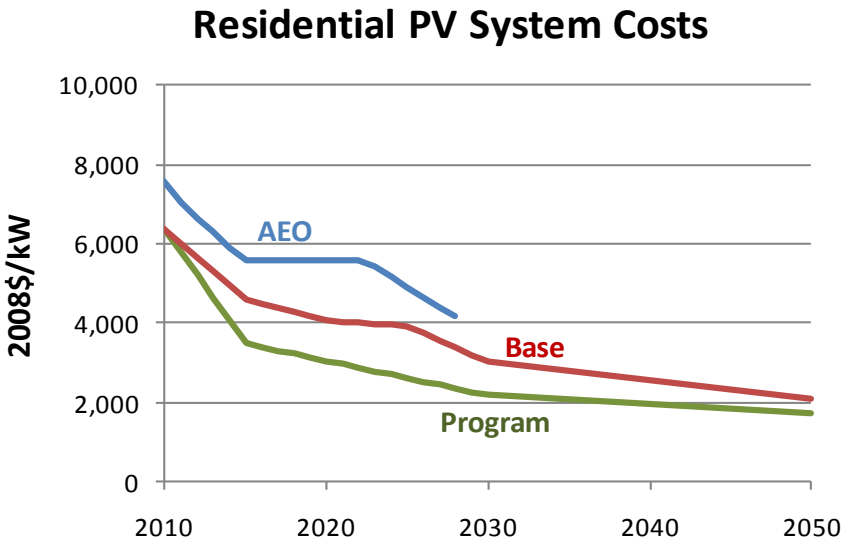
Benefits Modeling Process

- Collect technology characterizations with and without future R&D from EERE Program analysts
- Develop of “No Program Funding” Base Case
  - Modification of the most recent AEO reference case to reflect technologies and markets without DOE Program impacts
- Develop Single Program Cases
  - Activities for each program are represented assuming achievement of the program goals
  - Generally represented through technology characteristics (capital and O&M costs, performance)
- Develop Cluster and EERE Portfolio Cases
  - Subsets and all of the Programs are combined
  - Integrated impacts of the Portfolio case will not be equal to the sum of the individual programs
- Develop alternative scenarios to look at the value of EERE’s R&D portfolio under other possible futures, such as carbon mitigation policies or high fuel prices

Example of Input Metrics

- PV costs are assumed to decline significantly in the Base Case. The Solar Program R&D accelerates this cost decline.
  - The Base case does not necessarily match the AEO which also includes some technological progress.





DOE/EERE Programs

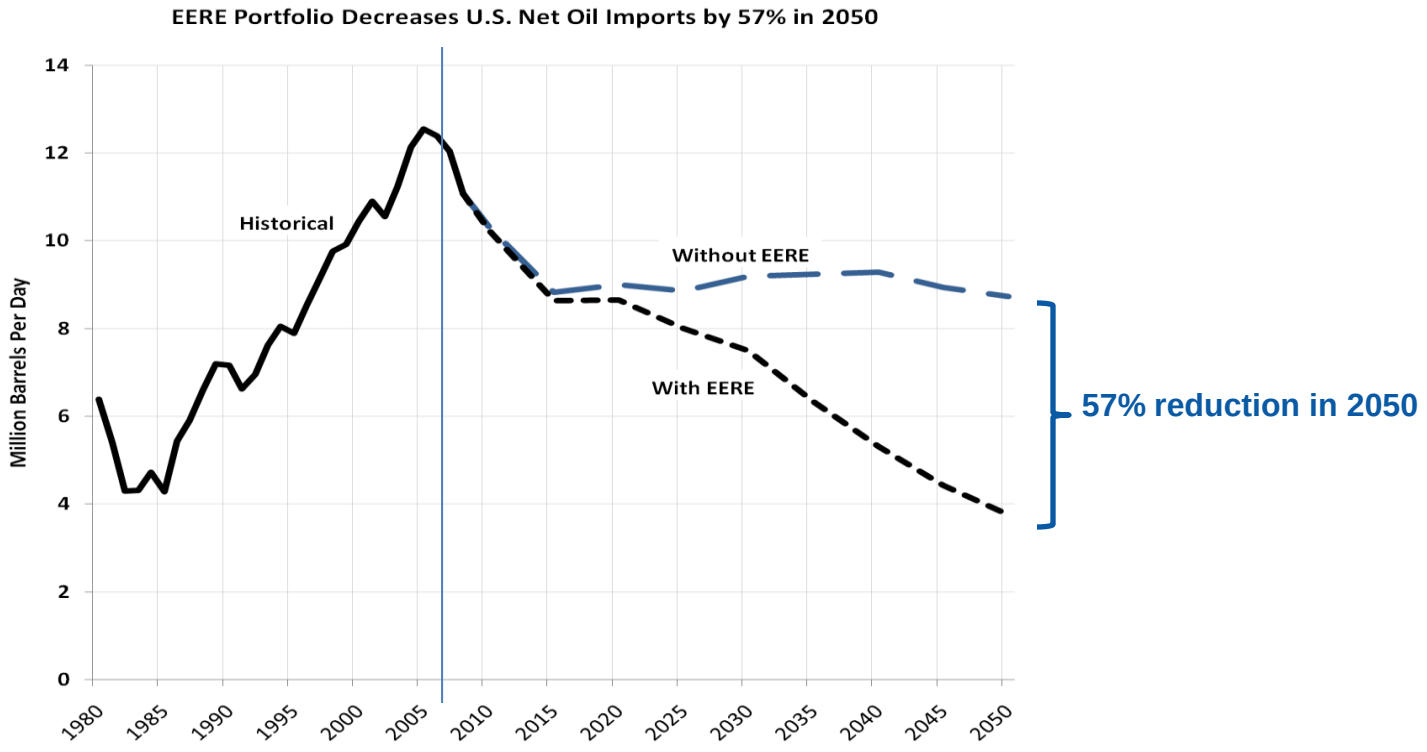
- Efficiency Cluster
  - Buildings Energy Technologies
  - Industrial Technologies
  - Weatherization and Intergovernmental Programs
  - Federal Energy Management Program (FEMP)
- Renewable Electricity Generation Cluster
  - Solar Energy Technologies
  - Wind Technologies
  - Geothermal Technologies
- Alternative Fuels and Vehicles Cluster
  - Vehicles Technologies
  - Biomass and Biorefinery Systems
  - Hydrogen and Fuel Cell Technologies

Benefits Metrics

- Benefits are reported at the Program and Cluster levels and for the Portfolio as a whole although applicability varies by Program.
- Economic Benefits
  - Energy expenditure savings
  - Power industry costs
  - Total energy system savings (long-term)
- Environment Benefits
  - Carbon dioxide emission reductions
- Security Benefits
  - Oil import reductions
  - Oil consumption reductions
  - Natural gas consumption reductions
- Market Indicators
  - Percent of electricity generation with renewable energy
  - Non-hydro renewable capacity
  - Annual biofuels supply
  - Percent of sales that are advanced vehicles
- Market shares of individual technologies reported as well
- Some benefits reported as annual values, some as cumulative

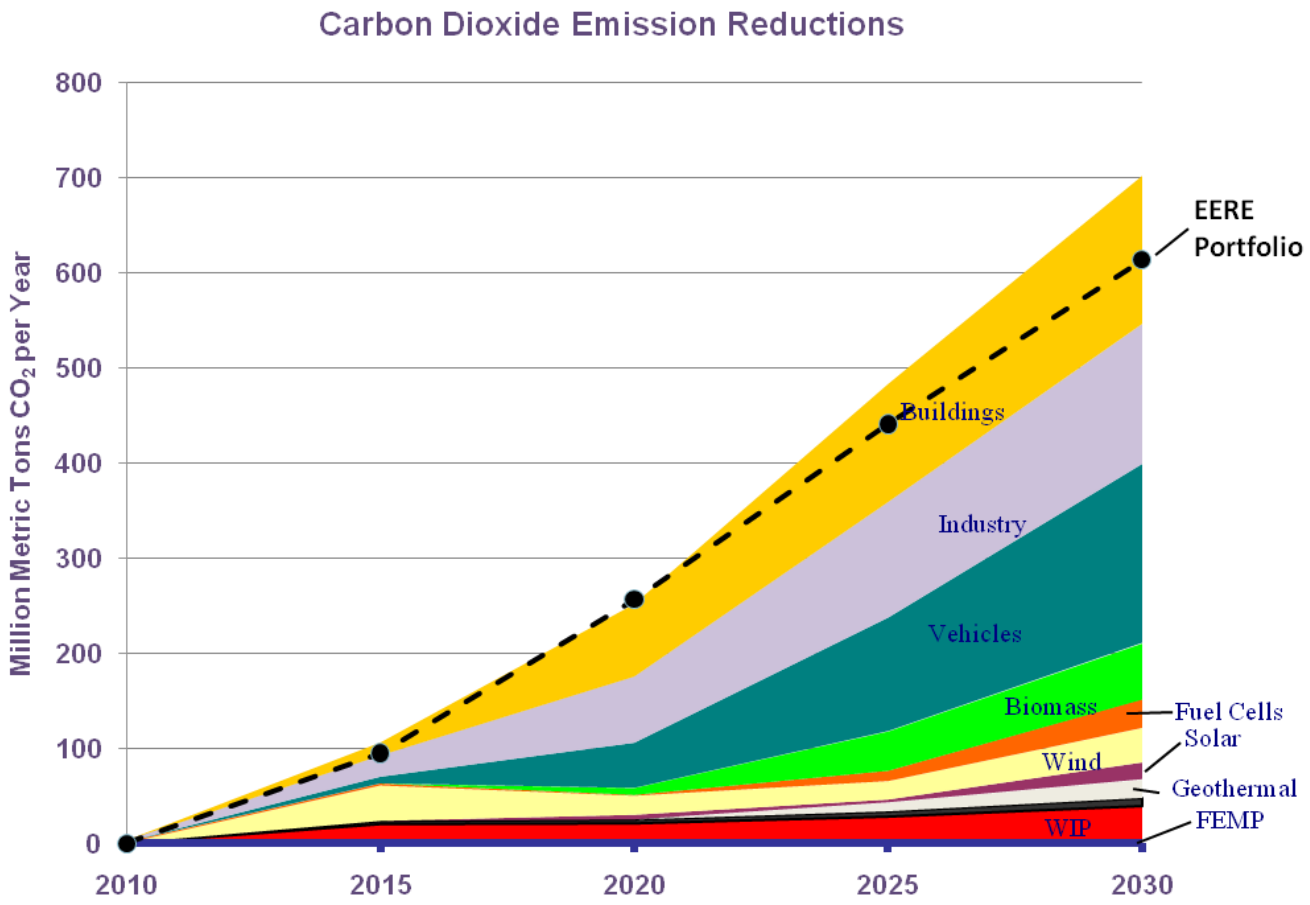
Oil Import Illustration

- Benefits are measured by the difference in projections ***with*** and ***without*** the R&D programs.
  - Here illustrated with historical context (FY11 example)



CO2 Emission Reductions

- All the programs contribute to reducing emissions, but the EERE Portfolio does not equal the sum of the programs due to interactive effects.

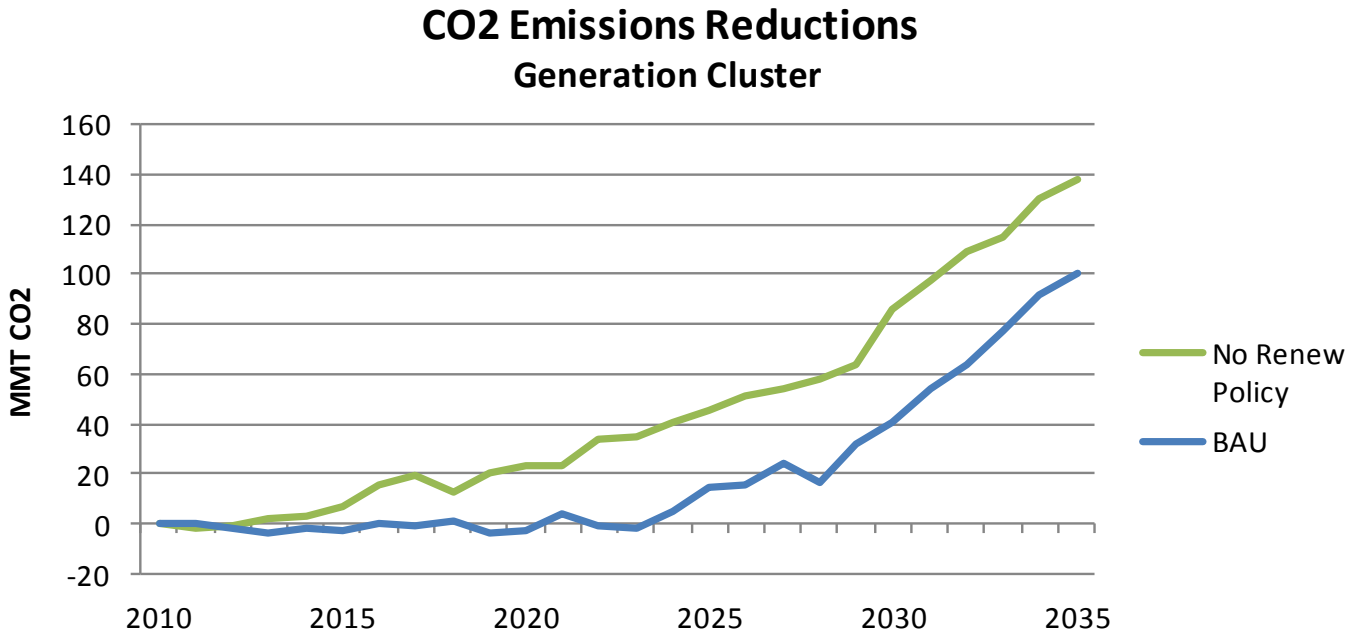


Interaction with Existing Policies

- Existing regulatory policies may alter the benefits from future R&D, reducing emissions savings but increasing cost savings
  - Renewable incentives and State RPS requirements lead to increases in renewable generation even without R&D advances, so incremental renewable generation with advanced technologies may be small (at least initially)
  - CAFE standards increase the fuel economy of new vehicles, and advanced technologies may allow reduced adoption of conventional fuel economy measures
- Although difficult to quantify (and outside the traditional scope), R&D improvements could facilitate more aggressive future policies
  - In fact, past R&D efforts may have facilitated current standards including RPS, CAFE, biofuels and appliances

Interaction with Existing Policies

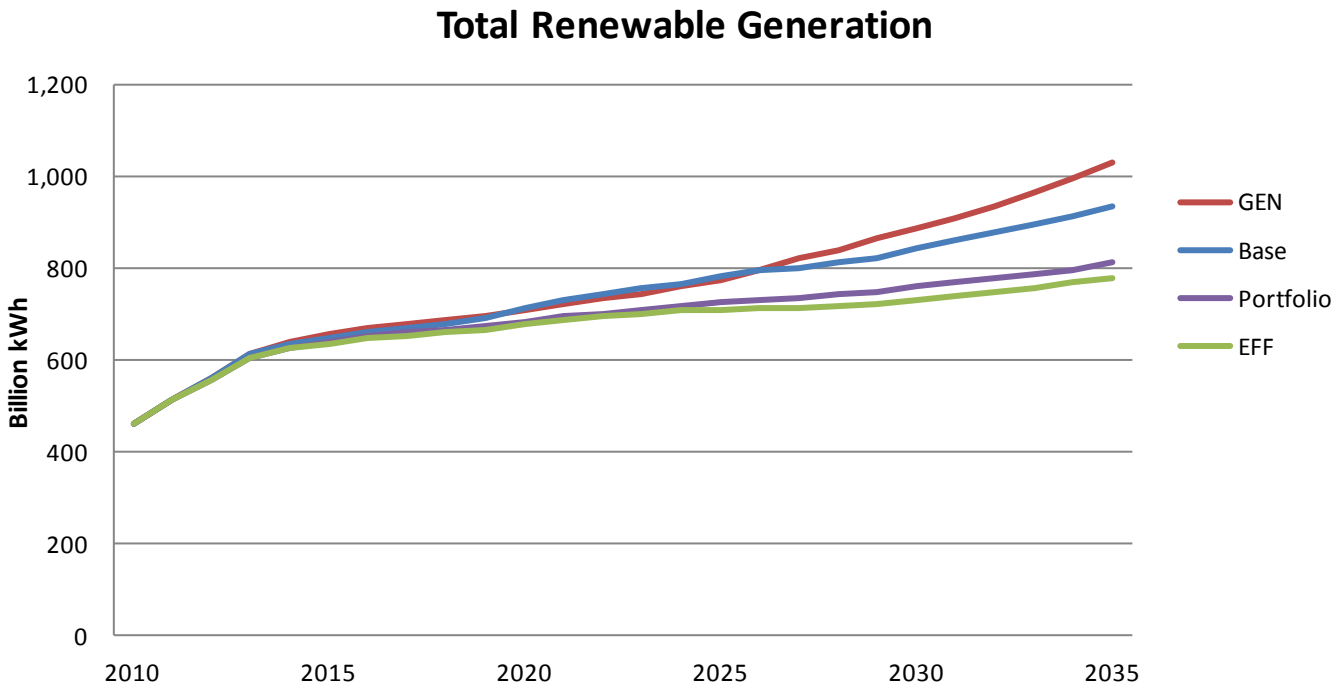
- Existing regulatory policies may alter the benefits from R&D – lower cost of achieving standards rather than reducing emissions



For illustrative purposes only

Interaction Across Technologies

- Significant deployment of energy efficiency technologies could reduce the market for renewable generation



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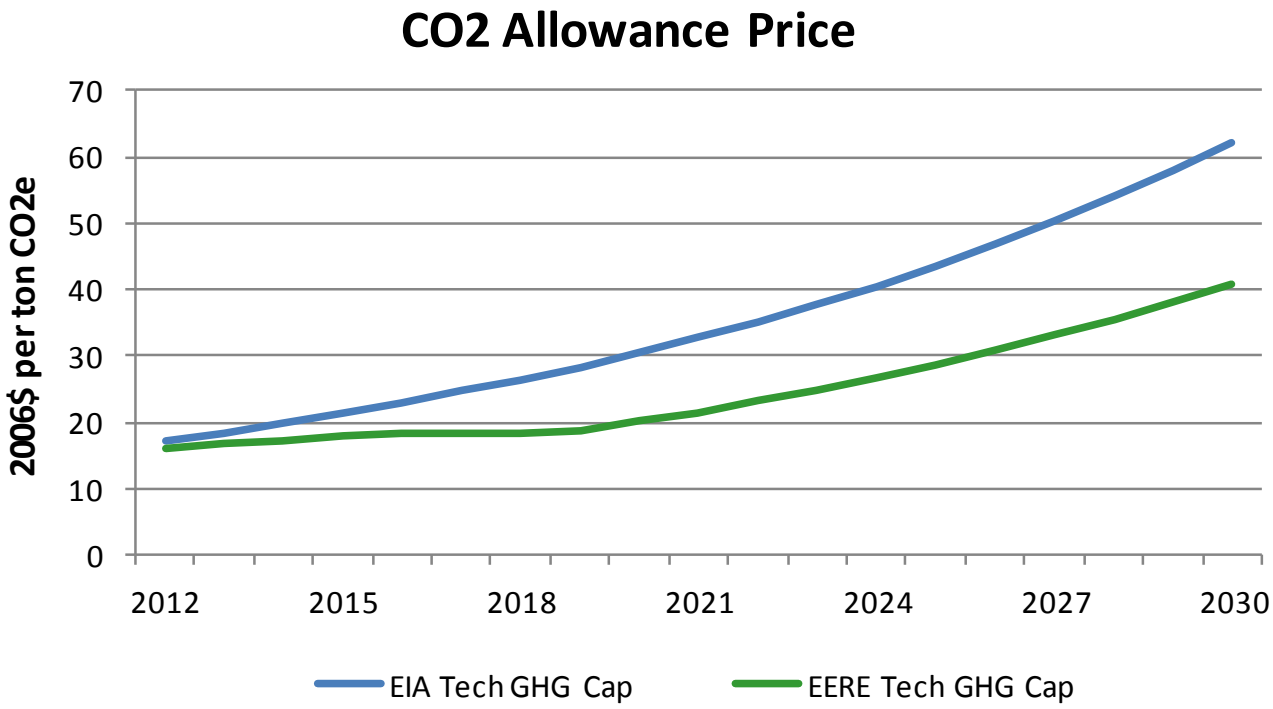
R&D Impact under Emissions Cap

- Advanced EE and RE technologies reduce the cost of meeting a GHG emissions Cap (example here is from Waxman Markey bill).



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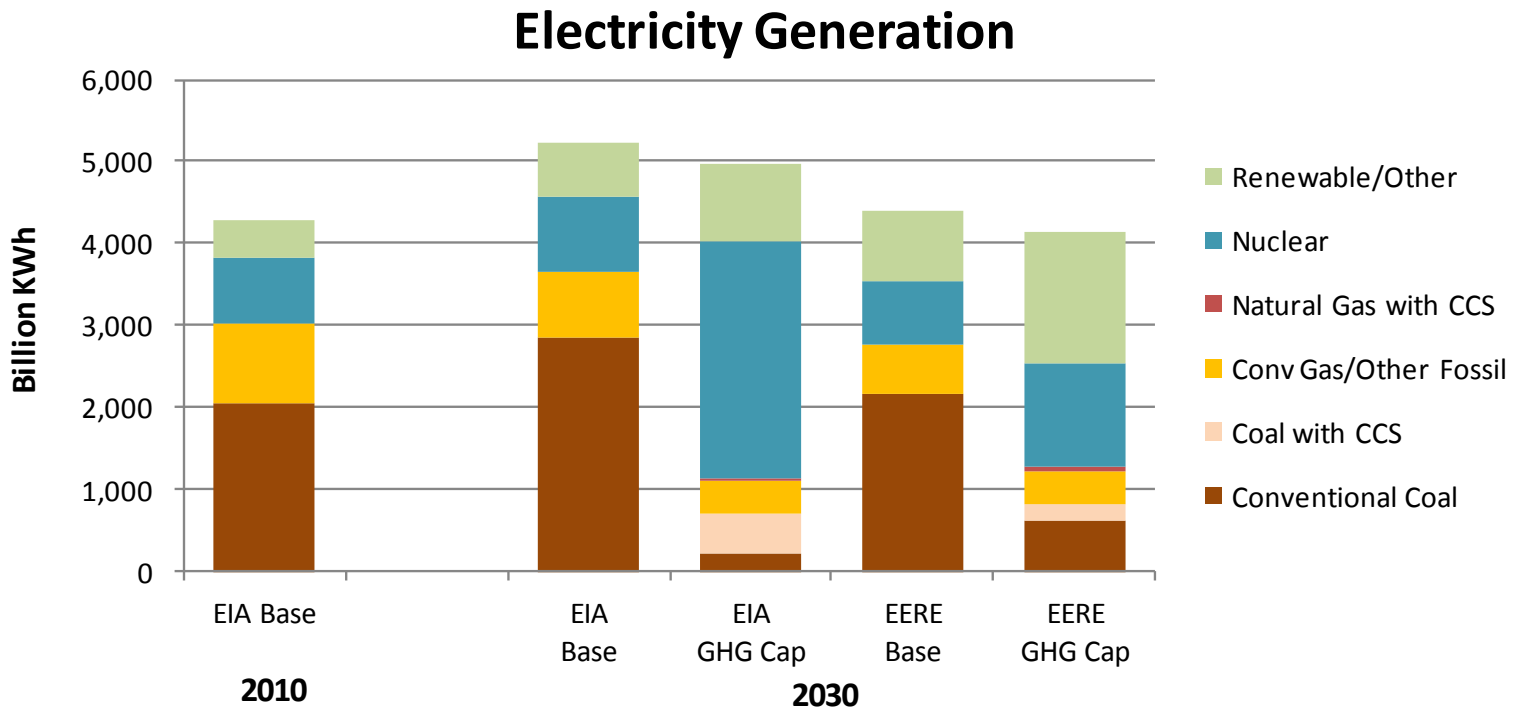
R&D Impact under Emissions Cap

- The magnitude and mix of electricity generation is also impacted.



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Challenges

- In budget context where measuring incremental impacts, estimating the Base (no R&D) case is as important as the R&D case – and can be more difficult to assess
- Relative optimism of programmatic goals may be uneven and lead to skewed results in the Portfolio
- Interaction of program goals with deployment levels (learning-by-doing)
- Energy efficiency R&D more difficult to represent than power technologies
  - Wider range of technologies
  - Uncertainty of consumer adoption of new technologies under various market conditions

Thanks.

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